

Track circuit breakers System Specification

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1 Introduction

A track circuit breaker is included in the plus side of the metro traction power supply and can switch off sections of the power supply rail. A track circuit breaker can also switch sections on at nominal load and should therefore actually be called a " switch-disconnector ". Because the term track circuit breaker is used everywhere in the Netherlands, the factually incorrect term track circuit breaker is also used in this document.

A track circuit breaker is placed between different power supply rail sections of the metro line, and is connected to these power supply rails by means of interconnecting cables. The interconnecting cables must be multiple, in other words, sufficient cross-sectional area must be used.

Depending on the application, there are situations in which one or both of the outbound side(s) of the track circuit breaker signals the traction voltage, so that the operator can remotely see whether there is voltage on the section in question.

A track circuit breaker (BS) consists of a switch-disconnector; control/message, cabinet. The control is in the switch-disconnector itself, which only requires a power supply and a command/signal cable. The power supply and the control by means of a CBI node (remote I/O) for the switch-disconnector must be placed in a separate cabinet, the "control and supply cabinet". When installing new track circuit breakers, fixed short-circuit points must be provided.

1.1 Abbreviations

Abbreviation	Meaning
A	Amps
AWI	Auto-reclose
BLVC	Accessibility, Livability, Safety and Communication
CAB	Central remote control
CBI	Central control of installations
dB	Decibel
DC	Direct Current
DO	Final Design
EBH	Electrical Engineering Operations Manual
EKS	Erd Kurzschluss Schalter (Electronic short-circuit switch)
AND	European Standard
FIT	Factory Integration Test
FO	Functional Design
GOOSE	Generic Object Oriented Substation Event
GVI	DC switchgear assembly
HMI	Human Machine Interface
Hz	Hertz
IEC	International Electrotechnical Commission
IED	Intelligent Electronic Device

Abbreviation	Meaning
IO	Input Output
IP	International Protection Marking
iSAT	Integral Site Acceptance Test
kPa	Kilo Pascal
kV	Kilovolt
kWh	Kilo Watt hour
LVI	Low-voltage switchgear
MVA	Mega Volt Ampère
Ni-Cad	Nickel Cadmium
NSA	Emergency power unit
OG	Client
ON	Contractor
PLC	Programmable Logic Controller
SAT	Site Acceptance Test
SCADA	Supervisory Control And Data Acquisition
SIT	Site Integration Test
(S)IV	(Strategic) Installation Manager
sPVE	(project)Specific Programme of Requirements
SS	Traction power switchgear substation
UO	Implementation design
V	Volt
VLD	Voltage Limiting Device
WCD	Socket

1.2 Binding documents

Title	Document nr	Version	Date
Afkortingen en acroniemen	CEB\OVG\19462	1.0.0.0	15-7-2019
Elektrotechnisch Bedrijfsvoering Handboek voor Railinfrastructuur Metro en Tram Amsterdam	WLS\OVG\18867	3.2	10-7-2018
Netcode Elektriciteit	https://wetten.overheid.nl/BWBRo037940/2021-02-13		13-2-2021
VB AMS 053 Areaaldecompositie en codering van locaties, installaties, objecten en kabels	CEB/OVG/20507	3.0	20-5-2019
Eenlijnschema typical Schakelstation	CEB\OVG\25947	1.0.2.0	21-4-2021
Opstellingstekening installaties Schakelstation	CEB\OVG/25948	1.0.2.0	21-4-2021

Title	Document nr	Version	Date
Schakelmatrix Schakelstation	CEB\OVG\26035	0.1.0.0	3-5-2021
Tripmatrix Schakelstation	CEB\OVG\25952	1.0	27-3-2020
Blokschema CBI Metro	CEB\OVG\25957	1.0	11-2-2020
Template I/O-lijst Schakelstation	CEB\OVG\25956	3.0	31-7-2020
Overzicht RAMS grenswaarden	CEB\OVG\24071	0.3	03-09-2020
Principe-ontwerp Minus-Aarde potentiaalbewaking volgens EN50122-1	CEB\OVG\25763	1.0	21-12-2020
TKF 630 mm2 kabelspecificatie	CEB\OVG\25764	-	-
Aansluitvoorwaarden NMA definitief	CEB\OVG\21512	1.0	08-10-2019
NMA Device specification form template	CEB\OVG\21512	1.0	08-10-2019
NMA Switchpoortaanvraag template	CEB\OVG\21512	1.0	08-10-2019
Operationele scenario's Gelijkrichterstation Metro	CEB\OVG\23093	2.7	23-4-2020
Schakeltoestanden Metro	CEB\OVG\26115	0.4.0.0	7-5-2021

1.3 Standards

This section provides an overview of relevant standards and guidelines.

The deliveries must comply with the Dutch laws and regulations and the Buildings Decree. In addition, the deliveries must meet all common requirements that can be set for the systems at the current state of the art. In addition, the delivery must comply with all the applicable standards, regulations and directives listed below in the prevailing order:

1. NEN (Dutch Standards)
2. GVB/MeT Specific Rules
3. EN (European Standards) and European Harmonisation Documents (HD)
4. IEC (Standards of the International Electrotechnical Commission)
5. NPR (Dutch Practice Guidelines)
6. EnergieNed Guidelines
7. VDE (guidelines of the German Association of Electrical Engineering, Electronics and Information Technology)
8. ATEX (European Directives on the danger of explosion)

The list of standards is not intended to be exhaustive. The Contractor shall include additional and/or replacement standards that are applicable in the work.

1.3.1 DC distribution system

NEN-EN 50123	Railtoepassingen – Gelijkstroomschakelinrichtingen voor vaste opstellingen
NEN-EN 50526	Spoorwegen en soortgelijk geleid vervoer – Overspanningsafleiders en spanningsbegrenzers voor gebruik met gelijkspanning
NEN-EN 50124-1	Spoorwegtoepassingen - Isolatiecoördinatie
NEN-EN 50123-1	Railtoepassingen - Gelijkstroomschakelinrichtingen voor vaste opstellingen - Deel 1: Algemeen (en)
NEN-EN 50123-2	Railtoepassingen - Gelijkstroomschakelinrichtingen voor vaste opstellingen - Deel 2: Gelijkstroomschakelaars
NEN-EN 50123-3	Railtoepassingen - Gelijkstroomschakelinrichtingen voor vaste opstellingen - Deel 3: Gelijkstroomscheiders en lastschakelaars voor binnenopstelling
NEN-EN 50123-4	Railtoepassingen - Gelijkstroomschakelinrichtingen voor vaste opstellingen - Deel 4: Gelijkstroomlastschakelaars, scheiders en gelijkstroomaarders voor buitenopstelling
NEN-EN 50123-6	Railtoepassingen - Gelijkstroomschakelininstallaties voor vaste opstellingen - Deel 6: Gelijkstroomschakelinrichtingen
NEN-EN 50123-7-1	Railtoepassingen - Gelijkstroomschakelininstallaties - Vaste opstellingen - Deel 7-1: Meet-, beheers- en beveiligingsinrichtingen voor specifiek gebruik in gelijkstroomtractiesystemen - Leidraad voor de toepassing
NEN-EN 50123-7-2	Railtoepassingen - Gelijkstroomschakelininstallaties voor vaste opstellingen - Deel 7-2: Meet-, beheers- en beveiligingsinrichtingen voor specifiek gebruik in gelijkstroomtractiesystemen - Isolerende stroomomzetters en andere ampèremeters
NEN-EN 50123-7-3	Railtoepassingen - Gelijkstroomschakelininstallaties voor vaste opstellingen - Deel 7-3: Meet-, beheers- en beveiligingsinrichtingen voor specifiek gebruik in gelijkstroomtractiesystemen - Isolerende spanningsomzetters en andere voltmeters
NEN-EN 50526-1	Spoorwegen en soortgelijk geleid vervoer - Overspanningsafleiders en spanningsbegrenzers voor gebruik met gelijkspanning - Deel 1: Overspanningsafleiders
NEN-EN 50526-2	Spoorwegen en soortgelijk geleid vervoer - Vaste installaties - Overspanningsafleiders en spanningsbegrenzers voor gebruik met gelijkspanning - Deel 2: Spanningsbegrenzers
NEN-EN 50526-3	Spoorwegen en soortgelijk geleid vervoer - Vaste installaties - Overspanningsafleiders en spanningsbegrenzers voor gebruik met gelijkspanning - Deel 3: Richtlijn voor de toepassing

1.3.2 Low-voltage supply

NEN 1010	Veiligheidsbepalingen voor laagspanningsinstallaties (complete versie)
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1.3.3 Miscellaneous

NEN-EN 50122-1	Spoorwegen en soortgelijk geleid vervoer – Vaste installaties – Elektrische veiligheid, aarding en retourstromen – Deel 1: Eisen in verband met bescherming tegen elektrische schok.
NEN-EN 50122-2	Spoorwegen en soortgelijk geleid vervoer - Vaste installaties - Elektrische veiligheid, aarding en retourstromen - Deel 2: Maatregelen tegen de effecten van zwerfstromen veroorzaakt door met gelijkspanning gevoede tractiestelsels
NEN-EN 50124-1	Spoorwegtoepassingen - Isolatie-coördinatie – Deel 1: Basiseisen – Slagwijdten en kruipwegen voor alle elektrische en elektronische uitrusting.
NEN-EN 50124-2	Spoorwegtoepassingen - Isolatie-coördinatie – Deel 2: Overspanningen en bijbehorende bescherming.
NEN-EN 50163	Railtoepassingen – Voedingsspanningen van tractiesystemen
NEN-EN 50388	Spoorwegen en soortgelijk geleid vervoer - Energievoorziening en rollend materieel - Technische criteria voor de coördinatie tussen energievoorziening (onderstations) en rollend materieel om interoperabiliteit te bereiken.
NEN 3140	Bedrijfsvoering van elektrische installaties – Aanvullende Nederlandse bepalingen voor laagspanningsinstallaties.
NEN 8012	Keuze van het leidingtype met als doel het beperken van schade als gevolg van brand van en via elektrische leidingen met inbegrip van glasvezelleidingen
NEN 3207	Geïsoleerde leidingen voor sterkstroom - Systemen voor de aanduiding van leidingtypen
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.
NEN 5152	Technische tekeningen - Elektrotechnische symbolen.
IEC 60146-1-1	Halfgeleideromzetters – Algemene eisen en omzetters met netcommutatie – Deel 1-1: Specificatie van basiseisen.
IEC 61850	Communicatienetwerken en – systemen in substations.
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.
NEN-EN-IEC 60228	Geleiders van geïsoleerde elektrische leidingen
NEN-EN-IEC 61914	Kabelzadels voor elektrische installaties
NPR 3626	Kabels geïsoleerd met vernet polyetheen voor spanningen van 6 kV tot en met 30 kV - Continu toelaatbare stroom en thermisch toelaatbare kortsluitstroom.

2 Requirements

The classification of the requirements in this specification is based on the object tree. Requirements have been set for each object. The requirements are linked to the objects named in Chapter 2.

2.1 Definition of requirements

Characteristic of this specification is the classification into various types of requirements and the relationship between the requirements. The requirements are divided into the following types:

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

Table 1 provides a definition for each type of requirement.

Type of requirement		Note
Functional Requirements		Functional requirements are requirements for the primary function or performance of the system and the objects of which the system is composed.
Aspect requirements	Reliability	The probability that the required function is performed under given conditions during a given time interval.
	Availability	The probability that the required function can be performed at a given arbitrary time under given conditions. This corresponds to the fraction of time that the required function can be performed under given conditions.
	Maintainability	Requirements concerning the necessary management and maintenance effort of the system or objects to be realised and the ease and speed with which a system can be restored to an operational status after failure.
	Safety	Requirements concerning the safety of the system to be realised or the objects during the usage phase, for both the user and the environment.
	Design	Requirements for the aesthetic appearance of the system or objects to be realised.
	Lifetime	Requirements regarding the required lifetime of the system or objects to be realised.
	Future-proof	Requirements for making the system suitable for future use.
Realisation requirements		During the implementation phase, the system should meet the requirements and preconditions as described in the "BLVC framework".
Interface requirements	External interface	Requirements for interfaces of the system with the (future) environment on the outside of the system boundaries
	Internal interface	Requirements for interfaces within the system related to systems/objects to be designed or realised by third parties or for the interaction between different objects within the system.

Table 1 - Requirement types definition

2.2 Requirement tables

The requirements in this System Specification are presented in accordance with the format of Table 2.

ID Title of the claim	
Requirement text	
Explanation (optional)	
Verification method (optional)	Prescription/Standards (optional)

Table 2 - Requirement format.

	:	Supplier of engineering and components (also called indicated by the letter L in the requirement number).
	:	Delivery/Implementation Installer (also called indicated by the letter I in the requirement number).
ID	:	Unique Requirement Number
Title of the claim	:	Short description of the requirement with keywords.
Demand text	:	Description of the requirement.
Explanation (optional)	:	Explanation of requirement included for information.
Verification method (optional)	:	Prescribed verification method.
Prescription (optional)	:	Description of verification method.

2.3 Unique Requirement Number

The unique Requirement Number is composed of 9 characters, W-XX-YY-ZZZ. Whereby the characters represent the following:

W	L or I	Coding requirement applies to the supplier (L) or to the installer (I)
XX	M, T or MT	Code requirement applies to M=Metro, T=Tram or MT=Metro and Tram
YYY	000-999	Coding for system group, see Table 3
ZZZ	001-999	Coding of requirement within system group

System group code YYY	Group name
000	General
001	Functionality
002	Test protocols
003	1-line diagram
004	Object Architecture
005	Contact list
006	Civilian Requirements/Designs
010	HVI
011	Metering
020	Traction Transformer
021	Auxiliary Transformer
022	Station energy supply transformer
030	Rectifier
031	Recovery Unit

System group code YYY	Group name
040	GVI general
041	GVI high speed circuit breaker
043	GVI-Plus-/mine separator
044	GVI-separator Recovery
045	Sectional switchgear (SSI)
046	Track circuit breaker
050	Low voltage general
051	Low-voltage switchgear
052	Low-voltage UPS
060	General Protection
061	Protection-HVI
062	Protection-Traction Transformer
063	Protection-EB transformer
064	Protection-Rectifier
065	Protection-GVI
066	Interlocks-SSI
070	Cabling general
071	Cable paths
072	Cabling-internal
073	Cabling-external
074	Cabling - fibre optic network
075	Wiring 61850
076	Connection CBI Metro
077	Connection CBI Tram
080	General controls
081	Control-CBI Metro
082	Control-CBI Tram
083	HMI operation
084	Emergency off circuit
090	Building-related installations
091	Project management
092	Interface management
093	Designs
094	Implementation
095	Testing
096	Verify/Validation
097	Completion/Delivery
098	Education/Training
099	Project Control and Project Support
100	Aftercare
101	Warranty
102	Parts supply

System group code YYY	Group name
103	Service and maintenance

Table 3 - Coding system group

2.4 Verification

The verification method is filled in in the requirements tables. The contractor must elaborate this verification through a verification and validation plan. The interpretation of the verification method in this specification should be seen as a conceptual proposal which the contractor should complete, detail, work out and specify further.

This specification distinguishes between the following verification methods:

- Document assessment Design: In this verification method, the design must provide an explicit description, substantiation of how the requirement is implemented. It is up to the contractor how this is worked out.
- Document review Design Drawing: In this verification method, the design should provide an explicit description, substantiation of how the requirement is implemented. A specific design drawing is explicitly required.
- Document review Design Calculation: In this verification method, the design should provide an explicit description, substantiation of how the requirement is implemented. A specific design calculation is explicitly required (example: short circuit calculation).
- Document review Design specification: In this verification method, the design should provide an explicit description, substantiation of how the requirement is implemented. A specification from, for example, a supplier is explicitly required (e.g. a control circuit diagram of a high speed circuit breaker field).
- Testing/inspection report visual: In this verification method, an explicit substantiation must be provided visually of how the requirement has been implemented. This should be recorded in a report. (For example, an inspection of the cable ducts).
- Testing/functional: In this verification method, a functional test should provide evidence that the requirement has been implemented. This should be recorded in a report (e.g. an IO test).
- Testing/measurement and report: In this verification method, a measurement should provide evidence that the requirement has been implemented. This must be laid down in a report (e.g. a measurement of the frame-earth insulation).

It should be noted that tests are normally divided into FAT, SAT and iSAT tests. It is up to the contractor to give further substance to this. The above enumeration forms a basis for this.

3 Requirements

3.1 Functional requirements Track circuit breakers

L-M-046-001 System Track circuit breaker - Function	
A track circuit breaker is included in the plus side of the metro's traction power system and can switch off parts of the power rail.	
Explanation:	
Verification method Document review Design	Prescription:
I-M-046-002 System Track circuit breaker - Connection	
A track circuit breaker is placed between different power supply rail sections of the metro line, and is connected to these power supply rails by means of interconnecting cables.	
Explanation:	
Verification method Document review Design drawing	Prescription:
I-M-046-003 System Track circuit breaker- Short Circuit Points	
Fixed short-circuit points have to be provided when new track circuit breakers are installed.	
Explanation:	
Verification method Document review Design drawing	Prescription:
L-M-046-004 System Track circuit breaker - Surface mounted	
A track circuit breaker consists of a cabinet placed on a concrete base with a switch-disconnector driven by a 230VAC 50 Hz drive motor.	
Explanation:	
Verification method Document review Design drawing	Prescription:
L-M-046-005 System Track circuit breaker - Control	
The control is in the switch-disconnector itself, it only needs power supply and a command/signal cable. Assuming a Ritter RGL 7 switch.	
Explanation:	
Verification method Document review Design drawing	Prescription:
L-M-046-006 System Track circuit breaker - Control and supply cabinet	
The power supply and the remote I/O for the switch-disconnector must be housed in a separate cabinet, the "control and power supply cabinet".	
Explanation:	
Verification method Document review Design drawing	Prescription:

I-M-046-007 System Track circuit breaker - Location of control and power supply cabinet	
The separate control and supply cabinet must be positioned near the switch-disconnector boxes, taking into account the maximum permissible length of the signal cables.	
Explanation:	
Verification method Document review Design drawing	Prescription:

L-M-046-008 System Track circuit breaker - Cables and I/O	
A fibre optic cable and power supply enter this separate control cabinet and a 230 VAC 50 Hz connecting cable and signal cable leave from each switch-disconnector. Four DI signals and two DO are required here, per switch-disconnector.	
Explanation:	
Verification method Document review Design drawing	Prescription:

L-M-046-009 System Track circuit breaker - Sectional voltage signalling and DI	
For the section voltage signal, additional DI are required.	
Explanation:	
Verification method Document review Design drawing	Prescription:

I-M-046-010 System Track circuit breaker - Glass fibre cable remote I/O	
The fibre optic required for remote I/O must be obtained from an existing Track Controller (BC).	
Explanation:	
Verification method Document review Design drawing	Prescription:

I-M-046-011 System Track circuit breaker - Power cable	
The power supply cable must be obtained from another location (passenger station, traction power substation).	
Explanation:	
Verification method Document review Design drawing	Prescription:

3.2 Technical requirements switch-disconnector

L-M-046-012 System Track circuit breaker - Surface mounted	
A track circuit breaker (BS) consists of a switch-disconnector; control/indication, cabinet.	
Explanation:	
Verification method Document review Design	Prescription:

L-M-046-013 System Track circuit breaker - Load break switch	
Switch-disconnector, in accordance with NEN-EN 50123-4, category III and NEN-EN 50124: Appendix E	
Explanation:	
Verification method Document review Design	Prescription:

L-M-046-014 System Track circuit breaker - Control/Registration	
Control/indication, in accordance with NEN-EN 1010	
Explanation:	
Verification method Document review Design	Prescription:

3.2.1 Technical requirements switch-disconnector

L-M-046-015 System Track circuit breaker - Technical requirements switch-disconnector		
#	Description	Value
1	Rated design operating voltage according to EN 50163	750 V DC
2	Maximum operating voltage	see EN 50163
3	Insulation voltage design	1200 V DC
4	Rated operating current	4000 A
5	Overvoltage class	0V ₄
6	Design impact resistance	14.4 kV
7	Maximum arc voltage	1700 V DC
8	Design short-circuit resistance (250 ms)	50 kA
9	Maximum switch-on power	31.5 kA
10	Design of inrush current	8 kA
Explanation:		
Verification method Document review Design specification		Prescription:

3.2.2 Technical requirements control/reporting

L-M-046-016 System Track circuit breaker - Manual operation	
Manual operation with spindle.	
Explanation:	
Verification method Document review Design drawing	Prescription:

L-M-046-017 System Track circuit breaker - remote control	
Remote/on-site operation by electric motor.	
Explanation:	
Verification method Document review Design drawing	Prescription:

L-M-046-018 System Track circuit breaker- Local Control	
Electrical operation on site inside the cabinet by means of electrically reversible pressure switches.	
Explanation:	
Verification method Document review Design drawing	Prescription:

L-M-046-019 System Track circuit breaker - "OFF" command	
The "OFF" command should have priority over the "IN" command, i.e. if an "IN" command is issued, it should always be overridden by an "OFF" command.	
Explanation:	
Verification method Document review Design specification	Prescription:

L-M-046-020 System Track circuit breaker - Electric Locking	
Electrically lock on and off so that they can never be active at the same time.	
Explanation:	
Verification method Document review Design specification	Prescription:

L-M-046-021 System Track circuit breaker - Utilisation category	
Utilisation category relay AC-3, tuned to the motor.	
Explanation:	
Verification method Document review Design specification	Prescription:

L-M-046-022 System Track circuit breaker - Protection Control and Heating	
Control and heating combined protected by circuit breaker with auxiliary contact for signalling.	
Explanation:	
Verification method Document review Design drawing	Prescription:

L-M-046-023 System Track circuit breaker - Motor protection	
Motor protected by a motor protection switch with auxiliary contact for signalling.	
Explanation:	
Verification method Document review Design drawing	Prescription:

L-M-046-024 System Track circuit breaker- Co-ordination class	
Coordination class "2".	
Explanation:	
Verification method Document review Design specification	Prescription:

L-M-046-025 System Track circuit breaker - Control

Control suitable for an externally supplied control voltage of 1 phase ~ 230 V in the box AC 50Hz.

Explanation:

Verification method

Document review Design drawing

Prescription:

L-M-046-026 System Track circuit breaker - BS "OFF" position transmitter

Two potential-free combined contacts (1 x NC and 1 x NO) for the BS "OFF" position transmitter.

Explanation:

Verification method

Document review Design drawing

Prescription:

L-M-046-027 System Track circuit breaker - BS "IN" position transmitter

Two potential-free combined contacts (1 x NC and 1 x NO) for the BS "IN" position transmitter.

Explanation:

Verification method

Document review Design drawing

Prescription:

L-M-046-028 System Track circuit breaker - Remote Switching On and Off

Suitable for remote operation by means of an external NO contact in the cabinet, for both switching on and off the track circuit breaker, this must be done with 1 phase ~ 230 V AC 50Hz.

Explanation:

Verification method

Document review Design drawing

Prescription:

3.2.3 Technical requirements for track circuit breaker cabinet**L-M-046-029 System Track circuit breaker - Cabinet**

Cabinet minimum IP65 and IK10, properly lockable and suitable for Euro cylinders (DIN 18252), with access doors on the operating side and on the side of the switch. The cabinet must be designed for outdoor use in the Dutch climate, unprotected against precipitation and sunlight. Metals should be protected against corrosion. Condensation must be prevented by applying measures.

Explanation:

Verification method

Document review Design specification

Prescription:

L-M-046-030 System Track circuit breaker - Base

The cabinet must be provided with a solid base that can anchor the cabinet sufficiently firmly in the ground, whereby the power/signal and traction cables can be easily fed into and mounted on the connection flags and terminal strips. When installing on a concrete structure (engineering structure/viaduct), place the box on a hot-dip galvanised base, which is attached to the concrete structure using chemical anchors.

Explanation:

Verification method

Document review Design drawing

Prescription:

L-M-046-031 System Track circuit breaker - Colour	
Colour: pebble grey RAL 7032.	
Explanation:	
Verification method Document review Design specification	Prescription:

I-M-046-032 System Track circuit breaker - Accessibility	
Once the cabinet is on site, it must be easily accessible for inspection and maintenance, and the doors must be easily accessible.	
Explanation:	
Verification method Document review Design drawing	Prescription:

I-M-046-033 System Track circuit breaker - PVR	
Cabinet must be outside PVR, even with doors open.	
Explanation:	
Verification method Document review Design drawing	Prescription:

L-M-046-034 System Track circuit breaker - Clearance height above fire chamber	
Sufficient free height above extinguishing chamber of switch to be able to extinguish possible arc, at least 500 mm.	
Explanation:	
Verification method Document review Design drawing	Prescription:

L-M-046-035 System Track circuit breaker - cabinet heating	
Thermostatically controlled cabinet heater, minimum 100 W.	
Explanation:	
Verification method Document review Design specification	Prescription:

L-M-046-036 System Track circuit breaker - Controlling/checking section voltage relays	
The control unit and the section voltage relay shall be housed in an additional watertight enclosure within the cabinet, with the pushbuttons for manual operation located on the outside of this enclosure. This cabinet should be electrically isolated from the (frame) of the track circuit breaker.	
Explanation:	
Verification method Document review Design drawing	Prescription:

L-M-046-037 System Track circuit breaker - Connection for shock hazard protection	
A connection for a surge arrester must be provided on the frame (frame) so that the frame can be connected to the minus by a 120 mm ² cable via the surge arrester.	
Explanation:	
Verification method Document review Design drawing	Prescription:

L-M-046-038 System Track circuit breaker - Nameplate	
Name plate on the outside of the track circuit breaker, which contains the chosen name.	
Explanation:	
Verification method Document review Design drawing	Prescription:

L-M-046-039 System Track circuit breaker - isolation 230 V circuit	
The 230 V circuit must be double insulated.	
Explanation:	
Verification method Document review Design drawing	Prescription:

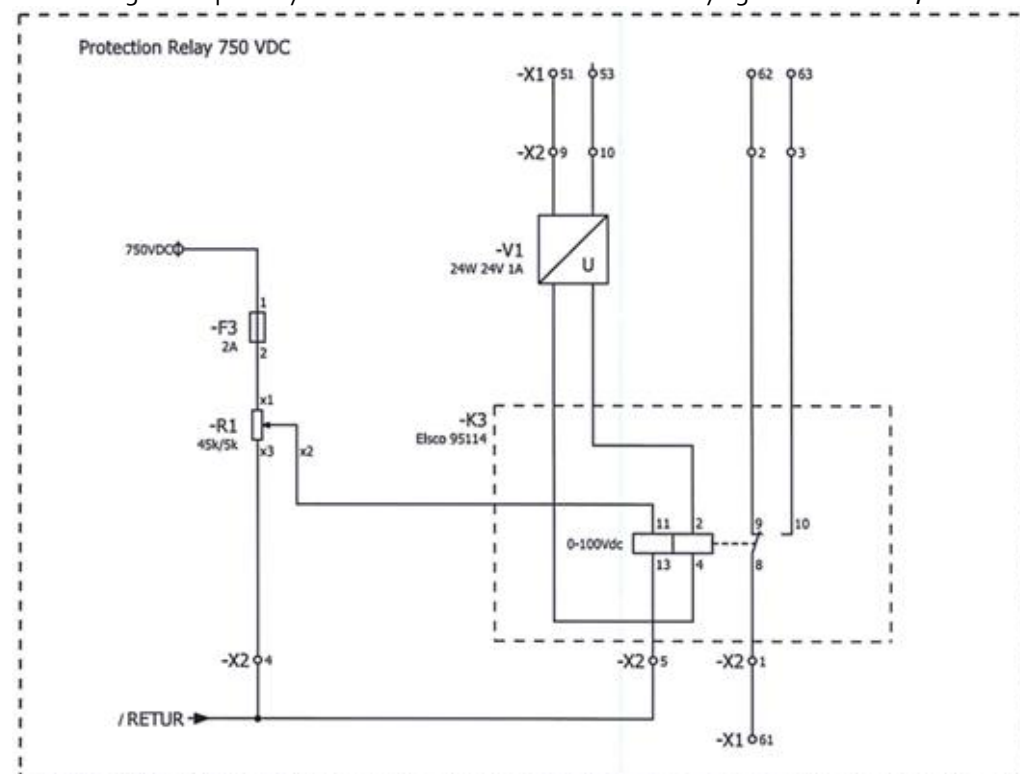
3.2.4 Technical requirements Sectional voltage signalling (in enclosure)

L-M-046-040 System Track circuit breaker - Section Voltage Signalling

The section voltage signal shall be included in the switch-disconnector box and comply with the following conditions.

- Section voltage signalling on outbound section, setting (upper limit) 530 V ~ 53 V (1:10) with a proportional band (lower limit) of 8 % = 4 V ~ 49 V (1:10);
- Section voltage relays must be connected to the traction voltage by means of a voltage divider (resistor) with a ratio of 1:10;
- Branching of traction power has to be made with a cable RMvL 3/6kV 1x 2.5mm² or equivalent;
- Power supply 230 VAC / 24VDC, 24W, for sectional voltage signal relays.

The cabling of the primary section must not be mounted directly against the frame, but must be insulated.



Explanation:

Verification method

Document review Design specification

Prescription:

3.3 Technical requirements Separate control and supply cabinet

L-M-046-041 System Track circuit breaker - control and supply cabinet

A separate control and supply cabinet must be installed.

Explanation:

Verification method

Document review Design

Prescription:

L-M-046-042 System Track circuit breaker - Functional control and power supply cabinet	
The control and supply cabinet is used to supply power to the circuit breaker and to communicate with the CBI.	
Explanation:	
Verification method Document review Design	Prescription:

L-M-046-043 System Track circuit breaker - Cabinet	
Cabinet minimum IP65 and IK10, properly lockable and suitable for Euro cylinders (DIN 18252), with access doors on the operating side. The cabinet must be designed for outdoor use in the Dutch climate, unprotected against precipitation and sunlight. Metals must be protected against corrosion. Condensation must be avoided.	
Explanation:	
Verification method Document review Design specification	Prescription:

L-M-046-044 System Track circuit breaker - Colour	
Colour: pebble grey RAL 7032	
Explanation:	
Verification method Document review Design specification	Prescription:

L-M-046-045 System Track circuit breaker - Base	
The cabinet must be provided with a solid base that can anchor the cabinet sufficiently firmly in the ground, whereby the power/signal and traction cables can be easily fed into and mounted on the connection flags and terminal strips. When installing on a concrete structure (engineering structure/viaduct), place the box on a hot-dip galvanised base, which is attached to the concrete structure using chemical anchors.	
Explanation:	
Verification method Document review Design drawing	Prescription:

I-M-046-046 System Track circuit breaker - Accessibility	
Once the cabinet is on site, it must be easily accessible for inspection and maintenance, and the doors must be easily accessible.	
Explanation:	
Verification method Document review Design drawing	Prescription:

I-M-046-047 System Track circuit breaker - PVR	
Cabinet must be outside PVR, even with doors open.	
Explanation:	
Verification method Document review Design drawing	Prescription:

L-M-046-048 System Track circuit breaker - Cabinet heating

Thermostatically controlled cabinet heater, minimum 100 W.

Explanation:

Verification method

Document review Design specification

Prescription:

L-M-046-049 System Track circuit breaker - selectivity low-voltage connection

The distributor for the low-voltage connection must be selective, i.e. if one circuit breaker fails due to an overcurrent, the other connected circuit breakers must not fail.

Explanation:

Verification method

Document review Design specification

Prescription:

L-M-046-050 System Track circuit breaker - Circuit breakers

Circuit breakers must have a characteristic curve for a motor and a 30 mA earth leakage protection with auxiliary contact for signalling per outgoing line rectifier power supply.

Explanation:

Verification method

Document review Design specification

Prescription:

L-M-046-051 System Track circuit breaker - Remote I/O

Extension with remote I/O with power supply of the CBI should be placed in this cabinet.

Explanation:

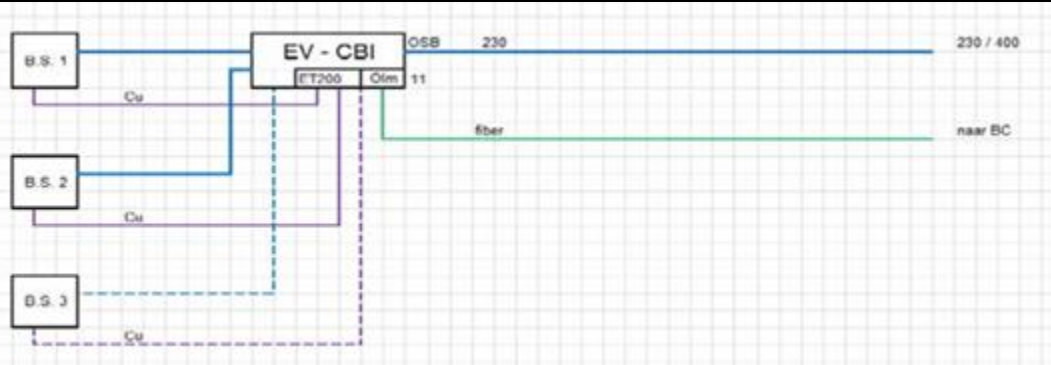
Verification method

Document review Design drawing

Prescription:

3.4 Overview of control and supply cables to be laid

I-M-046-052 System Track circuit breaker - Overview of control and supply cables to be installed



Explanation:

Verification method

Document review Design drawing

Prescription:

3.5 Technical requirements Wiring

L-M-046-053 System Track circuit breaker - Wiring in the cabinets	
The following applies to the wiring in the enclosures of the switch-disconnector cabinet and the control and supply cabinet.	
#	Requirement
1	Electrical cables and components are clearly arranged.
2	The wiring is mounted in such a way that no mechanical damage can occur due to vibrations and/or mechanical loads.
3	Connections between cables and power consumers/switching devices and between cables themselves are made using cable lugs and/or conductor end sleeves.
4	Clamping lugs and/or terminal blocks are not permitted.
5	Cables do not cause any tension on the feed-through glands when mounted on cabinets/fixtures.
6	It is not permitted to connect two cable lugs to one connection/bolt.
7	In the case of a tightened bolted joint, the bolt must protrude at least one passage through the nut.
8	The cable lugs for traction cables must be connected per cable with two bolt connections to the connection flag of the track circuit breaker.
Explanation:	
Verification method Document review Design drawing	Prescription:

I-M-046-054 System Track circuit breaker - Wiring between cabinet and power supply rails	
The following applies to the wiring between the switch-disconnector cabinets and power supply rails.	
#	Requirement
1	Connections to power supply rails are BMvKas 2 x 1 x 630mm ² Cu class 5 (flexible) per side.
2	The connections for the main current (power supply rail connection cables) must be suitable for 2 x 630 mm ² with two-hole cable lugs with a centre-to-centre distance of 40 mm and holes of Ø 13 mm. It must also be possible to connect 6 x 150 mm ² . Two cable lugs under 1 bolt is not permitted
3	The cables must be protected with a sturdy, tightly fitting concrete or plastic cable duct.
Explanation:	
Verification method Document review Design specification	Prescription:

3.6 Technical requirements Control and operating equipment

L-M-046-055 System Track circuit breaker - Remote Control and Signalling	
Track circuit breakers must be equipped with remote control and signalling, for all commands, position transmitters, alarms and measurements necessary for correct operation.	
Explanation:	
Verification method Document review Design	Prescription:

L-M-046-056 System Track circuit breaker - Remote and local control	
It must be possible to operate track circuit breakers both remotely (electrically) and locally. The same switching operations must be possible both remotely and locally.	
Explanation:	
Verification method Document review Design	Prescription:

L-M-046-057 System Track circuit breaker- Contacts	
Contacts required on the communication system (CBI notifications and commands):	
• BS "OFF" position transmitter - DI • Position transmitter BS "IN" - DI • Voltage present at section DI (possibly 2, in case of 2 signals) • Malfunction report auxiliary power supply DI • Motor protection switch DI fault message • Commands BS "OFF" - DO • Commands BS "IN" - DO	
Explanation:	
Verification method Document review Design specification	Prescription:

L-M-046-058 System Track circuit breaker - Remote I/O	
A remote I/O in accordance with §33.4 be included in the separate control and power supply cabinet for reporting and control by the communication system.	
Explanation:	
Verification method Document review Design drawing	Prescription:

I-M-046-059 System Track circuit breaker - Signal Cable	
The switch-disconnector cabinets are connected to the control and supply unit via a signal cable in accordance with § 33.4 with a maximum length of 200 metres.	
Explanation:	
Verification method Document review Design drawing	Prescription:

3.7 Technical requirements Network

I-M-046-060 System Track circuit breaker - Communication link	
To enable remote control of the track circuit breakers, a communication link is needed between the track circuit breakers and the GVB CBI system.	
Explanation:	
Verification method Document review Design	Prescription:

L-M-046-061 System Track circuit breaker - Availability of signals and commands

In the separate control and power unit, all signals and commands mentioned in §33.6 be available for communication with the CBI system.

Explanation:

Verification method
Document review Design

Prescription:

I-M-046-062 System Track circuit breaker - Connection Optical Link Module

The control and power supply cabinet to be installed will be connected to the Optical Link Module in the control and power supply cabinet and to the Track-side Controller in the nearest passenger station or traction power substation by a fibre optic cable to be installed by ON.

Explanation:

Verification method
Document review Design

Prescription:

I-M-046-063 System Track circuit breaker - cable finishing

The Contractor shall complete the cable in both the control and supply cabinet and in the passenger station or traction power substation.

Explanation:

Verification method
Document review Design drawing

Prescription:

I-M-046-064 System Track circuit breaker- Adaptation of picture plates CAB and circuit diagrams

In the event of a change in the power supply rail configuration, i.e. an additional section or a different section layout:

- The CBI and the graphics on CAB should be adjusted;
- Should the circuit diagrams Metro be adapted to the changed situation.

Explanation:

Verification method
Document review Design

Prescription:

I-M-046-065 System Track circuit breaker - Adjustments CBI

The work on the adjustments to the CBI system will be carried out by Siemens on behalf of ON. The order and execution will only take place after coordination with and approval of the Asset Manager of the Client.

Explanation:

Verification method
Document review Design

Prescription:

I-M-046-066 System Track circuit breaker - Adjustments to circuit diagrams

The work of modifying the circuit diagrams will be carried out by the GVB on behalf of ON.

Explanation:

Verification method
Document review Design

Prescription:

3.8 Technical requirements Distribution system

I-M-046-067 System Track circuit breaker - Power cable	
In order to supply the switch-disconnectores with 230 V, a supply cable must be laid from the nearest passenger station or other power supply location to the control and supply cabinet.	
Explanation:	
Verification method Document review Design	Prescription:

I-M-046-068 System Track circuit breaker- Cross-section and selectivity	
The contractor must demonstrate the correct thickness and selectivity by means of a cable calculation.	
Explanation:	
Verification method Document review Design Calculation	Prescription:

I-M-046-069 System Track circuit breaker - Voltage loss	
The maximum permissible voltage drop of 2 %, measured between the feed side and the end connection, should be used to determine the cross-sectional area of cables.	
Explanation:	
Verification method Document review Design Calculation	Prescription:

I-M-046-070 System Track circuit breaker - Connection of supply cable	
The power supply cable is connected in the low-voltage distribution board of the passenger station or other power supply location.	
Explanation:	
Verification method Document review Design	Prescription:

I-M-046-071 System Track circuit breaker - Free group	
It is assumed that a free group is available at the passenger station or other power supply location.	
Explanation:	
Verification method Document review Design	Prescription:

3.9 Technical requirements Earthing

I-M-046-072 System Track circuit breaker - Breakdown Safety	
The track circuit breaker must be provided with a direct connection via a surge arrester from frame to minus by cable 1 x 120 mm².	
Explanation:	
Verification method Document review Design drawing	Prescription:

I-M-046-073 System Track circuit breaker - Earthing	
The earthing of the supply and signal cable to the track circuit breaker must be connected to the control and supply cabinet. The earthing of the supply and signal cable must be disconnected and insulated in the switch-disconnector box.	
Explanation:	
Verification method Document review Design drawing	Prescription:

3.10 Technical requirements Fixed short-circuit point

I-M-046-074 System Track circuit breaker - Fixed short-circuit point	
A fixed short-circuit point must be provided near the connection to the track circuit breaker, consisting of: • A unique short-circuit number plate on the power rail; • On the power rail an Arcus ball stud 515.015, 25mm ball, M16, straight; • On the minus leg of the track an Arcus ball stud 515.036, 25mm ball, M12, 45° bend, • For minus leg on the other side, use an insulator.	
Explanation:	
Verification method Document review Design specification	Prescription:

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Bijlage 1 Preferred materials (informative)

#	Section	Supplier	Type
1	Switch-disconnector	Ritter	RGL 7
2	Thermostat	Rittal	SK3110000
3	Heating element	ABB	GHV 601 0100 V0006 230VAC/ 100W
4	Traction cable		BMvKas 1x630 mm ² Cu class 5
5	Minus cable	TKF	BMqK 1x120 mm ² Cu
6	Cable trays	Heatpoint	Plastic Max
7	Power supply section relay	Weidmuller	CP SNT 24W 24V 1A 1F~
8	Sectional voltage relay	Elsco	95114 100-DC; +/-10%; lower limit 53V; UH=24V-DC; 1CO; Test voltage 5 kV/1min
9	Voltage divider	Huyser	ZSDI 50K; 5%; 20W; 1000V; 28x100mm; branch on 5K/10%
10	Branch traction voltage		RMvL 3/6kV 1 x 2.5 mm ²
11	PLC		Siemens S7
12	Glass/Profibus converter	Siemens	FOBR 6GK1 503-2CB00
13	Profibus/PLC converter	Siemens	BT connector 6ES7972-0BB12-0XA0
14	PLC Remote I/O	Siemens	6ES7 133-1BL01-0XB0
15	Glass fibre cable		62.5/125 Multimode