Gemeente Amsterdam

# Station energy supply transformer system specification

*Z0536729579*

# Validation and authorisation

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# Authorisation

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# Contents

# 1 Introduction

This document provides a description of the technical specification of the transformers for the power supply of station systems in Metro traveller stations.

## 1.1 Abbreviations

| Abbreviation | Meaning |
|---|---|
| A | Ampère |
| AN | Air Natural |
| AWI | Automatic Re-engagement |
| BLVC | Accessibility, Quality of Life, Safety and Communication |
| CAB | Central Remote Control |
| CBI | Central Control of installations |
| dB | Decibel |
| DC | Direct Current |
| DD | Definitive Design |
| EBH | Electrotechnical Operations Manual |
| EBT | Self-contained transformer |
| EKS | Erd Kurzschluss Schalter (Electronic Short-Circuit Switch) |
| EN | European Standard |
| FIT | Factory Integration Test |
| FD | Functional Design |
| GOOSE | Generic Object Oriented Substation Event |
| GVI | Direct Current Distribution System |
| HMI | Human Machine Interface |
| HS | High-voltage |
| HVI | High-voltage distribution system |
| Hz | Hertz |
| IAC | Internal Arc Classification |
| IEC | International Electrotechnical Commission |
| IED | Intelligent Electronic Device |
| IO | Input Output |
| IP | International Protection Marking |
| kPa | Kilo Pascal |
| kV | Kilovolt |
| kWh | Kilo Watt hour |
| LVI | Low-voltage distribution system |
| MTTF | Mean Time To Fail |
| MTTR | Mean Time To Repair |
| MVA | Mega Volt Ampère |
| Ni-Cad | Nickel Cadmium |
| NSA | Emergency power generator |

| Abbreviation | Meaning |
|---|---|
| OG | Client |
| ON | Contractor |
| OR | OverviewReturn |
| PLC | Programmable Logic Controller |
| SAT | Site Acceptance Test |
| SCADA | Supervisory Control And Data Acquisition |
| SF6 | Sulphur hexafluoride |
| SIT | Site Integration Test |
| SSI | Section switch installation |
| TO | Technical Design |
| UO | Implementation Design |
| V | Volt |
| VLD | Voltage Limiting Device |
| WCD | Wall socket |

## 1.2 Binding documents

This paragraph provides an overview of the binding documents. The deliveries must comply demonstrably with the information from these documents.

| Title | Document number | Version | Date |
|---|---|---|---|
| Afkortingen en acroniemen | CEB\OVG\19462 | 1.0.0.0 | 15-7-2019 |
| Elektrotechnischbedrijfsvoering Handboek voor Railinfrastructuur Metro en Tram Amsterdam | WLS\OVG\18867 | 3.2 | 10-07-2018 |
| Netcode Elektriciteit | https://wetten.overheid.nl/BWBR0037940/2021-02-13 | - | 18-07-2020 |
| VB AMS 053 Areaaldecompositie en codering van locaties, installaties, objecten en kabels | CEB\OVG\20507 | 3.0 | 20-5-2019 |
| Overzicht RAMS grenswaarden | CEB\OVG\24071 | 0.3 | 03-09-2020 |
| Besturingsconcept o.b.v. IEC61850 | CEB\OVG\23094 | 0.2 | 23-03-2020 |
| Richtlijnen voor toelaatbare harmonische stromen | EnergieNed | - | Juni-1997 |

# Standards

This paragraph provides an overview of relevant standards and guidelines.
Deliveries must comply with Dutch Legislation and Regulations and the Buildings Decree. The deliveries must also satisfy the customary requirements that may be imposed on systems in the current state of the art.
In addition, the delivery must comply with all applicable standards, regulations and guidelines set out below, in the prevailing order set out below:

1. NEN (Dutch Standards)
2. GVB/MeT Specific Regulations
3. EN (European Standards) and European harmonisation documents (HD)
4. IEC (Standards of the International Electrotechnical Commission)
5. NPR (Netherlands Code of Practice)
6. EnergieNed Guidelines
7. VDE (guidelines of the German Verband der Elektrotechnik, Elektronik und Informationstechnik)
8. ATEX (European Directives in the area of the danger of explosion)

The overview of standards does not aim to be exhaustive. The contractor is required to include additional and/or replacement standards that apply to the work.

### 1.2.1 Station energy supply transformer

| | |
|---|---|
| NEN-EN-IEC 60076-1 | Energietransformatoren. Deel 1: Algemeen |
| NEN-EN-IEC 60076-2 | Energietransformatoren. Deel 2: Temperatuurverhoging |
| NEN-EN-IEC 60076-3 | Energietransformatoren. Deel 3: Isolatieniveaus, diëlektrische proeven en uitwendige slagwijdten in lucht |
| NEN-EN-IEC 60076-4 | Energietransformatoren. Deel 4: Leidraad voor het uitvoeren van proeven met bliksemspanningen en schakelspanningen |
| NEN-EN-IEC 60076-5 | Energietransformatoren. Deel 5: Kortsluitsterkte |
| NEN-EN-IEC 60076-8 | Energietransformatoren. Deel 8: Leidraad voor de toepassing |
| NEN-EN-IEC 60076-10 | Energietransformatoren. Deel 10: Bepaling van geluidsniveaus |
| NEN-EN-IEC 60076-11 | Energietransformatoren. Deel 11: Droge Energietransformatoren |
| NPR-IEC 60076-12 | Energietransformatoren. Deel 12: Leidraad voor het belasten van droge energietransformatoren |

### 1.2.2 Low-voltage power supply

| | |
|---|---|
| NEN 1010 | Veiligheidsbepalingen voor laagspanningsinstallaties (complete versie) |

### 1.2.3 Miscellaneous

| | |
|---|---|
| NEN-EN 50160 | Spanningskarakteristieken in openbare elektriciteitsnetten |
| NEN-EN 50163 | Railtoepassingen – Voedingsspanningen van tractiesystemen |
| NEN 3140 | Bedrijfsvoering van elektrische installaties – Aanvullende Nederlandse bepalingen voor laagspanningsinstallaties. |
| NEN 3840 | Bedrijfsvoering van elektrische installaties – Aanvullende Nederlandse bepalingen voor hoogspanningsinstallaties. |
| NEN-EN 50110 | Bedrijfsvoering van elektrische installaties – Algemene bepalingen. |
| NEN-EN 50522 | Aarding van hoogspanningsinstallaties van meer dan 1 kV wisselspanning. |
| NEN-EN-IEC 61936-1 | Sterkstroominstallaties met meer dan 1 kV wisselspanning – Deel 1: Algemene bepalingen. |

| | |
|---|---|
| IEC 60909 | Short-circuit calculation in three phase a.c. systems. |
| IEC 60038 | IEC Standard Voltages |
| IEC 60050 | International Electrotechnical Vocabulary |
| NEN-EN-IEC 60529 | Degrees of protection provided by enclosures (IP Code) |
| EnergieNed | Richtlijnen voor toelaatbare harmonische stromen. |

### 1.2.4 Definitions

| Term | Definition |
|---|---|
| Medium voltage | The medium voltage is defined as 1 kV - kV-52 pursuant to IEC 62271-200.<br>GVB's customary name for an installation with these current levels is High-voltage Installation.<br>Both terms are used interchangeably in the specification. Both terms refer to the 10 kV AC installation. |

# 2 Requirements

The classification of the requirements in this specification is based on the object tree. Requirements are imposed on each object. The requirements are linked to the objects referred to in Chapter 2. The requirements are in line with the typical implementation of the Rectifier station for Metro; see in this connection the typicals in the binding documents of par. 1.2.

Each requirement is provided with a colour code. This colour code indicates for which Contractor this requirement is intended.
We distinguish between the Supplier Engineering and Components and the Installer.

Both parties receive this full System specification. The requirements for the Supplier Engineering and components serve as starting point for the Installer and vice versa. The aim is to clarify the context of the requirements and the coherence. See paragraph 2.2 for the definition of the colour codes.

## 2.1 Definition of requirements

Characteristic of this specification is the classification into the various types of requirements and the coherence between the requirements. The requirements can be distinguished by the following types of requirements:

- Functional requirements.
- Aspect requirements.
- Interface requirements.
- Realisation requirements.

A definition per type requirement is provided in Table 1.

| Type requirement | | Explanatory notes |
|---|---|---|
| Functional requirements | | Functional requirements are requirements concerning the primary function or performance of the system and the objects that make up the system. |
| Aspect requirements | Reliability | The probability that the required function is carried out in the given circumstances during a certain period. |
| | Availability | The probability that the required function may be carried out at a given random moment in the given circumstances. This corresponds to the fraction of time in which the required function can be carried out in the given circumstances. |
| | Maintainability | Requirements with respect to the required management and maintenance efforts of the system or objects to be realised and the ease and speed with which a system can be restored to operational status following a failure. |
| | Safety | Requirements with respect to the safety of the system or objects to be realised during the use phase, for both the user and the environment. |
| | Design | Requirements with respect to the aesthetic appearance of the system or objects to be realised. |
| | Service life | Requirements with respect to the required service life of the system or objects to be realised. |

| Type requirement | | Explanatory notes |
|---|---|---|
| | Future-proofness | Requirements with respect to making the system suitable for future use. |
| Realisation requirements. | | The system must satisfy the requirements and preconditions set out in the 'BLVC framework' during the realisation phase. |
| Interface requirements. | External interface | Requirements with respect to the system's interfaces with the (future) environment outside the system limits. |
| | Internal interface | Requirements with respect to interfaces within the system in connection with the systems/objects that must be designed or realised by third parties or that are imposed with respect to the interaction between the various objects within the system. |

Table 1 – Types of requirements definition

## 2.2 Tables of requirements

The requirements in this System specification are represented in accordance with the format in Table 2 – Requirement format.

| ID Title of the requirement | |
|---|---|
| Text of the requirement | |
| Explanation (optional) | |
| Verification method (optional) | Regulation/Standards (optional) |

Table 2 – Requirement format.

| | | |
|---|---|---|
| | : | Engineering and components supplier (is also indicated with the letter L in the requirement number). |
| | : | Delivery/Implementation Installer (also indicated with the letter I in the requirement number). |
| ID | : | Unique Requirement Number. |
| Title of the requirement | : | Brief description of the requirement with keywords. |
| Text of the requirement | : | Description of the requirement. |
| Explanation (optional) | : | Explanation to the requirement included for information. |
| Verification method (optional) | : | Prescribed verification method. |
| Regulation (optional) | : | Description verification method. |

## 2.3 Unique requirement number

The unique Requirement Number consists of 9 characters, W-XX-YYY-ZZZ. The characters represent the following:

| | | |
|---|---|---|
| W | L or I | The requirement coding applies to the supplier (L) or the installer (I) |
| XX | M, T or MT | Coding requirement applies to M=Metro, T=Tram or MT=Metro and Tram |
| YYY | 000-999 | Coding for system group, see **Fout! Ongeldige bladwijzerverwijzing.**. |
| ZZZ | 001-999 | Coding of the requirement in the system group |

| Code system group YYY | Group name |
|---|---|
| 000 | General |
| 001 | Functionality |
| 002 | Test protocols |
| 003 | Single line diagram |
| 004 | Object Architecture |
| 005 | List of interfaces |
| 006 | Civil engineering Requirements/Designs |
| 010 | HVI |
| 011 | Metering |
| 020 | Traction Transformer |
| 021 | Own Company Transformer |
| 022 | Station energy supply transformer |
| 030 | Rectifier |
| 031 | Recovery Unit |
| 040 | GVI in general |
| 041 | GVI quick-switch |
| 043 | GVI Plus/minus separator |
| 044 | GVI Separator Recovery |
| 045 | Section switch installation (SSI) |
| 046 | Track separator |
| 050 | Low voltage general |
| 051 | Low-voltage switchgear |
| 052 | Low voltage UPS |
| 060 | Protection general |
| 061 | Protection HVI |
| 062 | Protection Traction Transformer |
| 063 | Protection EBI transformer |
| 064 | Protection Rectifier |
| 065 | Protection GVI |
| 066 | SSI locks |
| 070 | Cabling general |
| 071 | Cabling - cable ducts |
| 072 | Cabling - internal |
| 073 | Cabling - external |
| 074 | Cabling - fibreglass network |
| 075 | Cabling 61850 |
| 076 | Connection CBI Metro |
| 077 | Connection CBI Tram |
| 080 | Control general |
| 081 | Control CBI Metro |
| 082 | Control CBI Tram |

| Code system group YYY | Group name |
|---|---|
| 083 | Operation HMI |
| 084 | Emergency outlet circuit |
| 090 | Building-related installations |
| 091 | Project management |
| 092 | Interface management |
| 093 | Design |
| 094 | Implementation |
| 095 | Testing |
| 096 | Verification/Validation |
| 097 | Delivery/Transfer |
| 098 | Training |
| 099 | Project control and Project support |
| 100 | Aftercare |
| 101 | Guarantee |
| 102 | Provision of parts |
| 103 | Service and maintenance |

Table 3 – System group coding

## 2.4 Verification

The verification method is completed in the tables of requirements. The Contractor must elaborate this verification further by means of a verification and validation plan. The elaboration of the verification method in this specification must be considered to be a conceptual proposal, which the contractor will have to supplement, detail, elaborate and specify further.

This specification distinguishes the following verification methods:

- Document assessment Design: The design must provide an explicit description, substantiation of how the requirement is implemented as part of this verification method. It is up to the contractor how this is elaborated.
- Document assessment Design Drawing: The design must provide an explicit description, substantiation of how the requirement is implemented as part of this verification method. This expressly requires a specific design drawing.
- Document assessment Design Calculation: The design must provide an explicit description, substantiation of how the requirement is implemented as part of this verification method. This expressly requires a draft calculation (for example: short-circuit calculation).
- Document assessment Design Specification: The design must provide an explicit description, substantiation of how the requirement is implemented as part of this verification method. This expressly requires a specification from a supplier for example (such as a control current diagram of a high speed circuit breaker field).
- Test/inspection report visual: A visual, express substantiation of the implementation of the requirement must be provided as part of this verification method. This must be laid down in a report. (Inspection of the cable ducts for example)
- Testing/functional: As part of this verification method, a functional test must provide the substantiation that the requirement has been implemented. This must be laid down in a report (such as IO test).

- Testing/measurement and reporting: As part of this verification method, a measurement must provide the substantiation that the requirement has been implemented. This must be laid down in a report (such as a measurement of the frame earthing insulation).

It should be noted that testing is usually classified into FAT, SAT and iSAT testing. It is up to the contractor to elaborate this further. The list above forms the basis for doing so.

# 3 Traveller station

This specification forms part of the traveller station specification.

## 3.1 Top requirements

### 3.1.1 Functional General

| L-M-022-001 Traveller Station System – EVT Capacity | |
|---|---|
| The EV transformer must have a nominal capacity (in accordance with NEN-EN 50329) as included in the Schedule of Requirements of 250, 400, 630 or 1000 kVA. | |
| Explanation (optional) | |
| Verification method<br>Document assessment Design Specification | Standards:<br>NEN-EN-IEC 60076 |

| L-M-022-002 Traveller Station System – EVT Voltages | |
|---|---|
| The nominal primary voltage at medium voltage level is included in the sPVE and the secondary nominal voltage amounts to 420 V. | |
| Explanation:<br>See the sPVE for the nominal voltage to be applied. | |
| Verification method<br>Document assessment Design | Regulation/Standards |

| L-M-022-003 Traveller Station System – EVT tap positions | |
|---|---|
| The EV transformer must have five tap positions with the following values -5%, -2.5%, 0%, +2.5%, +5%. | |
| Explanation (optional) | |
| Verification method<br>Document assessment Design Specification | Regulation/Standards |

| L-M-022-004 Traveller Station System – EVT type | |
|---|---|
| The EV transformer must be of dry variety. | |
| Explanation:<br>Dry transformers do not require structural facilities to catch the oil, require virtually no maintenance and have a lower fire load. | |
| Verification method<br>Document assessment Design Specification | Regulation/Standards |

| L-M-022-005 Traveller Station System – EVT Cooling method | |
|---|---|
| The EV transformer must be cooled by means of the AN cooling method. | |
| Explanation:<br>Taking into account the room temperature in which the transformer is installed. | |
| Verification method<br>Document assessment Design Specification | Regulation/Standards |

| L-M-022-006 Traveller Station System – EVT Winding material |
|---|
| The material of the windings of the EV transformer may be copper or aluminium. The ultimate winding material does have to be equivalent as regards losses (see L-M-022-025 and L-M-022-026). |

| **L-M-022-006 Traveller Station System – EVT Winding material** | |
|---|---|
| Explanation (optional) | |
| Verification method<br>Document assessment Design Specification<br>Testing/measurement and reporting | Standard:<br>NEN-EN 50541-1, 3.9 |

| **L-M-022-007 Traveller Station System – EVT noise level** | |
|---|---|
| In case of a full load, the EVN transformer of the RS must cause a maximum noise level, measured in accordance with EN 60076-10 of the values in the table below:<br>250 kVA: $L_{WA}$ < 58 dB(A)<br>400 kVA: $L_{WA}$ < 60 dB(A)<br>630 kVA: $L_{WA}$ < 62 dB(A)<br>1000 kVA: $L_{WA}$ < 64 dB(A) | |
| Explanation:<br>Full load means nominal load. | |
| Verification method<br>Document assessment Design Specification<br>Testing/measurement and reporting in accordance with IEC 60076-10 | Standard:<br>EN 60076-10 |

| **L-M-022-008 Traveller Station System – EVT Surge arresters** | |
|---|---|
| Surge arresters must be included on the primary side of the EV transformer in order to discharge switching surges. | |
| Explanation:<br>High switching peaks can occur in case of a combination of a dry transformer and vacuum switches. | |
| Verification method<br>Document assessment Design Drawing<br>Test/inspection report visual | Regulation/Standards |

| **L-M-022-009 Traveller Station System – EVT Thermal protection** | |
|---|---|
| The transformer must be fitted with cast PT100 elements at the hotspots. Two units PT100 elements per phase on the secondary side of the transformer. | |
| Explanation<br>The measuring range of the PT100 elements must be ale to measure 150% of the maximum temperature of the transformer hotspots. | |
| Verification method<br>Document assessment Design Specification | Regulation/Standards |

| **L-M-022-010 Traveller Station System – EVT Protection** |
|---|
| The EV transformer must be fitted with the following protection:<br>• Thermal preliminary notification via EV transformer thermal module.<br>• Thermal trip via thermal module EV transformer.<br>The thermal function must be implemented by means of two PT100 elements per phase on the secondary side of the traction transformer. The thermal module must be an IED that is able to communicate with the station control via Profibus DP (IEC 61158) and via IEC 61850. |
| Explanation: |

| L-M-022-010 Traveller Station System – EVT Protection | |
|---|---|
| Verification method<br>Document assessment Design<br>Document assessment Design Specification<br>Test/inspection report visual<br>Testing/functional | Regulation/Standards |

| L-M-022-011 Traveller Station System – EVT Routine test | |
|---|---|
| Each transformer must undergo a routine test in accordance with IEC 60076-11, which consists of:<br>Winding resistance<br>Voltage ratio and phase displacement<br>Short-circuit impedance and load losses<br>No load losses and no-load current<br>Separate source AC withstand voltage test<br>Induced AC withstand voltage test<br>Insulation resistance<br>Partial discharge test<br>Measurement of sound level if required in sPvE | |
| Explanation (optional) | |
| Verification method<br>Test protocol | Regulation/Standards<br>IEC 60076-11 |

### 3.1.2 Aspect requirement: Maintainability

| L-M-022-012 Traveller Station System – EVT Connections | |
|---|---|
| The primary connection of the EV transformer must be implemented with Elastimold connections or equivalent, suitable for installing operating earthing. | |
| Explanation (optional) | |
| Verification method<br>Document assessment Design Specification<br>Test/inspection report visual | Regulation/Standards |

| L-M-022-013 Traveller Station System – EVT maintainability | |
|---|---|
| The EVT must be suitable for maintenance by the manager. The EVT must therefore be fitted with grounding balls. A 3-pole grounding kit must also be delivered. | |
| Explanation:<br>A 3-pole grounding kit must also delivered for each transformer. | |
| Verification method<br>Document assessment Design<br>Test/inspection report visual | Regulation/Standards |

| L-M-022-014 Traveller Station System – EVT Transport wheels | |
|---|---|
| The transformer must be fitted with 4 bidirectional wheels that can be turned 90 degrees. | |
| Explanation (optional) | |
| Verification method<br>Document assessment Specification<br>Inspection report visual | Regulation/Standards<br>EN 50216-4 |

| L-M-022-015 Traveller Station System – EVT Vibration dampers |
|---|
| The delivery of the transformers must include 4 vibration dampers (silent blocks). |
| Explanation (optional) |

| L-M-022-015 Traveller Station System – EVT Vibration dampers | |
|---|---|
| Verification method<br>Document assessment Specification<br>Inspection report visual | Regulation/Standards |

| I-M-022-016 Traveller Station System – Degree to which the EVT can be rolled out | |
|---|---|
| The EV transformer must be placed on rails and it must be possible to roll it out. | |
| Explanation (optional) | |
| Verification method<br>Document assessment Design Specification<br>Test/inspection report visual | Regulation/Standards |

| I-M-022-017 Traveller Station System – EVT Vibration dampers | |
|---|---|
| The EV transformer must be placed on vibration dampers. | |
| Explanation (optional) | |
| Verification method<br>Document assessment Design Specification<br>Test/inspection report visual | Regulation/Standards |

| L-M-022-018 Traveller Station System – EVT Lifting eyes | |
|---|---|
| The transformer must be fitted with lifting eyes. | |
| Explanation (optional) | |
| Verification method<br>Document assessment Specification<br>Inspection report visual | Regulation/Standards<br>IEC 60076-11 |

| L-M-022-019 Traveller Station System – EVT Coding and numbering | |
|---|---|
| All connections to the transformer must be provided with coding. All components must be fitted with component coding. | |
| Explanation (optional) | |
| Verification method<br>Document assessment Design<br>Inspection report visual | Regulation/Standards<br>IEC 60076-11 |

| L-M-022-020 Traveller Station System – EVT Identification plate | |
|---|---|
| The transformer must be provided with identification plates showing the data in accordance with NEN-EN 60076. | |
| Explanation (optional) | |
| Verification method<br>Document assessment Design Drawing<br>Test/inspection report visual | Regulation/Standards<br>NEN-EN 60076 |

### 3.1.3 Aspect requirement: Reliability

| L-M-022-021 Traveller Station System – EVT design life | |
|---|---|
| The EVT should have a design life of at least 30 years. | |
| Explanation (optional) | |
| Verification method<br>Document assessment Design Specification | Regulation/Standards |

| L-M-022-022 Traveller Station System – EVT operation in existing climate | |
|---|---|
| The EVT must operate without interruption in the Dutch climate. A moderate maritime climate must be assumed. The basic principle is that the EVT is installed in a protected space. | |
| Explanation:<br>The KNMI forecasts dated 2021 must be used as starting point for extremes in temperature, precipitation, drought and relative humidity. | |
| Verification method<br>Document assessment Design Specification | Regulation/Standards<br>KNMI forecast dated 2020 to 2050 |

| L-M-022-023 Traveller Station System – EVT ambient temperature | |
|---|---|
| The EVT must be able to operate without interruption at an outside temperature of 0 °C to +40 °C. | |
| Explanation:<br>It is up to the building contractor/installer to ensure that the space temperature does not exceed +40 °C by means of ventilation or air-conditioning. | |
| Verification method<br>Document assessment Design Specification | Regulation/Standards |

### 3.1.4 Aspect requirement: Future-proofness

| L-M-022-024 Traveller Station System – EVT Subsequent delivery of components | |
|---|---|
| The delivery of applied components must be guaranteed for at least 10 years. | |
| Explanation (optional) | |
| Verification method<br>Test/inspection report visual | Regulation/Standards |

| L-M-022-025 Traveller Station System – EVT Short-circuit loss | |
|---|---|
| The EV transformer must have a maximum short-circuit loss that satisfies Class Ak in accordance with Ecodesign No.548/2014 EU Commission Phase 2. | |
| Explanation (optional) | |
| Verification method<br>Document assessment Design Specification<br>Testing/measurement and reporting | Standard:<br>Ecodesign No.548/2014 EU Commission |

| L-M-022-026 Traveller Station System – EVT No-load loss | |
|---|---|
| The EV transformer must have a maximum no-load loss that satisfies Class Ak in accordance with Ecodesign No.548/2014 EU Commission Phase 2. | |
| Explanation (optional) | |
| Verification method<br>Document assessment Design Specification<br>Testing/measurement and reporting | Standard:<br>Ecodesign No.548/2014 EU Commission |

### 3.1.5 Aspect requirement: Availability

| L-M-022-027 Traveller Station System – EVT RAMS: MTTF | |
|---|---|
| The MTTF of the EV transformer must be at least $8.76^{E}+5$. | |
| Explanation (optional) | |
| Verification method<br>Document assessment Design Drawing | Regulation/Standards: |

**L-M-022-028 Traveller Station System – EVT Specifications**

The EV transformer must satisfy the following specifications:

| | | |
|---|---|---|
| Rated power | : | acc. sPvE |
| Rated voltage HV-winding | : | acc. sPvE |
| Rated voltage LV-winding | : | 420 V |
| Rated no-Load ratio | : | Rated HV voltage/420V |
| Tappings on HV-winding | : | 0, ±2.5%, ± 5% |
| Maximum ambient temperature | : | 40 °C |
| Insulation class | : | F |
| Primary Connection | : | Delta |
| Secondary Connection | : | Star + Neutral |
| Vector group | : | Dyn 11 |
| Primary Insulating Class | : | 12/28/75 kV |
| Secondary Insulating Class | : | 1.1/3/- kV |
| No load loss | : | acc. Ecodesign No.548/2014 EU Commission Tier 2 |
| Load losses at rated current | : | acc. Ecodesign No.548/2014 EU Commission Tier 2 |
| Supply Frequency | : | 50 Hz |
| Impedance | : | 4% @ 75°C for rated power ≦ 630 kVA;<br>5% @ 75°C for rated power 630 - 1250 kVA |
| Reference standard | : | IEC 60076 |
| Method of cooling | : | AN |
| Max. Temperature rise windings | : | 100 K |
| Protection class transformer | : | IP00 |
| Climate class | : | C2 |
| Fire class | : | F1 |
| Environmental class | : | E2 |
| Noise Emission Lwa | : | See L-M-022-007 |

*Explanation:
See the sPVE for the nominal voltage and capacity to be applied.

| Verification method | Regulation/Standards |
|---|---|
| Document assessment Specification | IEC 60076 |

# 4 List of requirements