No.:

154VZ1

Version:

241127

System / Product:

Train Protection System MIREL VZ1

v04

Title:

Maintenance manual, diagnostics v04

Further source and enclosed files:

File	Description	Pages / Connection
1		
2		
3		

The document form is based on template 2738M:201210

List of document versions:

Version	Description	Compiled by	Validated by	Approved by
000515	Document implementation			Ing. Horváth
001011	Addendum 1			Ing. Horváth
040511	Addendum 2, ŽSR V04, SW 2			Ing. Horváth
060117	Reformatting, addition of MÁV functionality			Ing. Horváth
061102	Modifications after MÁV, ŽSR V06, SW 3 functional tests			Ing. Horváth
070611	Additional of functional test (steps B08, B09, C64)			Ing. Horváth
070618	Change in labelling and order of steps in the functional test, C52 to B17			Ing. Horváth
071210	Changes from ŽSR, ČD test operations			Ing. Horváth
090110	Changes after completion of ŽSR, ČD test operations Expansion of MÁV functionalities to 160 $km.h^{-1}$			Ing. Horváth
090822	Modifications before approval of V03			Ing. Horváth
110828	Modifications before approval of V04			Ing. Horváth
141119	Modifications before approval of V04 – operational verification			Ing. Horváth
170624	Modification of prophylactic control conditions of D4	Ing. Adamec	Ing. Adamec	Ing. Michalec
180115	Changing conditions of assembly and disassembly	Ing. Adamec	Ing. Adamec	Ing. Michalec

Version	Description	Compiled by	Validated by	Approved by
190111	Completion and Maintenance of Document in Accordance with Technical Conditions	Ing. Praščák	Ing. Horváth	Ing. Michalec
201120	Addition and modification of error codes for MIREL STB and MIREL SHPE	Ing. Grman	Ing. Michalec	Ing. Michalec
221118	Modification of error codes for MIREL STB gateway	Ing. Grman	Ing. Michalec	Ing. Michalec
230215	Segmentation of system error list based on version of MIREL VZ1 Technical Conditions	Ing. Grman	Ing. Michalec	Ing. Michalec
230726	Modification of D1 test specification	Ing. Žilinec	Ing. Michalec	Ing. Michalec
231218	A more extensive update of the document	Ing. Bobek Ing. Horváth	Ing. Michalec	Ing. Michalec
241127	Specification of the description of the TSI configuration of vigilance control	Ing. Bobek	Ing. Michalec	Ing. Michalec

Table of Contents

1 Purpose of the Document

Document specifies standard servicing procedures and activities in course of diagnostics, scheduled and unscheduled train protection maintenance related with maintenance procedure for entire DRV. In actual version it describes train protection diagnostics and maintenance in version v04.

Train protection Maintenance Manual is a document primarily intended for train protection maintenance and service staff. Further, the manual has been intended as a help for implementation of training and checking activity, a help for system incorporation into DRV technology, its activation, testing and implementation of system tests.

Staff engaged in production, assembly, maintenance and diagnostics of MIREL VZ1 train protection must meet following general qualification criteria:

- specialist education in electrotechnics or transport
- demonstrably proven training for mentioned activity, with periodic renewal.

Qualification specification of requirements specific for individual MIREL VZ1 train protection diagnostics and maintenance levels are listed in relevant chapters.

Maintenance and diagnostics manual follows document 153VZ1 MIREL VZ1 Train Protection Operating Manual and 257VZ1 Technical Conditions describing operating functions of train protection and its operating method.

MIREL VZ1 train protection Maintenance Manual doesn´t, under any circumstances, replace any provisions of valid legislative and operating regulations and procedures related with control of driving rail vehicles and/or railway operation control. Valid legislative and operating regulations and procedures have an absolute precedence over present Maintenance Manual.

Document is intended for:

- staff carrying out operating, diagnostics and maintenance activities on MIREL VZ1 system,
- System Producer staff trained and authorized to conduct MIREL VZ1 system activities of fitting, activation, testing, tests implementation and maintenance,
- Staff of companies engaged in DRV production, reconstruction and maintenance, which has been trained and assigned to conduct activities of system operation, fitting, testing, diagnostics and maintenance.

Document follows up and refers to documentation below:

Related Documentation

No.		Version	Title
[A1]	153VZ1	231218	MIREL VZ1 Operating manual
[A2]	257VZ1	240129	MIREL VZ1 Technical Conditions
[A3]	547MAP	241001	KAM User manual
[A4]	1997MAP	150701	MAN User manual

Linked Documentation

No.		Version	Title
[B1]	206VZ1	231207	MIREL VZ1 Protocol from functional test D3
[B2]	498VZ1	240229	MIREL VZ1 Prophylactic inspection protocol
[B3]	460M	170717	Service note
[B4]	433VZ1	240520	MIREL VZ1 Protocol concerning installation and activation (including methodology)
[B5]	2313M	231207	MIREL Configuration protocol (including methodology)
[B6]	3046VZ1	231204	MIREL VZ1 Protocol of interface verification with ETCS

Cited and related standards and specifications

No.	Version	Title and Additional Information
[C1] -	-	-

2 Specification of Document Changes

Version 000515

Document implementation.

Version 001011

Addendum 1 dated 11 October 2000 to the Maintenance and Diagnostics Manual for the MIREL VZ1 train protection system based on requirements for technical security of the system (added in sections: D1 – Start-up self-diagnostic control, D2 – Continuous self-diagnostic control, D4 – Prophylactic control, Fault indication).

Version 040511

Addendum 2 dated 11 May 2004 to the Maintenance and Diagnostics Manual for the MIREL VZ1 train protection system based on the approval of Addendum 1 to the Technical Conditions for Serial Installation of the MIREL VZ1 Train Protection System (257-00-TW-4P-VZ, 5 March 2004).

Version 060117

Incorporation of functionalities based on EVM specifications dated 17 January 2006 on the basis of the Set of Functional Requirements for MÁV Rt On-board Train Protection Systems and Vigilance Equipment (738-06-TW-4P-VZ, 12 January 2006), the Specification of Changes to the MIREL VZ1 Train Protection System - integration of MÁV Rt functions (412-02-FW-4P-VZ, 15 January 2006) and Addendum 2 to the Technical Conditions for Serial Installation of the MIREL VZ1 Train Protection System (257-00-TW-4P-VZ, 16 January 2006).

Version 061102

Document update upon accomplishment of EVM functions test with software version v03.

Version 070611

Supplementation of steps B08, B09, C64 to D3 function test.

Version 070618

Update of designation and sequence of steps C52 through B17 of D3 function test.

Version 071210

Document update resulting from test operation on LS infrastructure.

Version 090110

Modification of functionalities based on LS specifications after completion of test operations for program version v03 and expansion of functionality based on EVM specifications for track speeds of up to 160 $km.h^{-1}$ based on the Set of Functional Requirements for MÁV Rt On-board Train Protection Systems and Vigilance Equipment (738VZ1: 081020).

Version 090822

Document update prior train protection approval in version v03.

Version 110828

Addition of functionalities based on SHP specifications on the basis of the Basic Specifications and SHP Technical Description (1054VZ1: 120910) including the incorporation of comments from operations.

Completion and adjustment of Maintenance and Diagnostics Manual for MIREL VZ1 train protection in accordance with system technical conditions (257VZ1 : 110610). Addition of functionality to support stand-by regime and cooperation with ETCS-type train protection systems.

Version 141119

Document update in extent of changes which have resulted from verification operation of version v04.

Version 170624

Update of conditions for D4 prophylactic inspection.

Version 180115

Update of conditions for fitting and dismantling.

Version 190111

Completion and adjustment of Maintenance and Diagnostics Manual for MIREL VZ1 train protection in accordance with technical conditions of systems (257VZ1: 190121). Completion of procedure for data reading from recording device. Completion of diagnostics and error codes when integrating with MIREL SHPE device.

Version 201120

Update and supplementation of error codes for MIREL STB and MIREL SHPE.

Version 221118

Error code update for MIREL STB.

Update of indication elements on train protection central unit in connection with approval process of INO2019 changes.

Supplementation by System Configuration chapter.

Update of Function Test chapter, Data Readout from Recording Unit chapter and Fitting and Dismantling chapter.

Document form update to actual technical documentation template.

Version 230215

List segmentation of detected system errors based on version of MIREL VZ1 Technical Conditions (257VZ1: 211203 and 257VZ1: 200401).

System Configuration Chapter Update.

Version 230726

Addition of the D1 interval specification also for systems after useful life in chapter 8.1.

Version 231218

- Refinement of the timing specifications of the one-time D1 diagnostic check in Section 8.1
- Clarification of the dates for the D3 functional test in Section 8.3
- Clarification of the dates for the D4 prophylactic inspection in Section 8.4

- Clarification of the conditions for performing an S1 operational repair in Section 9.1
- Specification of S2 service repair location in Section 9.2
- Unification of the fault codebook in Section 10
- New Chapter 11 - Initial Commissioning of the System
- Addition of Chapter 12.2 – Setting of Configuration Parameters
- New Chapter 12.4 - Configuration of the TSI Vigilance Check Interval
- New Chapter 13 – System Release for Operation under ECM Conditions

Version 241127

Clarification of the description of the configuration concerning the vigilance check according to the TSI referred to in section 12.4

3 Applied Designation and Terminology

Active driver cab	Engine driver cab on a rail vehicle with control switch engaged
C1, C2, C3	Config interface of MIREL VZ1 train protection
D1	One-time system diagnostic check
D2	Continuous system diagnostic check
D3	System function test
D4	System prophylactic inspection
DD, DB, Hummel M16	Types of industrial connector pieces on central unit
EVM	Train protection function specification for operation in Hungary
DRV	Driving rail vehicle or driving trailer, eventually
HP	MIREL VZ1 train protection horn
KAM	MAP application module for config of 2nd generation MIREL systems
LS	Train protection function specification for operation in Slovak and Czech Republics
MAP	MIREL Application Manager (software on personal computer)
Maximum design speed	Maximum speed specified by rail vehicle producer, or speed laid down as a maximum one upon a reconstruction
Maximum operating mode speed	Maximum speed laid down for actually active train protection operating mode
Maximum speed derived from transmitted signals, target speed	Rail vehicle maximum speed, allowed for ride at rail line section end with respective signal indication
NO	Signal repeater of MIREL VZ1 train protection
Self-acting halt, emergency halt, train protection intervention	Automatic rail vehicle halt upon train protection intervention by means of directly-acting brake EPV valve opening due to violation of any safety condition
S1	Operational system repair
S2	Service system repair
SHP	Train protection function specification for operation in Poland
SHPE	MIREL SHPE evaluating and checking unit intended to protect a rail vehicle on Polish rail line infrastructure
SID	Software identification
SL	Service sheet issued upon a repair
Predefined speed	Speed specified in accordance with applicable regulations for train set and conditions on rail track as maximum one (as a rule stipulated in railway guide book)
STB	Train protection function specification for STM module operation in standby mode
MIREL STB	MIREL STB function port providing interface between central unit of MIREL VZ1 train protection and ETCS on-board unit
Rail line part of train protection	Stationary part of line-type train protection, operating with a carrier frequency of 50 Hz or 75 Hz, stationary part of point-type train protection of SHP type
TSI	Technical specifications of interoperability
UP	Upgrade of MIREL VZ1 train protection
VZ, train protection	MIREL VZ1 train protection
Z1, Z2	Fitting interface of MIREL VZ1 train protection
ZJ	Central unit of MIREL VZ1 train protection

4 General Characteristics

The MIREL VZ1 train protection system is the mobile unit of the train protection system. It is designed for locomotives operating in Czech Republic, Slovakia, Hungary and Poland. The system is compatible with LS and EVM type track infrastructure. The system cooperates with ETCS and SHP type on-board train protection system equipment. MIREL VZ1 is an open system that may be expanded in the future to accommodate different types of systems used to transmit track information to locomotives.

The MIREL VZ1 train protection system is specifically designed to monitor engineer vigilance, transmit information from track infrastructure to the engineer's cab, check maximum speed with respect to the maximum design speed of the locomotive and the speed set point and receive information from track infrastructure. Other system functions monitor for a match between the selected and actual direction of travel, assess radio commands to remotely stop the locomotive and check the braking of a stopped locomotive.

A complete MIREL VZ1 train protection system includes the central unit, two signal repeaters at both of the engineer's cabs and two signal horns. A serial communication link connects the central unit to the signal repeaters. It is also possible to operate a single signal repeater depending on the required configuration of the system. MIREL VZ1 is configurable for single and double cab locomotives. The system is configurable for locomotives that must transmit information from the track infrastructure to the engineer's cab and for locomotives operated on track without train protection system infrastructure. The MIREL VZ1 train protection system is operable on electric and diesel locomotives and in control cab rolling stock.

The locomotive's on-board battery source is used to power the MIREL VZ1 train protection system. MIREL VZ1 configuration is dependent upon battery source voltage. The train protection system is operated and controlled exclusively from the engineer's cab using the signal repeater and other controls, including dead man's buttons and other controls on the locomotive's control panel. No interference into the mechanical space of the locomotive is required to operate the MIREL VZ1 train protection system.

The MIREL VZ1 train protection system is a digital electronic system designed specifically as secure equipment. Secure operation is ensured by a pair of processor units, a group of special watch-dog circuits, two-channel transmission of information from track infrastructure, and two-channel measurements of speed, travelled distance and direction of travel. The signal repeaters are composed of redundant single-board computers designed specifically for this use. The components used in the central unit meet demanding criteria for reliability and robustness.

The MIREL VZ1 train protection system conducts start-up and continuous self-diagnostic controls and supports a functional test to ensure the proper function of all parts of the MIREL VZ1 train protection system and cooperating functional units. The system is maintenance-free apart from the performance of the functional test and prophylactic control.

5 System Configuration

Complete configuration:

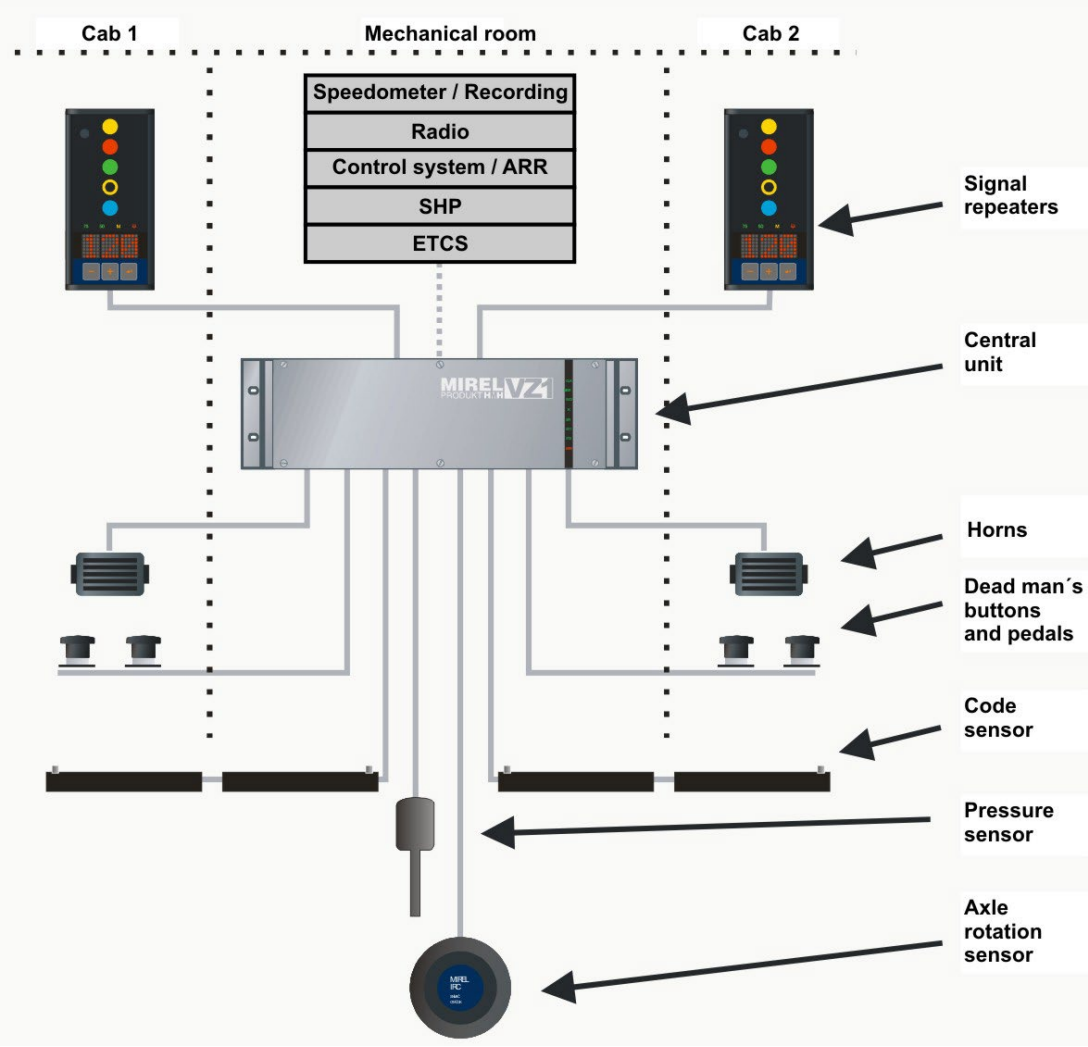
- Central unit 1x
- Signal repeater 2x
- Horn 2x

Required sub-assemblies:

- Dead man's buttons and pedals number/type given by type of locomotive
- Incremental RPM sensor 1x
- Main brake pipe pressure sensor 1x
- Recording equipment 1x

Optional sub-assemblies:

- Track infrastructure signal sensors optional configurations: 4x, 2x, 0x
- Speedomete depending on type of locomotive
- Control system or ARR depending on type of locomotive
- Radio depending on type of locomotive
- SHP system depending on type of locomotive
- ETCS system depending on type of locomotive



Note: System composition diagram is illustrative. Components of system composition can have various design versions.

6 Central Unit

The central unit performs the majority of the safety and operational functions of the MIREL VZ1 train protection system.

- Filtering and decoding transmitted information from track infrastructure
- Filtering and evaluation of the signal from the incremental RPM sensor on the locomotive
- (Measuring speed travelled distance and direction of travel)
- Calculation of safety algorithms
- Monitoring pressure in the main brake line
- Monitoring inputs (control switches, dead man's buttons and pedals, drive controllers, the direct acting brake, direction controllers, traction system switch, etc.)
- Sending outputs (controlling the EPV valve, horns, blue and red indicators, etc.)
- Communication with the signal repeaters
- System diagnostics
- System functional test
- Indicators

8 LED indicators are installed on the front panel of the central unit. No control elements are located on the central unit and there is no need for the operator to interfere with the central unit during operation of the train protection system.

The central unit is powered from the locomotive's battery source. Power is provided through a separate circuit breaker dedicated for the train protection system installed with other breakers for the locomotive or in another specific location depending on the specific type of locomotive. There is no need to turn off the system power circuit breaker under any operating situation. Other MIREL VZ1 train protection system peripherals are powered by the central unit.

The central unit in BOXTUX version is constructed with a 19" width to comply with the IEC 60297 standard for rack-mounted equipment. The design height is a U module = 44.5 mm. Central unit modules are installed in an AL enclosure. Indicators are installed on the front panel. A 72-pin DD-type industrial connector is installed on the rear panel.

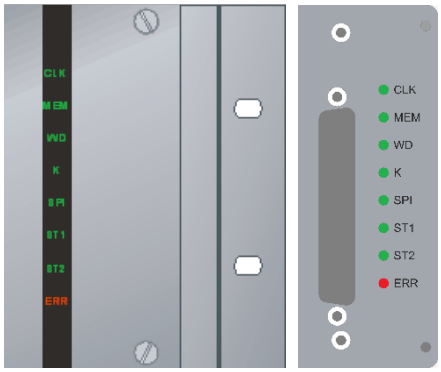
Mechanical design of central unit in BOXTUG version have modules of central unit located in a separate AL-box and is available in two different modifications, depending on assembly orientation. Indication elements are located at front panel, 37-pin connector of DB type, 25-pin connector of DB type, 15-pin connector of DB type and two 10-pin industrial connectors of type Hummel M16.

Structural design of central unit in BOXKOG has central unit modules located in a separate AL-box of modular BOXKOG-type structural system, for easy device fitting in standard 19” cases with height 3U. Indication elements are located at front panel, 37-pin connector of DB type, 25-pin connector of DB type, 15-pin connector of DB type and two 10-pin industrial connectors of type Hummel M16.

The central unit will operate in any position. The central unit is installed inside the locomotive based on the specific type of locomotive. Access to the front panel without requiring any disassembly is sufficient for ordinary operating conditions and when maintenance is required.

Indication elements on central unit front panel

Illustrative picture



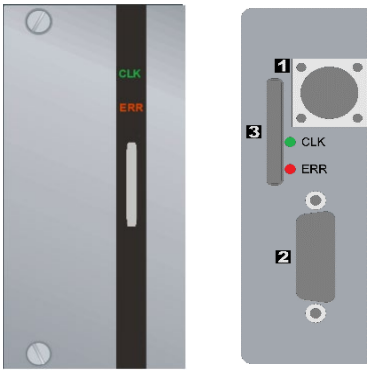
Indication elements on VZ1ZJ.0 VZ1ZJ.1

CLK	ZJ1	Indication of operation
MEM	ZJ2	Indication of D1 diagnostics
WD	ZJ3	Indication of D2 diagnostics
K	ZJ4	Indication of information transfer from line part
SPI	ZJ5	Indication of communication on SPI bus
ST1	ZJ6	Indication of communication with 1st driver cab
ST2	ZJ7	Indication of communication with 2nd driver cab
ERR	ZJ8	System error

Full designation of indicators is OIZJ1 through OIZJ8. In order to achieve transparency of Operating Manual, we shall present abbreviated designation ZJ1 through ZJ8.

Indication elements on recording part of central unit

Illustrative picture



Indication elements on VZ1ZJ.0 VZ1ZJ.1

CLK	ZJ9	Activity indication of recording unit
ERR	ZJ10	Recording unit error

Full designation of indicators is OIZJ9 through OIZJ10. In order to achieve transparency of Operating Manual, we shall present abbreviated designation ZJ9 through ZJ10.

7 Signal Repeater

The signal repeater displays information sent the track infrastructure to the engineer's cab, signals the detected carrier frequency of the signal in the track-side part of the train protection system, signals actions taken by the train protection system and displays maximum speed. It is also used to configure the operating parameters of the train protection system by the operator.

The unit is connected to the central unit with a four-conductor cable that powers the signal repeater and secures data communication between the central unit and the signal repeater.

The signal repeater is installed inside of a stand-alone AI enclosure or is a control panel-mounted device. 4 signal signs, blue light, 4 LED indicators, a three-digit alphanumeric display and three control buttons are installed on the front. A flexible cabling bundle is installed on the bottom of the AI enclosure model and the signal repeater is installed on articulated hinges that may be adjusted to an angle of -30° to +210°. The cabling bundle is installed on the rear of the model installed in the control panel. The signal repeater is installed in a vertical position.

The control switch determines the active cab of the train protection system.

Indicators and controls on the fron panel of the signal repeater

Illustrative picture

	NO1	▪ yellow signal sign in PRE working regime ▪ required brake line pressure reduction in MEN working regime
	NO2	red signal sign
	NO3	green signal sign
	NO4	▪ annulus signal sign in PRE working regime ▪ increased speed regime in MEN working regime
	NO5	vigilance check
	NO6	light intensity sensor
75	NO7	75 Hz carrier frequency
50	NO8	50 Hz carrier frequency
M	NO9	MANUAL / MÁV
	NO10	▪..reduced maximum speed ▪ stopped indicator
	NO11	three-digit alphanumeric display
	NO12	MINUS button
	NO13	PLUS button
	NO14	CONFIRM button

The full names of the indicators are OI1NO1 to OI1NO14 and OI2NO1 to OI2NO14. Abbreviated labels NO1 to NO14 are used in the maintenance manual to make it easier to read. Context makes clear the distinctions between signal repeater models.

8 System Diagnostics

Four levels of MIREL VZ1 train protection system diagnostics

D1	**Start-up diagnostic control**
D2	**Continuous diagnostic control**
D3	**Functional test**
D4	**Prophylactic control**

The first two levels (D1 and D2) are conducted automatically by the system itself. If a fault is detected, the operator is notified of such fact and the system is placed into safe mode. Actions are taken to lock out the system if the discovered fault prevents subsequent operation of the train protection system. System operational repairs (S1) must be conducted when a fault is detected).

A functional test (D3) is conducted by the operator's trained personnel. The functional test checks the overall functionality of the system, meaning the functionality of all indicators and keypads, the functionality of all input and output circuits and cooperation with other equipment on the locomotive (including driving controls, EPV, incremental RPM sensor, pressure sensor, etc.). System operational repairs (S1) must be conducted when a fault is detected. Prophylactic control (D4) of the system is performed periodically by the manufacturer of the train protection system or by other trained persons. In addition to performing the functional test, an in-depth control of the entire system is conducted (measuring input code filters, reading internal variables of the train protection system, checking input/output circuits and checking the devices that work in conjunction with the train protection system). This check is conducted to check the complete functionality of the equipment and for any wear and tear. Operational repairs (S1) or maintenance repairs (S2) are required depending on any faults that may be detected.

Anyone conducting diagnostics of the train protection system must be instructed with regards to occupational safety and must be demonstrably trained to perform such activities with certification to perform the individual levels of MIREL VZ1 train protection system diagnostics.

8.1 D1 – Start-up Diagnostic Control

Purpose:

This control verifies the status, integrity and functionality of the system during start-up. In the case of continuous operation of the system, the D1 diagnostic check has the function of a repeated daily test.

Execution:

The train protection system starts and performs the D1 diagnostic check automatically. With the exception of controller tests at the engine driver's position, the D1 diagnostic check shall be carried out without the intervention of operating or maintenance staff. In the case of controller tests, the helping cooperation of a staff member is necessary.

Schedule:

Each time the MIREL VZ1 train protection device is switched on and repeatedly after 24 hours of continuous operation of the system. For systems operated beyond their technical lifetime, the specified time interval of 24 hours shall be reduced to 8 hours. At the end of the specified time interval, the system shall have a 4 hour interval available to start a repeated test.

When integrated with ETCS, the ETCS master system may trigger the execution of the D1 test before the specified time interval has expired.

Description:

D1 start-up diagnostic control is executed once the system is switched on and diagnoses the functionality of communication inside the central unit, communication between the central unit and signal repeaters, the circuit for signals transmitted from track infrastructure to the on-board equipment, control elements in the engineer's cab and the emergency brake EPV.

A one-time D1 diagnostic test is performed each time the system is switched on. For continuous operation of the system, it is required repeatedly at a specified time interval. Repeated run of the D1 diagnostic test is performed automatically, without operating staff intervention, when the following conditions are met:

- a repeated start of D1 test is carried out upon first DRV standstill after expiration of specified time interval since last D1 diagnostic test start
- if the HDV does not reach zero speed within 4 hours after the specified time interval, the D1 test cannot be restarted. The system detects a fault.
- D1 start-up diagnostic control is blocked when the system is operating using EVM specifications in MEN working regime and a speed order of 0 is transmitted until a different speed order is transmitted
- if the system is in standby mode and does not perform any safety functions (vigilance check, remote shutdown), the repeated start of the one-time diagnostic test D1 is blocked and the 4-hour test interval is extended. After the end of this operating mode, if the extension has already caused the expiry of the 4-hour interval for the D1 test, additional 60 seconds are available to start the test.
- if more than 20 minutes remain before the end of the 4-hour test interval, the operator is alerted to this fact 15 seconds before the D1 diagnostic test is repeatedly started by a flashing D1 display on the signal repeater and an audible ZS10 signal. During this interval, the operator may press the  button to delay the repeat of the D1 start-up diagnostic control for 15 minutes. If there doesn´t happen any operation of pushbutton  , the D1 diagnostic test D1 is started automatically and its accomplishment is absolutely necessary for further operation.
- The D1 start-up diagnostic control includes check of the circuits for the transmission of signals from track infrastructure to the on-board equipment of the train protection system. When executing this portion of the D1 start-up diagnostic control, the transmission of information from track infrastructure is not active, even if the system is in working regime. The time to check the circuits for signal transmission from track infrastructure is approximately 90 seconds from the start of the D1 control.
- the reduction of the specified time interval for performing the D1 diagnostic test from 24 hours to 8 hours is indicated by a sticker on the signal repeater.

The D1 start-up diagnostic control includes a check of the functionality of the EPV on the emergency brake valve. The system activates the opening of the emergency brake EPV two times, which results in two brief drops in air pressure in the main brake pipe. The emergency brake EPV function check is subject to an accomplished control switch test, the control switch being switched on at the active cab, the DRV self-acting air brake being released and the system being in active operating mode. In the standby operating mode, the EPV test is not triggered.

D1 start-up diagnostic control includes diagnostics of the input signals from cab controls. The operator is forced to manipulate the controls as notified by four short acoustic signals and the **D1** code on both signal repeaters. If the operator does not perform the defined action with the controls, the train protection system cannot be switched to working regime in either cab. This process involves the following controls:

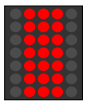
- Control switch in the cab
- Directional lever or other direction selector
- Input from the pressure switch on the direct acting brake

The operator in the active cab is obliged to conduct the following manipulations of the controls during every D1 control:

- set the control switch into OFF position at all control cabs,
- Move the directional lever into the neutral position,
- Move the directional lever into the FORWARD position,
- Move the directional lever into the BACKWARD position,
- engage the direct-acting brake,
- release the direct-acting brake.

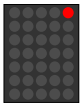
The sequence of manoeuvres with the control elements is not binding, manoeuvres with the direction lever and brake valve must be carried out with the control switch on. Manoeuvres with control elements need only be performed at the active DRV cab.

The procedure for executing the individual diagnostic steps is indicated on the signal repeater by the seven-segment column in front of the D1 code. If the segment is lit, the given step hasn´t been executed. Of segment light gets off, the respective test step has been successfully accomplished. The meanings of the individual segments are as follows:

	Position	Description
	1st row	Signal repeater communicates with the central unit
	2nd row	Control switches are in their null position
	3rd row	Directional lever in the active cab in null position and 1st direction (forward or backward depending on type of locomotive)
	4th row	Directional lever in the active cab in null position and 2nd direction (backward or forward depending on type of locomotive)
	5th row	Direct-acting brake has performed both functions (engaged, released)
	6th row	The required pressure drop in main brake pipe has been achieved by emergency brake EPV opening via channel M
	7th row	The required pressure drop in main brake pipe has been achieved by emergency brake EPV opening via channel C

Once all of the steps above have been completed, the D1 control indicator on the signal repeater is off and the system switches into working regime.

The locomotive is prevented from moving in any direction if the pressure in the main brake pipe is higher than 3.5 bar during the D1 start-up diagnostic control. If DRV starts to move, system intervenes by opening of emergency brake EPV. The audible indication is active by means of ZS11 signal during DRV movement. All of the completed steps of the D1 control are then rendered invalid. After the locomotive stops, the acoustic signal switches off and the operator must repeat the entire D1 control in full. System performs closure of emergency brake EPV only after accomplishment of control switch test at active cab.



The system checks for the presence of a MIREL STB functional gateway when conducting the D1 start-up diagnostic control. Initiating communication with MIREL STB is indicated by a red dot in the left segment of display NO11. If communication with MIREL STB is not initiated during the execution of the D1 control, the system does not initiate communication with MIREL STB in subsequent operation and works independently.

If train protection system diagnostics detect a fault (with the exception of a communication fault with the signal repeater in the inactive cab), the system is placed into safe mode and signal repeater displays NO11 in both cabs display **ERR**. The system is placed into safe mode by activating both output channels to control the EPV.

List of tests conducted within start-up diagnostic D1 control:

Program integrity check – the system calculates the checksums in memory containing the saved programs and compares them to the expected values. Memory fault error codes are: **E03, E40, E42, E43, E44, E45** or **E46**. The system is not functional during this test.

Program parameter integrity check – the system calculates the checksums in memory containing the saved program parameters and compares them to the expected values. Memory fault error codes are: **E02** or **E03**. The system is not functional during this test.

Processor working register functionality check – a read and write test for all bit combinations of data in all registers of all processors. The error code for this fault is: **E41.**

RAM functionality check – a read and write test for all bit combinations of data in all memory cells of all processors. The error code for this fault is: **E41.**

Communication check between PMM processor modules and the PMC central unit – the PMM processor module sends a SYNC packet to initiate communication with the PMC processor module. If communication is not initiated within 5 seconds, the error code is: **E06**. The system is functional during this test.

Communication check between the central unit and the signal repeaters – the PMM processor module of the central unit sends a SYNC packet to initiate communication with the signal repeaters. If communication is not initiated with the active station within 5 seconds, the error code is **E04** or **E05**. The system is functional during this test.

Check of transmission routes to monitor information from track infrastructure – the system tests transmission filters, the connections of sensors and the sensors themselves in both transmission channels. The test involves 24 steps. A progression of combinations of the following parameters is defined:

Transmission channel:	M, C
Carrier frequency:	50 Hz, 75 Hz
Transmission route from cab:	ST1, ST2
Signal intensity:	low, moderate, high

The full scope of the transmission route test is only conducted in the full scale if the locomotive is standing in a section of track where there is no signal sign transmission. If the system detects a 50 Hz or 75 Hz carrier frequency in the track circuit, this step of the test is skipped. The error code is: **E07**.

The system is functional during this test. There is no transmission of information from the track infrastructure if the system is switched into PRE or MEN working regime during the execution of the transmission route check.

Emergency brake EPV functionality check – the system executes a check of EPV control using both channels. The test is performed in two steps. The EPV is opened briefly when the locomotive's brake is first released, first using channel M and then channel C. The system evaluates the drop in pressure in the main pipe and compares it to the expected values. The error code: **E08**. The system is functional during this test.

Completion protocol:

Not issued.

Resolving nonconformity:

Upon detection of any fault during the D1 one-time diagnostic test, the train protection system is re-initialized by switching-off the train protection circuit breaker for a time of at least 5 seconds and by subsequent switching on. **If a fault is detected repeatedly, then it is a system fault which excludes any further train protection operation.** Operational repairs (S1) are required.

8.2 D2 – Continuous Diagnostic Control

Purpose:

This control verifies the status, integrity and functionality of the system during its operation.

Execution:

The train protection system automatically executes this control without intervention by the operator or maintenance.

Schedule:

During the operation of the train protection system.

Description:

Train protection system executes the continuous diagnostic check by means of watchdog circuits, by comparing the M and C evaluation channels in central unit, by comparison of indication and check channel in signal repeater, by comparing the M and C evaluation channels in MIREL STB function port and MIREL SHPE generator and by execution of other continuous tests, which monitor the proper operation of train protection. In devices featuring a double-channel architecture, train protection continuously compares results in individual channels. Upon a detection of differences, continuous self-diagnostics detects a system fault and switches the train protection into a safe status. Other operation being continuously submitted to diagnostics by train protection is the communication of central unit, signal repeaters, MIREL STB function port, MIREL SHPE generator. Communication system tests are carried out within the range of actual system configuration. Upon detection of a communication fault with signal repeater of active cab (cab with powered control), the train protection doesn´t allow further operation. If a communication fault is detected in the signal repeater at the inactive cab, the system will continue to operate in a limited scope and operational repairs are required (S1).

Tests conducted during continuous self-diagnostic controls:

Watchdog circuit test – both processor modules of the central unit and all signal repeater modules are equipped with a pair of watchdog circuits. One monitors the proper operation of the processor itself and the second monitors the operation of the processor in cooperation with the other circuits. Watchdog circuits monitor the proper operation of the processors, correct execution of the program, timer activity and the functionality of processor interruption systems. The watchdog circuits operate with a time base of 16 ms and 100 ms. When a watchdog fault is detected, the given functional block is re-initialised and an error message is generated for the entire system. The error code for a fault involving a processor module (PMM, PMC) of the central unit is **E01**. The error code for a fault involving a signal repeater indicator module is **E03**. The error code for a fault involving a signal repeater control module is **E50**.

Integrity test of defined operating parameters – the central unit and the signal repeater permanently monitor for consistency between defined parameters and the valid parameters in the central unit. This concerns the selected working regime and the defined train speed setting. The time limit for matching the defined and valid parameters is 1 second. If the parameters are inconsistent during system operation (e.g., there is a communication fault between the central unit and a signal repeater) or if the central unit does not confirm the accepted newly set parameters within the defined period of time, the system detects an integrity fault of the defined parameters and the corresponding error code is **E31** or **E03**. Evaluation channels M and C in the central unit mutually compare the active working regime. A fault is detected if the active working regime is inconsistent between channels M and C for longer than 3 seconds and the error code is **E27**. The active working regime in both channels is permanently tested against the configuration permissions for the specific train protection system application. The system detects a fault if the active working regime is not consistent with the configured permissions (prohibited for the given configuration) and the error code is **E28**.

Communication functionality test – each unit continuously monitors the functionality of data communication on the RS485 link. The system reports a communication fault if the PMC processor module or any signal repeater module does not receive the correct data packet from the PMM module after more than 5 seconds. The system also reports a communication fault if the PMM processor module does not receive the correct response packet from any other module after 50 attempts. The system detects one of the fol-

lowing error codes: **E04, E05, E06, E03, E50, E51** or **E00**. If a MIREL STB functional gateway is detected during the start-up of the system, the train protection system checks the functionality of communication with the functional gateway during system operation. A loss of channel M communication with the MIREL STB functional gateway is considered a fault and the error code is **E80**. A loss of channel C communication with the MIREL STB functional gateway is considered a fault and the error code is **E81**. Should a MIREL SHPE cooperating device be enabled in the system by the configuration, the train protection checks the functionality of their communication during entire further system operation. In case of communication loss between MIREL SHPE device and M-channel, the system detects and indicates error **E85**. In case of communication loss between MIREL SHPE device and C-channel, the system detects and indicates error **E86**.

Train protection system intervention integrity test – the system continuously compares the results of channels M and C of the central unit with a frequency of 10 Hz. A fault is detected if there is a difference in results when monitoring train protection system intervention for longer than 5 seconds and the error code is **E10**.

Maximum permitted speed evaluation integrity test – the system continuously compares the results of channels M and C of the central unit with a frequency of 10 Hz. A fault is detected if the difference in speed exceeds 5 $km.h^{-1}$ when evaluating maximum permitted speed for longer than 180 seconds and the error code is **E14**.

Signal sign transmission integrity test – the system continuously compares the results of channels M and C of the central unit with a frequency of 10 Hz. A fault is detected if the difference in the results when decoding transmitted signal signs or speed orders exists for longer than 20 seconds and the error code is **E15**.

Speed measurement test – speed measurements are completed using the four-channel incremental RPM sensor. Actual instantaneous speed is calculated from measurement channels 1, 2 and 3 and 4 in both evaluation channels (M and C). The calculated speeds are compared and every evaluation channel works with the higher of the two calculated speeds. A fault is detected if the difference between the measured speeds is larger than 20 pulses from the sensor and the error code is **E20**. The mutual comparison of results in both evaluation channels continues. A fault is detected if the difference in the speeds measured by channels M and C is greater than 2 $km.h^{-1}$ for more than 10 seconds and the error code is **E25**.

Pressure measurement test – the pressure sensor in the main brake pipe is connected to the system by a 4-20 mA current circuit. The system continuously tests the upper and lower limits. A fault is detected if the limit values are exceeded and the error code is **E24**. The mutual comparison of results in both evaluation channels continues. A fault is detected if the difference in the pressure measured by channels M and C is greater than 0.2 bar for more than 20 seconds and the error code is **E26**. The final main brake pipe pressure test checks for conformity between pressure and the movement of the locomotive. A fault is detected if pressure in the main brake pipe is less than 0.5 bar and the locomotive accelerates to more than 10 km/h and the error code is **E12**.

Actual direction of travel evaluation test – the conformity of direction of travel measurements are checked in the same way as speed measurements. The error code is **E21** if the evaluated directions do not match for a period of 3 seconds.

EPV check during train protection system intervention – the EPV valve is opened using channel M if train protection system intervention is activated. The decrease in pressure in the main pipe is then measured and compared to the expected values. EPV opening is activated using channel C and if there is low pressure in the main pipe, a fault is detected and the error code is **E11**. The expected pressure drop values are pressure of less than 4.5 bar within 5 seconds and pressure of less than 3.5 bar within 10 seconds.

Incremental RPM sensor power test – the system uses a comparator to test the power to the incremental RPM sensor. A fault is detected if the current draw is too low (power loss) or too high (short circuit) and the error code is **E22**.

Main pipe pressure sensor power test – the system uses a window comparator to test the pressure sensor supply voltage. A fault is detected if voltage is too low or too high and the error code is **E23**.

Test of decoding and processor execution of instructions – the proper decoding and executing of the applied sub-set of the instruction file of processes is tested by triggering a special diagnostic part of the program, which is conducted cyclically in 4 branches with a comparison of results. A period of 100 ms is required to conduct a single cycle. The testing period for all input data bit combinations is 26 s. A fault is detected in decoding and executing instructions and the error code is **E30**.

D1 start-up self-diagnostic control completion test – an error is detected if the complete scope of D1 control is not completed within 4 hours from the moment the train protection system is switched on and the error code is **E09**.

D1 start-up self-diagnostic control restart test – an error is reported if the system is unable to restart D1 start-up self-diagnostic control within 24 to 28 hours of the most recent test (if the locomotive has not stopped completely) and the error code is **E32**.

Signal sign indicator test – information from the signal repeater indication and control module is compared in the PMM and PMC processor modules of the central unit to detect any nonconformity between the indicated signal sign and the blue light. The error code is **E52**.

Signal repeater button test – information from the signal repeater indication and control module is compared in the PMM and PMC processor modules of the central unit to detect any fault in the signal repeater buttons. The error code for a  button fault is **E53**. The error code for a  button fault is **E54**. The error code for a  button fault is **E55**. The system detects an unprompted intervention if the confirmation button  on the signal repeater is improperly operated and the error code is **E56**.

MIREL STB functional gateway fault detection – detection is conducted autonomously of the actual functional gateway. The train protection system displays applicable error codes in the range from **E60** to **E74**.

Error detection of MIREL SHPE device – detection is carried out autonomously by device proper. Train protection realizes the indication of respective error code in range from **E90** to **E93**.

Configuration parameter integrity check – the system calculates the checksums in memory containing the configuration parameters and compares them to the expected values. The error code for a memory fault is **E33**. System also compares config parameters of central unit´s M and C channels. Comparation takes place independently from each other in both channels. Their 100% consistency is required. Upon loss of config parameters integrity, the system detects error **E34**.

Check of stand-by regime control inputs – the system detects any incorrect combinations of stand-by regime control inputs depending on the configuration permissions and the error code is **E82**.

Status check of recording equipment – the system checks the communication status and internal status of recording equipment depending on configuration permissions. The error code is **E83**.

SHP interface test – the system checks the status of the digital interface with the SHP system depending on the configuration permissions. The train protection system detects an error if an incorrect combination of digital inputs is detected from the SHP system and the error code is **E84**.

Processor module restart test – a fault is detected if an uncontrolled repeated start of either of the processor modules, PMM or PMC, in the central unit occurs during the operation of the train protection system; the error code is **E17**. The error code if an uncontrolled restart of the indicator module on the signal repeater in the active cab occurs during operation of the train protection system is **E18**. The error code if an uncontrolled restart of the control module on the signal repeater in the active cab occurs during operation of the train protection system is **E19**.

Completion protocol:

Not issued.

Resolving nonconformity:

If any fault is discovered during the continuous self-diagnostic test, simply switch off the circuit breaker for the train protection system for at least 5 seconds and then re-energise the equipment to re-initialise the equipment. **Any fault displayed after re-initialising the equipment prevents subsequent operation of the train protection system.** Operational repairs (S1) are required.

8.3 D3 – Functional Test

Purpose:

This test verifies the basic functionality and integrity of the operated system. Verification of interaction with track infrastructure, with odometry system, DRV brake system, other integrated systems (ETCS, JRU,...). Functionality verification of interface with operating staff.

Execution:

The train protection system operator's trained personnel or other demonstrably authorised and trained person of maintenance.

Schedule:

The functional test should be performed at system activation and repeated after 6 months with a tolerance of +1 month. In extraordinary situations, the functional test must be carried out when the system configuration is changed, whenever a significant change is made to the system, after the accomplishment of an operational repair S1. The time limit for repeating the D3 function test starts with the successful completion of the previous regular or extraordinary D3 function test.

Performing a D4 prophylactic check replaces performing a D3 function test and restarts the repeated test interval for D3 function test.

Description:

The functional test serves to ensure proper operation of all basic functions of the train protection system. The functional test comprises 3 sections:

A. Preparation and basic functionality
B. Functionality of defined parameters
C. Diagnostic TEST regime

The special diagnostic TEST regime is used by the train protection system to perform Section C of the functional test. This regime is selected in the cab by pressing the  button and engaging the control switch. The locomotive must be completed stopped and the system must be in ZAV regime or in a state where D1 self-diagnostics are not under way. Press  to complete a step and move to the next in Section C. Press  to return to the previous step. Press  to activate the given system output in the current step. Switch off the control switch to terminate the TEST regime.

Analogue input parameters (speed and pressure in the main pipe) are controlled with the system in ZAV regime or in a state where D1 self-diagnostics are not under way. Pressing  and  simultaneously shows the speed of the locomotive with precision of 1 $km.h^{-1}$ on the NO11 display, while pressing  and  simultaneously displays the pressure in the main brake pipe with accuracy of 0.1 bar on the NO11 display. MIREL VZT test equipment is required to conduct the full scope of the D3 functional test.

Document 206VZ1 has the methodology and template protocol for conducting the D3 functional test on the MIREL VZ1 train protection system. The person responsible for conducting the D3 function test shall also be responsible for releasing the system to service in accordance with the requirements of Section 13.

Completion protocol:

The completion protocol for the functional test must contain the following details:

- Date and site
- Serial number of the system and the central unit
- The number of the locomotive on which the equipment is installed
- The name of the person who conducted the test
- The result of the functional test (no faults / with faults)
- A description of all faults must be provided
- The signature of the person who conducted the test

Resolving nonconformity:

Operational repairs of the system S1 must be conducted when a fault is detected.

8.4 D4 – Prophylactic Control

Purpose:

In-depth verification of the condition, integrity and functionality of the system with regard to its safety and reliability. Verification of the status and interoperability of the system with the DRV and other integrated systems. Execution of system function test in extent of D3.

Execution:

Manufacturer-trained personnel of system or other persons demonstrably authorised and trained by the manufacturer explicitly for this purpose.

Schedule:

In case that the previous D4 prophylactic control was performed in the Basic range, the following D4 prophylactic control is performed after 24 months with a tolerance of +2 months.

If the previous D4 prophylactic check was performed in the Extended Extent, the next D4 prophylactic check will, as a rule, performed on one of the following major DRV repairs, but maximum within120 months from the successful completion of the previous D4 prophylactic check.

For systems that are operated beyond their technical lifetime, the time since the last D4 prophylactic control must not exceed 24 + 2 months, regardless of the extent of the previous prophylactic control.

The first D4 prophylactic check time limit starts to run on the date of the final inspection when the following components are shipped from the manufacturer: base unit and signal repeaters of the MIREL VZ1 train protection device, MIREL STB function gate, MIREL SHPE generator. If the above components are not shipped at the same time, the deadline starts to run with the component shippen first.

In the event of an unscheduled D4 prophylactic check, a new interval starts.

The D4 system prophylactic control does not have to be performed in its entirety in one service activity, but individual parts can be performed at different times: the MIREL VZ1 base unit, MIREL VZ1 signal repeaters, MIREL STB function gate and MIREL SHPE generator, system interaction with DRV. In this case, the counting of the new D4 prophylactic check interval uniformly for all system components starts according to the part that was carried out first.

A D4 prophylactic control can also be carried out on individual components, usually in spare parts mode. In this case, the scope and validity of the prophylactic control is recorded separately for each component.

In the event that components are operated in one system that have different D4 prophylactic check validity, then the D4 prophylactic check validity for the entire system is determined by the component whose D4 prophylactic check validity expires first.

Place of inspection:

Prophylactic inspection D4 of the MIREL VZ1 system can be carried out in one of ways as shown below :

- on drive railway vehicle (DRV)
- prophylactic inspection of components carried out at the manufacturer's service centre. Prophylactic control of the system's interaction with the DRV carried out on the DRV.

Description:

The execution of D4 prophylactic control is subject to the methodology of a specific internal procedure issued by the manufacturer for in-depth checks of the system. The methodology for performing the D4 prophylactic control is adapted to the different installation conditions for individual classes of locomotives on which the MIREL RM1 VZ1 train protection system is installed. D4 prophylactic control may be conducted in the standard scope or in an expanded scope for version v04. Any future installations with conditions and difference that have an impact on the scope and procedure for executing the D4 prophylactic control shall be incorporated into D4 prophylactic control methodology.

Document 498VZ1 has the methodology and template protocol for conducting the D4 prophylactic control on the MIREL VZ1 train protection system.

A D4 system prophylactic control shall only be deemed to have been carried out if it has been carried out in full. Fully means that a prophylactic control of all system components and a prophylactic control of the system's interoperability with the DRV have been carried out.

The validity of the D4 prophylactic control of the system is indicated by a sticker on the base unit of the system, is registered by the manufacturer at the level of the entire system and is valid for all components of the system. If the D4 prophylactic control is performed on individual components, then its validity is marked on each component and is recorded by the manufacturer on a component-by-component basis. If a component does not have a valid D4 preventive control marked, the manufacturer shall provide this information from his records on request.

The D4 prophylactic inspection also includes part of the system´s functional test. It is carried out on the DRV as the final part of the whole methodological procedure. The person responsible for carrying out the final functional test as part of the prophylactic control shall also be responsible for releasing the system to service in accordance with the requirements in Section 13.

Completion protocol:

The completion protocol for the prophylactic test must contain the following details:

- Date of completion or the completion dates for the individual sections
- Place or places of performance
- The serial numbers of the system and the individual components
- The number of the locomotive on which the equipment is installed
- The name and position of the person who conducted the test
- The results of the prophylactic control
- A description of findings, nonconformity, faults, problems and deficiencies if identified
- Signature of the person who conducted the test

Resolving nonconformity:

If a fault is detected, operational repairs (S1) of the system or maintenance repairs (S2) are required depending on the nature of the detected problem.

9 System Maintenance

All components of the MIREL VZ1 train protection system are maintenance-free. No part needs to be periodically replaced, calibrated or adjusted.

Two levels of MIREL VZ1 train protection system maintenance

S1	Operational repairs
S2	Maintenance repairs

Operational repair (S1) is carried out by a trained employee of the operator or of a service organization. The repair shall be carried out if a fault of the train protection device is detected during one of the diagnostic check levels (D1 to D4) or if a fault is detected during operation of the train protection device. The aim of the operational repair is to eliminate faults in the cabling, power supply, connection of interacting equipment on the driving rail vehicle. During the operational repair no intervention shall be made inside the individual components of the system, which are protected by appropriate seals.

Maintenance repairs (S2) are performed by the manufacturer or persons trained and authorised by the manufacturer. Maintenance repairs are conducted if a fault cannot be resolved by performing operational repairs (S1). A service repair is usually carried out at the manufacturer's service centre. The aim of the service repair is to eliminate faults in the individual components of the system.

Anyone conducting maintenance on the train protection system must be adequately instructed with regards to occupational safety and must be demonstrably trained to perform such activities with certification to perform the individual levels of MIREL VZ1 train protection system maintenance.

9.1 S1 – Operational Repairs

Execution:

A trained employee of the train protection operator, service organisation or other demonstrably authorised and trained person.

Schedule:

If any train protection system faults are detected by any of the diagnostic controls (D1 to D4) or in connection with a fault indicated during operation of the train protection system.

Description:

Operational repairs serve to remedy faults in:

- power supply and connection of base unit
- power supply and connection of signal repeaters
- power supply and connection of MIREL STB function port
- power supply and connection of MIREL SHPE generator
- System cabling,
- Connection of the incremental RPM sensor
- Connection of the pressure sensor in the main brake pipe
- Code sensor connections
- Connectors
- Connections of input and output circuits
- Connection of interacting system
- Dead man's button connections
- Mechanical anchors

The portions of the D3 functional test that can be of assistance in more precisely determining the exact faults involved should be performed before proceeding to S1 operational repairs. The approved technical documentation for the system must be available to the worker when carrying out operational repairs. In addition to maintenance manual, he shall follow the provisions of the general technical documentation of the system and the system installation documentation for the series of rolling stock. If the operational repair S1 cannot eliminate all faults that have emerged, a service repair S2 of the train protection device is necessary.

S1 service repair includes assembly and disassembling of individual components from/on the DRV, including assembly and disassembly required for S2 service repair.

In cases where the S1 service repair has eliminated all faults, or where the S1 service repair is used to reassemble components on the DRV that were repaired during the S2 service repair, or where spare parts have been fitted to the DRV, it is necessary to carry out a D3 full-scale functional test of the system with an appropriate report on its performance. Successful completion of the D3 functional test is a prerequisite for releasing the system into service. The person responsible for releasing the repaired system into service is the person who carried out the final D3 functional test.

The execution procedure of the operational repair must be documented in a service sheet. A template of a service sheet that can be used for this purpose is provided in the 460M documentation.

Record – maintenance sheet:

The maintenance sheet for operational repairs must contain the following details:

- Date, time and place
- System registration number and serial numbers of repaired components
- The number of the locomotive on which the system is installed
- The name of the person conducting the operational repairs
- Description of the faults that have been resolved and their root causes (if known)
- Description of the faults that could not be resolved by operational repairs
- The serial numbers of the removed and installed components
- The signature of the person who conducted the repairs

9.2 S2 – Maintenance Repairs

Execution:

A trained member of the manufacturer's staff or other demonstrably authorised and trained person

Schedule:

Perform when the train protection system has faults that cannot be remedied by operational repairs S1.

Description:

The aim of the service repair is to eliminate faults in:

- Base unit of MIREL VZ1
- Signal repeaters of MIREL VZ1
- Horns of MIREL VZ1 train protection
- MIREL STB function port
- MIREL SHP generator
- MIREL IRC speed sensor
- MIREL ST pressure sensor
- other system components
- Cooperation between the train protection system and cooperating equipment and other components of the locomotive that could not be remedied with S1 operational repairs

Service repair S2 is nested within operational repair S1 where the need for service repair has been identified. Service repair S2 is normally carried out at the manufacturer's service centre or at another suitable location (e.g. mobile service workshops) specified by the manufacturer. In exceptional cases, the service repair shall be carried out directly on the DRV. The S2 service repair does not include the assembly and disassembly of components to/from the DRV, this is part of the S1 operational repair. The S2 service repair does not release the system for operation. The completion of the S2 service repair must always be followed by the completion of the corresponding S1 service repair with the corresponding D3 functional test.

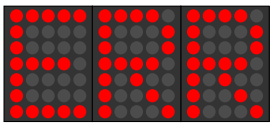
The execution procedure of the service repair must be documented in the service sheet. A template for the service letter is provided in the 460M documentation.

Record – maintenance sheet:

The completion protocol for maintenance repairs must contain the following details:

- Date, time and place
- System registration number and serial numbers of repaired components
- The number of the locomotive on which the equipment is installed
- The name of the person conducting the maintenance repairs
- Description of the faults that have been resolved and their root causes (if known)
- The serial numbers of removed and installed components (if applicable)
- The signature of the person who conducted the repairs

10 Faults



Train protection faults are divided into two groups. Specifically, there are faults that prevent subsequent use of the train protection system and faults that restrict subsequent use of the train protection system. The system is automatically switched into safe mode when a fault that prevents subsequent use of the system is detected; the EPV opens and the emergency brake is activated. The **ERR** (ZJ8) indicator lights on the front panel of the central unit. When a fault occurs, the operator should first switch off the train protection system circuit breaker for at least 5 seconds and then switch it back on to re-initialise the train protection system. If the fault appears again, the locomotive operator should not take any additional action to remedy the fault.

After re-initialising the system, it should be noted that the system operates using the pre-set operating parameters.

For more precise troubleshooting, the error code can be displayed by pushing the button (NO14) on the signal repeater in the active cab showing a fault to bring up with numbered system error code. List of errors as detected by system within the diagnostic tests framework, is provided in two tables. Each table is related to the respective version of MIREL VZA Technical Conditions.

10.1 Faults Precluding Further Operation

List of errors excluding further operation of train protection:	
E00	permanent loss of communication between signal repeater main module and central unit
E01	error detected by monitoring WD-type circuits of central unit
E02	EEPROM memory error of central unit
E03	combined error of signal repeater main module at active driver´s cab: ■ error detected by WD-type monitoring circuits ■ error of FLASH, EEPROM, RAM memories ■ errors of decoding and of processor instruction execution ■ communication error ■ integrity error of pre-set parameters
E04	communication error between central unit and signal repeater main module at 1st driver´s cab
E05	communication error between central unit and signal repeater main module at 2nd driver´s cab
E06	communication error between M- and C- channels of central unit
E07	error of code-sensing transfer path detected by one-time D1 diagnostics
E08	EPV error detected by one-time D1 diagnostics
E09	non-execution error of D1 diagnostic test within 4 hours after switch-on of system
E10	intervention integrity error of processor modules in central unit
E11	EPV error upon intervention of train protection – insufficient pressure drop in main brake line
E12	DRV movement with insufficient pressure in main brake line
E14	error of maximum speed evaluation integrity
E15	error of evaluation integrity regarding transmitted signal aspect according to LS specification or speed command according to EVM specification
E17	start-up error of central unit processor modules
E18	start-up error of signal repeater main module at active driver´s cab
E19	start-up error of signal repeater control module at active driver´s cab
E20	measurement error of actual speed
E21	evaluation error of actual travel direction
E22	powering error of incremental speed sensor
E23	powering error of pressure sensor in main line
E24	pressure measurement error in main line

E25	actual speed integrity error between M- and C- channels
E26	pressure integrity error in main line between M- and C- channels
E27	integrity error of pre-set operating mode between M- and C- channels
E28	integrity error of required operating mode – requirement for prohibited operating mode
E30	error of decoding and processor instruction execution of central unit
E31	integrity error of set operating parameters
E32	error of repeated D1 diagnostic test start-up
E33	integrity error of train protection configuration data
E34	integrity error of configuration data between M- and C- channels
E35	validity error of D4 diagnostic test
E36	error of system real time setting
E40	central unit FLASH memory error
E41	central unit RAM memory error
E42	software integrity error – UNI section
E43	software integrity error – LS section
E44	software integrity error – EVM section
E45	software integrity error – SHP section
E46	software integrity error – STB section
E50	combined error of signal repeater control module at active driver´s cab ■ error detected by WD-type monitoring circuits ■ error of FLASH, EEPROM, RAM memories ■ errors of decoding and of processor instruction execution ■ communication error
E51	error of central unit communication with signal repeater control module at active driver´s cab
E52	signal aspect indication integrity error on signal repeater at active driver´s cab
E53	functional error of  signal repeater button at active driver´s cab
E54	functional error of  signal repeater button at active driver´s cab
E55	functional error of  signal repeater button at active driver´s cab
E56	error of unrequired termination of system intervention
E60	combined error of STBM or STBC blocks of MIREL STB gateway: ■ error detected by WD-type monitoring circuits ■ FLASH, EEPROM memory errors – checksums ■ RAM – R/W memory error ■ errors of decoding and execution of processor instructions ■ stack error ■ error of data areas range in EEPROM and RAM ■ real time system error ■ EEPROM memory update error ■ integrity of UNI software block – checksums ■ configuration data integrity error ■ power supply error of communication lines KL1 (bus KZ1) and KL2 (bus KZ0)
E61	integrity loss of active MIREL STB gateway mode and operating mode of MIREL VZ1 system.
E62	integrity loss of: ■ STM_CMD command (command for MIREL VZ1 system) between channels M and C of MIREL STB gateway ■ exposed binary outputs between channels M and C of MIREL STB gateway ■ configuration bytes of MIREL STB gateway between M and C channels ■ configuration of the active interface for controlling STM module (active binary and communication interface)
E63	communication error between MIREL STB gateway with MIREL VZ1 system
E64	communication error between MIREL STB gateway with ETCS system

E65	integrity loss of command from ETCS or VCS: ■ required active mode (DA) for more than 1 national system and configurationally, switching to STB-I mode is not allowed even during operations ■ MIREL is in active mode (DA) and ETCS requests fault state (FA) or MIREL has fault state (FA) and ETCS requests active mode (DA) ■ ETCS operating modes of corresponding STM modules aren´t identical
E66	integrity loss of generated safety-relevant messages between M and C channels of MIREL STB gateway
E67	integrity loss of MIREL STB binary outputs
E68	combined error of STBGW block of MIREL STB gateway: ■ errors detected by WD-type monitoring circuits ■ error detected by software restart ■ FLASH memory error – checksums ■ RAM – R/W memory error ■ stack error ■ power supply error of communication lines ■ error of communication on KZ0 communication bus ■ errors of decoding and execution of processor instructions ■ error of internal parameters ■ integrity of UNI software block – checksums ■ real time system error ■ archive error in FRAM memory ■ error of communication with FRAM memory ■ error of communication with MVB module ■ error of free loop
E69	communication error between M- and C- channels of MIREL STB gateway
E70	communication error with STBGW block of MIREL STB gateway
E71	Error of STBGW unit´s config parameters ■ integrity error of config parameters from STBGW unit ■ discrepancy between NSDB configuration and configuration VZ1/STB
E72	integrity loss of state two MIREL STB gateways in function master/slave: ■ wrong CRC in data part of security packet of the function f_MS ■ incorrect state of status bits of security packet of the function f_MS ■ mismatch between NID_STMSTATE and NID_STMSTATEORDER variables
E73	communication error between gateways MIREL STB master and slave: ■ non-updated security packet timestamp of the function f_MS ■ malfunction of security packet of the function f_MS
E74	error of external communication interface including the master/slave function: ■ failure of an inactive gateway (E68, E70, E71, E74) evaluated by an active MIREL STB gateway
E80	communication error of central unit with M-channel of MIREL STB gateway
E81	communication error of central unit with C-channel of MIREL STB gateway
E82	integrity error of standby mode control binary inputs
E83	combined error of recording unit ■ communication error with MIREL BB recording device ■ internal error of MIREL BB recording device ■ communication error with MIREL SPIO recording device gateway ■ internal error of MIREL SPIO recording device gateway
E84	integrity error of binary interface with SHP system
E85	communication error of central unit with M-channel of MIREL SHPE generator
E86	communication error of central unit with C-channel of MIREL SHPE generator
E90	combined error of MIREL SHPE generator ■ error detected by WD-type monitoring circuits ■ errors of decoding and of processor instruction execution ■ error of internal communication with peripheral circuits ■ error of FLASH, EEPROM, RAM memories ■ error of power supply
E91	integrity error between M- and C- channels of MIREL SHPE generator
E92	communication error of MIREL SHPE generator
E93	antenna error of MIREL SHPE generator

For the purpose of analyzing the registered data of faults detected in the C channels of the base unit, the MIREL STB gateway and the SHPE generator, an additional offset of +100 is added to the code according to the following table. Faults detected in M channels are detected according to the table without additional offset.

△	A different detection of some faults is possible in older systems, as indicated below
E60	Combined error of MIREL STB port – channel M ■ error detected by WD-type monitoring circuits ■ error of FLASH, EEPROM, RAM memories ■ errors of encoding and of processor instructions execution
E61	integrity error of operating mode required by MIREL STB port – channel M and actual operating mode of MIREL VZ1 system
E62	integrity error of required operating mode between channels M and C of MIREL STB port detected by channel M
E63	Combined error of MIREL STB port – channel M communication ■ error of MIREL STB port communication with MIREL VZ1 system ■ communication error between M and C channels
E64	Error of MIREL STB port – channel M communication with ETCS
E65	Combined error of ETCS command detected by MIREL STB port – channel M ■ ETCS requires DA status for more than a single STM module ■ ETCS requires FA status for all STM modules
E70	Combined error of MIREL STB port – channel C ■ Error detected by WD-type monitoring circuits ■ error of FLASH, EEPROM, RAM memories ■ errors of encoding and of processor instructions execution
E71	integrity error of operating mode required by MIREL STB port – channel C and actual operating mode of MIREL VZ1 system
E72	integrity error of required operating mode between channels M and C of MIREL STB port detected by channel M
E73	Combined error of MIREL STB port – channel C communication ■ error of MIREL STB port communication with MIREL VZ1 system ■ communication error between M and C channels
E74	Error of MIREL STB port – channel C communication with ETCS
E75	Combined error of ETCS command detected by MIREL STB port – channel C ■ ETCS requires DA status for more than a single STM module ■ ETCS requires FA status for all STM modules

10.2 Faults Limiting Further Operation

When a fault occurs that restricts further operation of the train protection device, the EPV valve is not opened and the emergency brake is activated. No fault shall be indicated on the front panel of the base unit or on the signal repeater at the active cab. These are faults in the inactive signal repeater and faults detected while driving in ZAV mode.

Signal repeater failures at inactive cab restrict the operation of the train protection device only to the cab where the signal repeater is in fault-free operation.

List of faults limiting further operation of the train protection device which are indicated on the signal repeater of an inactive cab:

E00	Combined error of signal repeater main module at active cab ■ Fault detected by WD-type monitoring circuits ■ Error of FLASH, EEPROM, RAM memories ■ errors of encoding and of processor instructions execution ■ communication error

All faults detected during operation in the ZAV operating mode while driving have been classified as faults limiting further operation of the system. When the rolling stock is stopped, these faults are reclassified according to the type of fault in the standard way. The opening of the EPV emergency brake due to fault detection in ZAV mode occurs only after the DRV has come to a standstill.

11 Initial Commissioning of the System

Prior to the first commissioning, it is necessary that the installation into the DRV is carried out in accordance with the system installation interface according to the existing application documentation that has been developed and approved for the specific use of the system for that DRV type/series/modification. In the absence of such documentation, application documentation for the new specific use shall be developed and approved prior to the first commissioning of the system.

The mounting interface of the MIREL VZ1 train protection device is two-level

Z1	Primary (prototype) system installation for a new specific use
Z2	Serial (repeated) system installation for existing and approved specific use

The initial commissioning of the system shall include the configuration of the system in accordance with the system configuration interface described in Section 12. In the case of installation level Z1, the system configuration shall be followed by the system configuration at level C1. In the case of installation level Z2, the system configuration shall be followed by the system configuration at level C2.

11.1 Z1 – Primary System Installation

The aim of the primary (prototype) system installation is to develop application documentation for a new specific use of the system, installation and activation of the system on the DRV, verification of the suitability of the proposed application solution, verification of the completeness and correctness of the prepared application documentation, verification of the compliance of the system installation with the developed documentation in the scope specified by the 2313M methodology. Primary installation of the system in the scope of Z1 level for a new specific application includes the following stages:

Stage	Contents	Performed by
Preliminary documentation	Engineering solution proposal and preparation of preliminary application documentation in full extent for new specific use.	System integrator
DRV preparation	DRV preparation for installation of the system electrically, mechanically and pneumatically according to the prepared preliminary application documentation.	Installation executor
System installation	Installation and connection of all system components to the prepared DRV without switching them on. Procedure follows the prepared preliminary application documentation.	Installation executor
System activation	Activation of the system in accordance with the preliminary application documentation drawn up according to the 433VZ1 methodology.	System producer
System configuration	Preparation of a configuration for a new specific use and its application to a system being commissioned in the scope of level C1 (specified in section 12) according to the 2313M methodology.	System producer
System verification	Verification of the system in accordance with the developed preliminary application documentation, accomplishment of functional test D3 in accordance with chapter 8.3 D3 Functional Test according to the 206VZ1 methodology.	System producer
Final documentation	Finalization of application documentation based on actual condition in course of system activation and verification.	System integrator
Approval of specific application	Approval of the specific application in accordance with the required legislative process, including an independent assessment of compliance with all functional and safety requirements (if required).	System integrator

A system integrator is an entity that meets the professional requirements for this activity and is demonstrably authorised by the manufacturer of the train protection device to do so. The integrator's staff involved in the commissioning process shall be trained for this activity. The validity of the training shall be

limited in time and shall be renewed periodically. The integrator is responsible for the correctness and completeness of the installation design, for the correctness and completeness of the application documentation, for the fulfilment of the related requirements resulting from the general system documentation and for the homologation of the specific application.

The installation executor is the entity that meets the professional requirements for this activity and is demonstrably authorised by the manufacturer of the train protection device to carry out this activity. The staff of the installation executor involved in the commissioning process shall be trained for this activity. The validity of the training shall be limited in time and shall be renewed periodically. The installation executor shall be responsible for the preparation of the DRV and the installation of the system in accordance with the application documentation and the general documentation for the system.

The system manufacturer can carry out the integration and installation of the system in its entirety without additional requirements.

11.2 Z2 – Serial System Installation

The aim is to install and activate the system on the DRV according to the existing application documentation, to verify the functionality of the system, to verify the compliance of the installation of the system with the developed documentation in the scope specified by the 2313M methodology. The serial installation of the system in the Z2 level range for an existing specific application includes the following stages:

Stage	Contents	Performed by
DRV preparation	DRV preparation for installation of the system electrically, mechanically and pneumatically according to the existing application documentation.	Installation executor
System fitting	Installation and connection of all system components to the prepared DRV without switching them on. Procedure follows the existing application documentation.	Installation executor
System activation	System activation in accordance with existing application documentation, based on methodology 433VZ1.	System producer
System configuration	Configuration of the system to be commissioned, in C2 level extent (specified in Section 12) based on methodology 2313M.	System producer
System verification	Verification of the system in accordance with the existing application documentation, accomplishment of functional test D3 in accordance with chapter 8.3 D3 Functional Test according to the 206VZ1 methodology.	System producer

The installation executor and system producer are subject to identical requirements for serial installation of the system at Z2 level as for Z1 level as specified in section 11.1. The responsibility for DRV/ DRV change approval is subject to contractual arrangements and, as a rule, passes to the customer.

All personnel involved in the processes described must be adequately instructed in occupational safety, have demonstrable training to perform these activities, and be in possession of demonstrable authorization to perform the tasks and activities.

11.3 Protocols

The scope and results of the Z1 and Z2 processes must be clearly stated in the relevant protocol. The records in the protocol shall mainly focus on the following findings:

1. No functional non-conformities have been identified that need to be rectified.
2. Functional non-conformities from the previous activation have been resolved.
3. Functional non-conformities have been revealed
4. No non-conformities with the technical specification and application documentation have been found
5. Non-compliances with the technical specification and application documentation have been revealed
6. Conformity assessment to the technical specification was not subject of the service
7. The system is fit for operation

8. After the installation deficiencies have been corrected, the system is fit for operation
9. The system is fit for verification operation
10. After the installation deficiencies have been corrected, the system is fit for verification operation
11. The system isn´t fit for operation

Records must be entered with relevant evidence and supplementary information.

11.4 Extended Scope of Commissioning

If the base unit or any signal repeater of the MIREL VZ1 train protection system or the MIREL STB function port or MIREL SHPE generator has been shipped from the manufacturer earlier than 12 months from the date of the first placing in service of the system, the commissioning of components exceeding the 12-month limit must be carried out in an extended scope. The specification for the extended scope is given in 433VZ1. This fact shall be indicated in the protocol.

If the whole system or its base unit or any signal repeater of the MIREL VZ1 train protection system or MIREL STB function port or MIREL SHPE generator is out of service for more than 12 months, a re-commissioning of these components must be carried out in an extended scope identical to the previous paragraph before the system is put into service. This fact must be recorded in the protocol. The term „out of service“ means, that a specific component has neither been installed on rolling stock, nor on test stand, or it has been installed, but system hasn´t been connected to supply voltage within the specific period. The requirement to re-commission components in an extended scope can be replaced by performing a D4 prophylactic check for the entire system.

11.5 Additional Verification of Interfaces with Third Party Systems

Beyond the processes described in the previous sections, the initial system commissioning process may include additional testing and verification of interfaces with third-party systems that cannot be performed in the implementation of Z1 and Z2. This is most often due to the unpreparedness of the third party systems for activation of common interfaces at the time when the first system commissioning for MIREL VZ1 is required.

In this case, the interfaces can be verified with a time delay from the first commissioning of the system. In case the first commissioning of the system was carried out at level Z1, the additional verification of interfaces shall always be carried out by designated and trained staff of the manufacturer of the MIREL VZ1 train protection device.

In case the first commissioning of the system was carried out at level Z2, additional verification may also be carried out by staff of another entity that meets the professional requirements for this activity and has been demonstrably trained and authorised by the manufacturer of the train protection device for this activity. Usually, this is the DRV manufacturer.

Requirements listed below must be met for the procedure of additional verification of interfaces :

1. A clear methodological procedure for additional verification shall be developed with an appropriate model protocol to ensure the consistency of the procedure, its demonstrability and safety. For the interface with the ETCS system, this is the methodology and protocol 3046VZ1.
2. The fact that the system has been put into operation for the first time without verification of all interfaces must be clearly indicated in the Z1/Z2 protocol.
3. Between the first commissioning of the system and the additional verification of the interfaces, it shall be ensured that functions requiring an unverified interface have been blocked and not used in operation. This must be achieved by technical or organisational measures. It is not the responsibility of the manufacturer of the MIREL VZ1 train protection device to take adequate measures.
4. Irrespective of the fact who performs the additional interface verification, the completed and validated protocol about additional interface verification shall be provided to the manufacturer of the train protection device without undue delay.

11.6 Specific Requirements for System Upgrade

The list of specific requirements for performing a system upgrade depends on the nature and objectives of the upgrade being performed. The types of changes to the system that trigger specific requirements for recommissioning the system after the upgrade are listed in the following table.

The nature of the change made within the upgrade framework	Change in application documentation	Change of installation on DRV	Repeated activation – Z1/Z2	System configuration – C1/C2	SID software identification	System verification D3
Change of connection on DRV	x	x	a	A	–	●
Replacement of rolling stock cabling (conductors, connectors, ...) in circuits which have effects on safety functions	–	x	a	–	–	●
Adding of any component	x	x	x	A	A	●
Type change of any component	x	–	x	A	A	●
Replacement of any system component with a spare piece which hasn´t been activated	–	–	x	–	A	●
Change of components layout on rolling stock	a	x	a	A	–	●
System reconfiguration	x	–	–	●	A	●
Change of configuration parameters in an existing system configuration	a	–	–	●	–	●
Software upgrade/downgrade.	a	–	–	●	●	●

Legend:

x	Always to be performed, in extent depending on upgrade nature.
●	Always to be performed, in full extent.
A	Performed/not performed depending on the nature of the upgrade. If performed, then always in full extent.
a	Performed/not performed depending on the nature of the upgrade. If performed, then in extent depending on upgrade nature.
–	Not performed.

The requirements and authorisations of the organisations to carry out the various upgrade activities and the requirements placed on the staff of these organisations are identical to those for the initial commissioning of the system. Changes not listed in the Table above do not trigger any specific requirements and can be implemented within the standard maintenance interface procedures.

Change documentation must be prepared for each system upgrade, which is in the nature of an application documentation modification or change procedure. For each upgrade, an upgrade execution protocol must be issued. Standard protocols corresponding to these processes shall be issued for the CA/C2 configuration of the system and the implementation of the D3 functional test. The Z1/Z2 standard protocol does not need to be issued as long as the necessary information is documented in the upgrade protocol.

12 System Configuration

The configuration interface includes all the processes to be carried out by the engineering staff in order to configure the equipment for the specific conditions of use on a given type of rolling stock. For the MIREL VZ1 train protection device, a triple-level configuration interface has been specified.

Configuration interface of MIREL VZ1 train protection has three levels

C1	Primary system configuration
C2	Installation system configuration
C3	Repeated system configuration

The range of activities in configuration level C3 is a subset of those specified for level C2. The scope of activities in configuration level C2 is a subset of those specified for level C1.

The range of the primary configuration C1 corresponds to the processes for the Z1 primary installation of the MIREL VZ1 train protection system. The range of the installation configuration C2 corresponds to the processes for the Z2 serial installation of the MIREL VZ1 train protection system. Repeated configuration C3 shall be performed on a train protection device already in service. The aim of the repeated configuration is to reconfigure the operating parameters of the system in accordance with the changed conditions of use of the equipment (e.g. change of the diameter of the vehicle wheel to be scanned, change of the DRV number...). It is carried out according to the technical documentation of the installation of the MIREL VZ1 train protection system for the given type of rolling stock. The general specifications of the repeated configuration are given in 1122VZ1.

12.1 General Principles and Procedures

Configuration of MIREL VZ1 train protection is carried out by means of a diagnostic computer with installed MAP application manager with KAM module.

Diagnostic computer shall be connected to train protection or to interacting registration speedometer MIREL RM1 by one of alternatives listed in Connection of Configured Devices in 547MAP KAM User Manual.

Establishing of communication between diagnostic computer and train protection system is indicated on diagnostic computer display and by means of indication light ZJ5 at front panel of central unit.

Configuration setting is carried out on diagnostic computer by means of MAP application manager in KAM module. Service, maintenance and operation staff follows in course of system configuration User Manual 547MAP for KAM software comprising binding rules, safety notices and system configuration procedures.

Upon execution of entry, reading and correctness verification of train protection config parameters in accordance with 547MAP, it is necessary to verify proper operation of train protection in extent listed below:

- central unit indicates operation by means of indicators ZJ1 and ZJ9,
- central unit doesn´t indicate system error by means of indicators ZJ8 and ZJ10,
- execution of D3 function test in accordance with protocol 206VZ1.

In the case of configuration parameter adjustments made during an S2 service repair, a functional test will be performed by maintenance personnel who will deploy the repaired equipment on the DRV as part of the accomplishment of the S1 repair.

The system configuration must be documented in an appropriate manner, for example by means of the 2313M protocol, which also contains a methodical procedure for the configuration of MIREL systems.

12.2 Setting of Configuration Parameters

General principles and procedures listed in Chapter 12.1 must be complied with when setting configuration parameters.

The individual configuration levels of the train protection system include:

Item	C1	C2	C3	C3 [1)]
preparation of a set of configuration parameters for a specific application	x			
specification of interval for vigilance control in accordance with TSI	x			
Selection of configuration parameters set for specific application	x	x		x
DRV registration number	x	x		x
Diameter of scanned axle wheel	x	x	x	x
System functionality scope	x	x		x [2)]
Interval for D1 test execution	x	x		x

[1)] applies for configuration of spare parts.
[2)] the system functionality scope can be only reduced by a configuration.

The competence of a given service workplace may be limited to only some of the above points according to the actual needs. This means that it is not possible to configure all parameters at a given workstation. The operator's service personnel generally only set the axle diameter data of the scanned axle.

12.3 Diameter Setting of Scanned Axle

General principles and procedures listed in Chapter 12.1 must be complied with when setting scanned axle diameter.

The periodicity of setting the wheel diameter of the scanned axle is specified by the operator's regulation. Further, the operator shall establish in his regulation the procedures for obtaining the actual value of the diameter of the sensing axle and the means of documenting the set diameter. This maintenance regulation establishes the procedure for how the new diameter is to be set, but does not establish the procedures and rules for when the setting of the new diameter is to be carried out.

For each specific application there is a permissible range of the diameter of the axle to be scanned. The KAM module checks the entered diameter in mm and does not allow to enter an axle diameter outside the allowed range.

12.4 Configuration of Vigilance Check Interval in Accordance with TSI

The TSI vigilance system requirements specification explicitly requires the ability to set the system cyclic vigilance check interval between 5 and 60 s. The TSI vigilance check interval configuration is part of level C1 of the configuration interface.

The data is entered into the CONTSI/b0-5 variable, which is part of the standard set of configuration parameters for each specific system application. If the CONTSI/b0-5 variable is set to 0, then the TSI vigilance check is not performed. Due to the fact that the MIREL VZ1 vigilance check cycle is terminated by a 3.5 second acoustic prompting interval, the CONTSI/b0-5 variable shall be set to a value 4 s smaller than the total required TSI vigilance check interval in seconds, which includes the duration of the acoustic prompting.

For each system configuration, the resulting set of configuration parameters, including the CONTSI/b0-5 variable, is loaded into the system base unit in the standard manner. No additional actions are required from the technical staff providing the C2 and C3 configuration levels in relation to the configuration of the vigilance control interval.

13 System Release for Operation

The release of the MIREL VZ1 train protection system into service in accordance with ECM requirements shall be governed by the following rules.

Nature of performed activity	Requirements	Person responsible for system release into operation	Protocols
Initial system commissioning	Successful completion of system activation, system configuration and D3 functional test with result *fit for operation*.	A person which performs the D3 function test. As a rule, an employee of the system manufacturer.	●Z1/Z2 ●C1/C2 ▲SID ●D3
S1 operational repair	Successful remedy of a fault on the DRV and passing the D3 functional test with a result *fit for operation* after operational repair accomplishment.	A person which performs the D3 function test. As a rule, member of operational maintenance.	▲SL ●D3
S2 service repair	Successful fault remedy of individual system components. Completion of the S2 service repair does not release the system for operation. The system can only be released to service as part of an S1 operational repair within which an S2 service repair has been requested.	Without ability to release system into service.	●SL
System upgrade	Successful completion of all required upgrade tasks, finished by a D3 functional test execution with a result *fit for operation*.	A person which performs the D3 function test. As a rule, an employee of the system manufacturer.	●UP ▲Z1/Z2 ▲C1/C2 ▲SID ●D3
D3 function test	Execution of a planned D3 function test with the result *fit for operation.*	A person which performs the D3 function test. As a rule, member of operational maintenance.	●D3
D4 prophylactic check	Execution of a planned D4 prophylactic check test with the result *fit for operation.*	A person which is responsible for execution of D4 prophylactic check. As a rule, an employee of the system manufacturer.	●D4
System configuration	Successful system reconfiguration and execution of D3 function test with result *fit for operation*.	A person which performs the D3 function test. As a rule, member of operational maintenance or an employee of the producer.	●C1/C2/C3 ●D3
Verification of interfaces	Successful verification of interface with a third party system and execution of D3 function test with a result *fit for operation*.	A person which performs the D3 function test. As a rule, employee of a subject which is responsible for verification of interaction with the given system.	●Z2E1 ●D3

Legenda:

●	Issue of this type of protocol is mandatory.
▲	The issue of a given type of protocol is optional with regard to the nature and extent of the activity carried out
D3	The performance of the D3 function test is governed by the provisions and methodology of 206VZ1
D4	The execution of the D4 prophylactic inspection is governed by the provisions and methodology of 498VZ1

The decision to release the system to service is specified in the D3 or D4 protocol.

The person responsible for the release of the system must have available or be able to consult all the mandatory issued protocols when deciding whether to release the system for operation. Where this is not possible for procedural reasons, the responsible officer must be otherwise demonstrably informed of the results contained in the mandatory protocols, which are critical in the process of releasing the system into service.

The responsible officer must indicate in the D3 (or D4) protocol the types and numbers of all mandatory protocols that he/she has taken into account when deciding whether to release the system to service.

The decision to release a MIREL VZ1 system equipped rolling stock into service shall be made and documented in accordance with the set processes of the specific entity performing rolling stock maintenance. The method of execution and documentation is not specified in present Manual.

14 Data reading from recording equipment

Depending on the configuration of the system, one of the options for integrating the registration device is directly via the RS485 communication bus, using a recording module integrated into the VZ1ZJ base unit device.

In the case of configuring a system with hardware of base unit with replaceable storage medium of the recording module, this registered data module is accessible from the front panel of the base unit. Removing the memory card is done by pushing it and then pulling it out of the slot. To return the memory card, insert it into the slot and push the card fully in.

Upon data download, memory card replacement and train protection powering, the proper train protection operation must be verified in extent described below:

- central unit indicates operation by means of indicators ZJ1 and ZJ9
- central unit doesn´t indicate any system error by means of indicators ZJ8 and ZJ10

The system time for registration is set automatically when the system is configured, according to the time on PC which the configuration is performed with. For a more detailed specification of the time setting conditions during system configuration, see the document 547MAP.

The presentation of the recorded data from the removable storage medium is performed in the MAP programming environment using the MAN module. A detailed specification is given in 1997MAP.

If data registration is implemented by an interacting unit connected to train protection, then relevant technical documentation of registration unit producer must be adhered to when downloading data and evaluating them.

15 Installation and Disassembly

After performing the assembly steps, it is necessary to carry out the D3 Test .

Central unit installation and removal in version VZ1ZJ.0

The central unit is mounted using 4 M6 bolts along the sides of the front panel. A 72-pin DD connector with 2 locking latches and a DB connector are located on the rear wall of the central processing unit. The battery source of the locomotive must be switched off or the circuit breaker for the train protection system must be switched off when installing and removing the train protection system. The installation procedure follows:

- Connect the 72-pin DD connector
- Close the latches on the connector
- Connect the DB connector
- Position in the desired location
- Install and fasten the mounting bolts

Reverse this procedure to remove.

Fitting and Dismantling of Central Unit in Version VZ1ZJ.1

Central unit is structurally fastened with 4 M6 bolts on front panel sides. Indication elements, 37-pin DB-type connector piece, 25-pin DB-type connector piece,15-pin DB-type connector piece and a pair of 10-pin industrial connectors of Hummel M16 type are situated on front panel. When fitting and dismantling, the vehicle battery power source or train protection circuit breaker must be disconnected. Fitting procedure is as described below:

- positioning into a proper position
- fitting and fastening of mounting bolts
- fitting of DB-type connector pieces and their securing with safety bolts
- fitting of Hummel M16-type connectors

Dismantling is carried out in reverse order of steps.

Fitting and Dismantling of Signal Repeater with Rear Installation

The signal repeater is inserted into an enclosure in the locomotive control panel and is secured with a pair of mounts. A terminal strip is located on the rear of the unit for connecting electrical cabling. The battery source of the locomotive must be switched off or the train protection system circuit breaker must be switched off when installing and removing a signal repeater. The installation procedure follows:

- Install the unit into the metal enclosure
- Install the mounts
- Connect cabling to terminal strip on the unit
- Position the enclosure in the desired position
- Mount the enclosure to the control panel in the cab (depending on type of locomotive)

Reverse this procedure to remove.

Fitting and Dismantling of Signal Repeater with Front Installation

Signal repeater is structurally inserted into a covering part in driving rail vehicle board and is fastened with a pair of fixation bolts. A terminal box for connection of electrical cables is situated on units rear side. When fitting and dismantling, the vehicle battery power source or train protection circuit breaker must be disconnected. Fitting procedure is as described below:

- cables wiring into unit´s terminal box
- insertion of unit into cover sheet
- securing of unit by means of fixation bolts

Dismantling is carried out in reverse order of steps.

Installation and removal of a stand-alone model horn

The horn is mounted on hinges secured with 2 M4 bolts. A terminal strip is installed on the rear of the enclosure. The battery source of the locomotive must be switched off or the circuit breaker for the device must be switched off during installation and removal. The installation procedure follows:

- Connect the terminal strip on the rear of the enclosure
- Position in the desired location
- Install and fasten the mounting bolts

Reverse this procedure to remove.

Fitting and Dismantling of Horn with Rear Installation

Identical procedure like with signal repeater with rear installation

Fitting and Dismantling of Horn with Front Installation

Identical procedure like with signal repeater with front installation

16 Notes