MANUAL FOR INSTALLATION OF

LOCO KAVACH V2.0

IN

WAP-4, WAP-5, WAP-7, WAG-7, WAG-9, WDM & WDG Locomotives

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CHANGE HISTORY

#	Name of the Document	Date	Reason for changes	Version No.
1	Loco Kavach V2.0 Installation Manual	20-11-2024	Initial Version	1.0

REFERENCES

#	Document Name	Document Number	Version Number/Year	Source
1	Safety and Reliability Requirements of Electronic Signaling Equipment	RDSO/SPN/ 144/2006	Rev 2	RDSO
2	RDSO Specification for Train Collision Avoidance System	RDSO/SPN/ 196/2020	4.0	RDSO
3.	Railway Applications - Specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS)	EN50126-1&2	1999 (with corrigendum 1-28 Feb 2007), Feb 2007	CENELEC

GLOSSARY OF TERMS

#	Abbreviation	Meaning
1	CAN	Controller Area Network
2	EMI	Electro-Magnetic Interference
3	GPS	Global positioning System
4	GSM	Global System for Mobile
5	HW	Hardware
6	I/O	Input/ Output
7	LED	Light Emitting Diode
8	OCIP	Operation Cum Indication Panel
9	PCB	Printed Circuit Board
10	RDSO	Research Designs and Standards Organization
11	RFID	Radio Frequency Identification
12	RS485	Recommended Standard 485
13	RX	Receiver
14	SIL	Safety Integrity Levels
15	SM	Station Master
16	SPAD	Signal Passing At Danger
17	TX	Transmitter
18	WFMS	Work Flow Management System

Table of Contents

1.0 Purpose:

1.1 This document provides guidelines for correct installation of Loco Kavach system along with its peripheral components. It also provides instructions for correct interconnection of all sub-systems for proper functioning of Kavach V2.0.

2.0 Specification

2.1 The TCAS System has been designed to meet the RDSO Specification No: RDSO/SPN/196/2020 V4.0 Amdt 3.

3.0 Components of Loco Kavach System:

3.1 Loco Kavach System consists of the following sub-systems.

- 3.1.1 Loco Kavach Unit
- 3.1.2 Loco Pilot Operation-cum-Indication Panel (LP-OCIP)
- 3.1.3 RFID Reader
- 3.1.4 RF Communication and GPS/GSM Antennae
- 3.1.5 Pulse Generators
- 3.1.6 Speedometer Interface Unit
- 3.1.7 Brake Interface System
- 3.1.8 Other equipment
  - 3.1.8.1 EMI Filter Box
  - 3.1.8.2 Cab Input Box
  - 3.1.8.3 RFID Reader Power Supply &
  - 3.1.8.4 Radio Unit
- 3.1.9 Inter-connection Cable Assembly

4.0 List of documents required for installation and inter-connection:

Ref #	Activity	Document title	Document number
1	General documents	Loco Kavach Installation Locations in various locomotives	IRISET/COE/Kavach/Misc dated 03-08-2023
2		Personnel Safety Instruction Manual	5 16 76 0014
3		WFMS Operational Manual	5 53 75 0003
4	Power Supply arrangement	Loco Kavach Power Supply Connectivity Diagram	5 16 49 0426
5	Kavach Interconnectivity	Loco Kavach inter connectivity diagram for E-70	5 16 49 0608
6		Loco Kavach inter connectivity diagram for CCB	5 16 49 0618
7		Loco Kavach inter connectivity diagram for IRAB	5 16 49 0619
8	Loco Kavach Cables installation	Loco Kavach Cable Routing Plan for WAP-7/WAP-5/WAG-9 locomotives with E-70 braking system	5 16 49 0620
9		Loco Kavach Cable Routing Plan for WAP-7/WAP-5/WAG-9 locomotives with CCB braking system	5 16 49 0621

Ref #	Activity	Document title	Document number
10		Loco Kavach Cable Routing Plan for WAG-7/WAP-4 locomotives with IRAB braking system	5 16 49 0622
11		Loco Kavach Cable Routing Plan for WDG/WDM locomotives with IRAB braking system	5 16 49 0623
12	Brake interface	Arrangement of Kavach Interfacing with E70 Brake System in WAP-5/WAP-7/WAG-9 locomotives	2454245/2023/O/o PED/Traction/RDSO
13		Arrangement of Kavach Interfacing with CCB Brake System in WAP-5/WAP-7/WAG-9 locomotives	Under RDSO scrutiny
14		BIU Schematic Interfaced with IRAB	5 16 67 0854
15	CAB Input Interface	Inter-connection drawing from Cab Termination Unit and SB Panels E-70	5 16 49 0624
16		Inter-connection drawing from Cab Termination Unit and SB Panels CCB	5 16 49 0625
17		Inter-connection drawing from Cab Termination Unit and SB Panels IRAB	5 16 49 0626
18	Loco Kavach Configuration	Loco Kavach Configuration File Request Form	EG-IC-FT-57
19		Loco Kavach Configuration File Generation Report	EG-EN-FT-21
20	Quality Control	In-Process QC Procedure for Loco Kavach Installation	5 16 76 0035
21		In-Process QC Checklist for Loco Kavach Installation	EG-IC-FT-62

5.0 Personnel safety instructions:

Installation of Loco TCAS and its associated sub-systems in a railway environment is prone to personnel safety risks. Instructions for personnel safety as indicated in document Personnel Safety Instruction Manual 5 16 76 0014 [Ref: 2] shall always be followed. Failure to follow these instructions will cause insurance claims to be invalid.

6.0 Adherence to Railway administrative procedures:

6.1 Relevant procedures and guidelines of zonal railways shall always be followed for taking up work in railway premises and locomotives, with advance permissions taken from relevant officials.

7.0 Installation Kit:

7.1 Each Loco Kavach system is supplied with an Installation Kit from the factory. The Installation kit components are listed below.

#	Part Number	Description	QTY	Unit	Used for assembly of	Purpose
1	1000056298	SCREW_SOCKETHEADCAP_M10X35_DIN_912_A2-70	4.00	PC	Onboard Kavach Installation Stand	For fixing Loco Kavach Unit on the welded stand / frame
2	1000025369	SPRING_WASHER_SS_M10	4.00	PC		
3	1000020818	WASHER_PLAIN_M10_SS	8.00	PC		
4	1000077613	NUT_HEX_M10_SS_DIN-934_A2-70	4.00	PC		
5	1000015683	SCREW_HEX_SOCKET HEAD CAP_SS_M8x35MM	4.00	PC	Radio Unit	
6	1000012019	NUT(HEX)_M8_SS	4.00	PC		
7	1000020908	WASHER_SPRING_M8_SS	4.00	PC		
8	1000020840	WASHER_PLAIN_M8_SS	8.00	PC		
9	1000111390	CHAIN_THIK_8MM_RING LENTH_30MM_MS_NICKEL	3.00	Mtrs	RFID Reader 1&2 Protection	
10	1000113473	RFID_MUD-GUARD_516670807	2.00	PC		
11	1000056108	SCREW_SOCKETHEAD_SS_M6X25_DIN_912_A2-70	8.00	PC	RFID PS Units	
12	1000012029	NUT(HEX)_SS_M6	8.00	PC		
13	1000020905	SPRING_WASHER_SS_M6	8.00	PC		
14	1000020837	WASHER_PLAIN_M6_SS	16.00	PC		
15	1000075906	ELBOW_2"_MS	2.00	PC	Fixing of RF & GPS/GSM Antennae	For RF Cable entry (one on each cab)
16	1000075905	STEEL_REINFORCED_PIPE_2"	12.00	Mtr		For cable conduit
17	1000011477	METALIC CABLE TIES SS TYPE_200MM	50.00	PC		For holding the conduit
18	1000020790	WASHER_M12 SS	1.00	PC		Fixing drive pin
19	1000020892	WASHER_SPRING_M12_SS	1.00	PC		Fixing drive pin

#	Part Number	Description	QTY	Unit	Used for assembly of	Purpose
20	1000086706	GASKET_LOCKPLATE_PULSE_GENRATOR_516670553	1.00	PC	Installation of Pulse Generators	Gasket between Axle box and lock plate
21	1000089983	SCREW_CSK_HEXA_SOCKET_TYPE_M10X30MM_SS	4.00	PC		Fixing lock plate
22	1000086707	GASKET_PULSE_GENRATOR_516670554	1.00	PC		Gasket between lock plate and PG
23	1000083436	SCREW_SOCKET HEAD_M8x25MM_SS	8.00	PC		Fixing PG to Axle box
24	1000020841	WASHER_PLAIN_M8-OD:14, ID:9, 1T_SS	8.00	PC		
25	1000020908	WASHER_SPRING_M8_SS	8.00	PC		
26	1000001397	BOLT(HEX)_MS_M8x20mm	2.00	PC		Fixing PG Cable clamp
27	1000012019	NUT(HEX)_M8_SS	2.00	PC		
28	1000020908	WASHER_SPRING_M8_SS	2.00	PC		
29	1000020840	WASHER_PLAIN_M8_SS	4.00	PC		
30	1000113472	PG_PROTECTIVE_COVER_516670806	2.00	PC		Protective Cover for PG
31	1000015683	SCREW_HEX_SOCKET HEAD CAP_SS_M8x35MM	4.00	PC	CAB I/P Box	
32	1000012019	NUT(HEX)_M8_SS	4.00	PC		
33	1000020908	WASHER_SPRING_M8_SS	4.00	PC		
34	1000020840	WASHER_PLAIN_M8_SS	8.00	PC		
35	1000015683	SCREW_HEX_SOCKET HEAD CAP_SS_M8x35MM	4.00	PC	EMI Filter Unit	
36	1000012019	NUT(HEX)_M8_SS	4.00	PC		
37	1000020908	WASHER_SPRING_M8_SS	4.00	PC		
38	1000020840	WASHER_PLAIN_M8_SS	8.00	PC		
39	1000010597	MCB_2P_32A_500V DC_A9N61535_SCH	2.00	PC	I/P MCB Fixing	MCBs are installed in Loco SB panel
40	1000104122	OMEGA RAIL_1.0 MTR	0.25	Mtrs		

#	Part Number	Description	QTY	Unit	Used for assembly of	Purpose
41	1000010402	MCB END_CLAMP	2.00	PC		Installed in Loco SB panel, for mounting MCBs
42	1000032840	SOCKETHEAD_CAP_SCREW_M6X20 DIN-912	2.00	PC		Fixing DIN-rail
43	1000012029	NUT(HEX)_SS_M6	2.00	PC		
44	1000020905	SPRING_WASHER_SS_M6	2.00	PC		Fixing DIN-rail
45	1000020837	WASHER_PLAIN_M6_SS	2.00	PC		
46	1000028078	CABLE_ELASTOMERIC_2.5Sqmm	50.00	Mtr	Input Power Supply	From SB Panel to MCBs and From MCBs to EMI Filter Unit & Cab I/P Unit
47	1000037005	FERRULE_INSULATED_2.5MM_58-514L8_JAINSON	4.00	PC		At Power cable terminals
48	1000114834	LUG_4SQ MM_CU_PIN_TYPE_HP7	8.00	PC		At SB Panel and MCB I/P & O/P of MCB-1 & MCB-2
49	1000010113	LUG_2.5SQMM_CU_RING TYPE M6_3D	4.00	PC		SB panel to CAB I/P signal
50	1000002934	CABLE_PVC INSULATED_4SQMM_1CORE_RED	0.25	Mtrs	EMI Filter Unit & CAB I/P Box	Looping at I/p of EMI filter unit - MCB-3 & MCB-4
51	1000002013	CABLE_COPPER_FLEXIBLE_1C_4SQMM_BLACK	0.25	Mtrs		Looping at I/p of EMI filter unit - MCB-3 & MCB-4
52	1000114832	LUG_10SQ MM_CU_PIN_TYPE_HP3	2.00	PC		Lug for looping cables at EMI filter I/P - MCB-3

#	Part Number	Description	QTY	Unit	Used for assembly of	Purpose
53	1000114834	LUG_4SQ MM_CU_PIN_TYPE_HP7	2.00	PC		Lug for I/P cable MCB-4
54	1000114834	LUG_4SQ MM_CU_PIN_TYPE_HP7	2.00	PC		Lug for I/P cable for Cab I/P Box - MCB-5
55	1000015683	SCREW_HEX_SOCKET HEAD CAP_SS_M8x35MM	4.00	PC	Brake Interface Unit	
56	1000012019	NUT(HEX)_M8_SS	4.00	PC		
57	1000020908	WASHER_SPRING_M8_SS	4.00	PC		
58	1000020840	WASHER_PLAIN_M8_SS	8.00	PC		
59	1000056407	CABLE_10SQMM_CU_MT_ST_1C_Y/G_IS:694	5.00	Mtr	Earthing Loco Kavach	Loco Kavach Earthing
60	1000010075	LUG_10SQ MM_CU_RING TYPE_M6	2.00	PC		
61	1000012029	NUT(HEX)_SS_M6	2.00	PC		
62	1000020905	SPRING_WASHER_SS_M6	2.00	PC		
63	1000020837	WASHER_PLAIN_M6_SS	2.00	PC		
64	1000001382	BOLT(HEX)_MS_M6x35mm	1.00	PC		
65	1000082017	SLEEVE_NYLON BRAIDED_12MM	5.00	Mtrs		
66	1000056407	CABLE_10SQMM_CU_MT_ST_1C_Y/G_IS:694	20.00	Mtrs	Earthing Loco Kavach sub-modules	Earthing for DMI, Radio Unit, Brake Interface Unit & Cab I/P Box
67	1000010075	LUG_10SQ MM_CU_RING TYPE_M6	9.00	PC		
68	1000012029	NUT(HEX)_SS_M6	14.00	PC		
69	1000020905	SPRING_WASHER_SS_M6	9.00	PC		
70	1000020837	WASHER_PLAIN_M6_SS	14.00	PC		
71	1000001382	BOLT(HEX)_MS_M6x35mm	4.00	PC		
72	1000082017	SLEEVE_NYLON BRAIDED_12MM	20.00	Mtrs		
73	1000001342	BOLT(HEX)_MS_M10x30mm	8.00	PC	For FAN fixing	For re-fixing Locomotive Fan
74	1000025369	SPRING_WASHER_SS_M10	8.00	PC		
75	1000020818	WASHER_PLAIN_M10_SS	16.00	PC		

#	Part Number	Description	QTY	Unit	Used for assembly of	Purpose
76	1000077613	NUT_HEX_M10_SS_DIN-934_A2-70	8.00	PC		
77	6000051890	HARNS_ASY_LOCO_KAVACH_4.0_EXTE_516490458	1.00	set	External Cables	Cables used for interconnection of Loco Kavach with all other equipment
78	1000114829	INSULATION_TAPE_PVC_BLACK_COLOR_STEEL_GRIP	8.00	PC	Consumables	Insulation of wires in SB Panel
79	1000114830	INSULATION_TAPE_PVC_GREEN_COLOR_STEEL_GRIP	5.00	PC		
80	1000114831	INSULATION_TAPE_PVC_RED_COLOR_STEEL_GRIP	5.00	PC		
81	1000114837	LOCTITE_542_50ML_HENKEL	1.00	PC	All screws, bolts & nuts	Thread-locking to prevent loosening of screws
82	1000050368	EPDM_GASKET_2MM_THICKNESS_1MTRX1MTR	10.00	Mtrs		Wrapping around cables for protection from sharp edges while routing in Locomotive cable tray
83	1000009467	TAPE_KAPTON_SILICON_1/2"	1.00	Roll		Weather-proofing of RF cable terminations (LMR 200 & LMR 400) and external cables of E-70 /
84	2000016017	BUTYL_TAPE_2MM THICK_2INCH WIDTH_5M LEN	0.50	Mtr		
85	1000026054	SLEEVE_HEAT SHRINKABLE_5MM_BLACK	0.50	Mtrs		
86	1000039184	SLEEVE_HEAT SHRINKABLE_20MM_BLACK	0.50	Mtrs		

#	Part Number	Description	QTY	Unit	Used for assembly of	Purpose
87	1000075562	HEAT-SHRINKABLE_SLEEVE_30MM_BLACK	0.25	Mtr		CCB Interface Units
88	1000114827	CABLE_TIES_FR_TYPE_200MMX7MM_SLV_200H	2.00	Packet		For securing loose wires and cables to nearby Stand/Frame/Unit
89	1000114828	CABLE_TIES_380MMX7MM_SLV_380H	5.00	Packet		
90	1000040029	HINGES_SS_3 Inch	4.00	PC		For making hinged door below drive desk, to operate ISOLATION COCK.
91	2000009908	TOWER BOLT_PC_3INCH	2.00	PC		
92	1000108351	ANABOND 685_RED SILICON SEALENT_310GM	4.00	PC	All cables routing	For sealing over all cable entry holes and cable entry points in conduits, to prevent entry of water.

8.0 Loco Kavach Installation work-flow management:

8.1 Please refer to WFMS Operational Manual [Ref: 3] for instructions on using the WFMS web portal.

8.2 Whenever a locomotive is allocated for installation of Kavach, the Loco Kavach I&C Manager shall initiate workflow in WFMS portal and assign the work to the Installation team.

8.3 Before beginning the installation work, Loco Kavach Configuration File Request Form [Ref: 18] shall be filled up by the Installation team and uploaded on WFMS. This shall trigger the Product Engineering team to generate Configuration files for the loco Kavach and upload it on WFMS, by the time installation work is completed.

8.4 During the installation work, QC inspector shall carryout in-process inspection, using the In-Process QC Procedure for Loco Kavach Installation [Ref: 20] and document the results in In-Process QC Checklist for Loco Kavach Installation [Ref: 21]. After the installation work is completed, the checklist shall be uploaded in WFMS portal.

8.5 Upon receipt of Configuration File and filled-in In-Process QC Checklist, Loco Kavach I&C Manager shall assign commissioning work to a Loco Kavach Commissioning engineer.

9.0 Preparing the locomotive for installation of Kavach:

9.1 The locomotive shall be brought on to the pit. This is necessary to weld RFID Reader mounting brackets to the locomotive chassis.

9.2 The roof of the locomotive shall be removed. This is necessary to install the Kavach cable bundle in an existing cable tray just below the roof.

9.3 If the space allocated for installation of Loco Kavach equipment is occupied by any other equipment, such equipment shall be relocated to a different location, by coordinating with Loco Shed officials. Alternately, another location for installation of Kavach equipment shall be finalized in consultation with Loco Shed officials.

10.0 Instructions for locally fabricated mounting brackets:

10.1 It is necessary for some mounting brackets to be fabricated in the Loco Shed, based on available space in the installation location. Following instructions shall be complied with by the Installation Team, while fabricating such brackets.

10.1.1 Unless otherwise specified, galvanized steel material, of minimum 3mm thickness, only shall be used for fabricating all mounting brackets.

10.1.2 Fabricated brackets shall be free from sharp edges, corners, burrs etc.

10.1.3 All mounting brackets shall be protected from corrosion after welding in their installation location.

11.0 Instructions for welding:

11.1 Welding shall always be done in a location where there is clear lighting and no crossflow of air.

11.2 Following equipment accessories and consumables are required for carrying out welding. The I&C Contractor shall arrange for these.

11.2.1 300Amps SMAW welding power source. Portable AC Inverter power source is preferred.
11.2.2 4mm diameter E6013 welding electrodes
11.2.3 Aerol Zinc spray 3060 corrosion inhibitor
11.2.4 3M Green wheel 60 grit & Scotch-Brite scrubber
11.2.5 Wire brush and chipping hammer
11.2.6 4-inch Angle Grinder
11.2.7 clean cloth
11.2.8 Welding goggles/ face shield, Nose masks & hand gloves
11.2.9 Dry powder Fire extinguisher

11.3 Preparation for welding:

11.3.1 Check the welding equipment for any damaged power cables or earth clamps. In case there are any damages, the same shall be rectified.
11.3.2 Wear Hand gloves/ Nose masks/ Welding helmets/ Welding Apron.
11.3.3 Secure the components to be welded on fixture / worktable.
11.3.4 Grind (using 4-inch angle grinder) the components 30 -40 mm on either side of the intended weld joint. Continue grinding till heavy sparks are seen coming out from metal surface.
11.3.5 Clean the ground area with Scotch-Brite scrubber and then with clean cloth.

11.4 Welding process:

11.4.1 Switch on the welding equipment and adjust the current setting to 140-150 Amps. The current can be adjusted depending on component thickness.
11.4.2 Assemble the components to be welded in the position and tack weld the components.
11.4.3 Complete full welding. Maintain electrode angle as 15-20 deg from vertical plane.

11.4.4 Do not stop welding, until the complete joint is welded. In case, welding is stopping without completing the joint, grind back the weld bead to a distance of 5 to 7mm, and then continue welding.

11.4.5 Once welding is completed, chip off the slag. Remove spatters, if any, with chipping hammer. Clean the weld with wire brush and Scotch-Brite scrubber and allow natural cooling.

11.5 Post-weld operation:

11.5.1 Spray Aerol Zinc 3060 spray coat over the welded area and 50mm beyond the welded area on both sides. 30 minutes after the first coat, spray Aerol Zinc 3060 spray coat again on the entire area.

11.5.2 Apply Berger Paints Red Oxide primer on the exposed galvanized steel parts. After the primer is completely dried, apply top coat with Berger Paints Smoke Grey or Black colour.

12.0 Instructions for fastening with bolts and nuts:

12.1 All bolts and nuts shall be secured with suitable spring washers and plain washers. These washers are already supplied in Loco Kavach Installation kit, separately packed for each sub-system to be installed.

12.2 All threaded connections (bolts, nuts, screws etc) shall be secured with thread-locker, supplied in the Loco Kavach Installation kit.

12.3 Suitable torque spanners shall be used to apply torque appropriate to each screw, bolt or nut, per the table below.

Fastener size	Torque to be applied, Nm
M4	2.5
M5	5
M6	8
M8	20
M10	40
M12	70

13.0 Installation Procedure:

13.1 Document “Loco Kavach Installation Locations for various locomotives” [Ref: 1] indicates the locations where each of the Loco Kavach sub-systems shall be installed.

13.2 Loco Kavach Unit

13.2.1 The Loco Kavach Unit shall be installed in the identified location.

13.2.2 The Loco Kavach Unit comes with a stand, which shall be welded to the floor in the identified location. In some locos, if the available space does not permit the use of factory-supplied stand, an alternate arrangement shall be made, with the approval of Loco Shed officials, and implemented. This may require some customized frames to be manufactured locally in the Loco Shed.

13.2.3 The Loco Kavach Unit shall be placed on the stand and secured with mounting bolts supplied in the Loco Kavach Installation Kit.

13.3 Loco Pilot Operation-cum-Indication Panel (LP-OCIP)

13.3.1 This is also called DMI.

13.3.2 DMI is supplied from factory, along with a mounting plate.

13.3.3 A mounting arrangement shall be custom-made for each loco, by the Installation Team, based on available space and welded in the installation location.

13.3.4 In some locos, it may be necessary to remove and relocate fans to install the DMI.

13.3.5 DMI shall be removed from the mounting plate. The mounting plate shall be welded to the mounting arrangement.

13.3.6 DMI shall be re-fixed to the mounting plate, using the bolts removed during step 13.3.5.

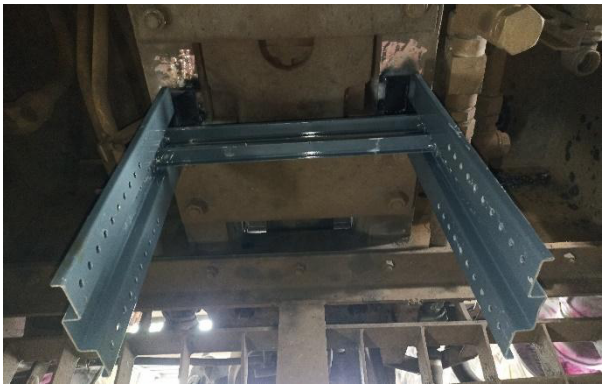
13.4 RFID Reader:

13.4.1 On either side of the loco, RFID readers shall be installed in their designated locations. Each RFID reader shall be installed at a distance of 2 to 3 meters from the end of the cattle guard.

13.4.2 Each RFID reader is supplied with a mounting bracket.

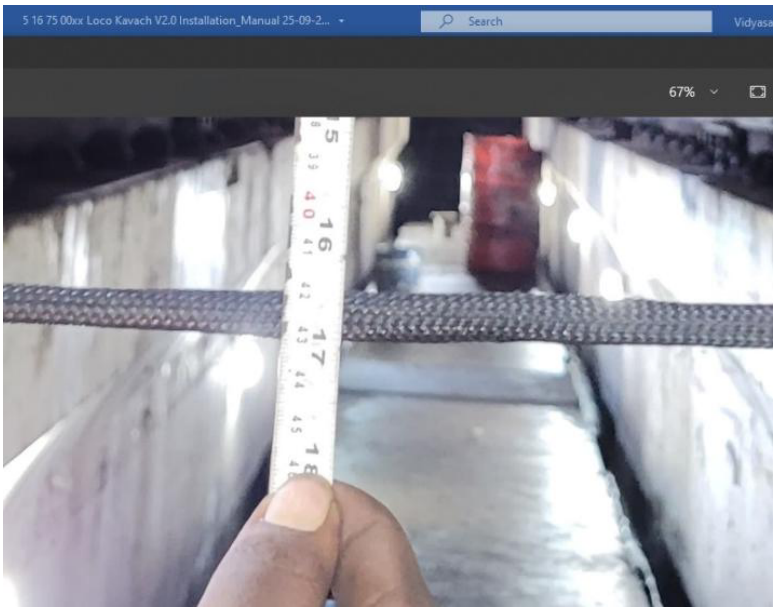
13.4.3 The RFID reader shall be removed from the mounting bracket.

13.4.4 This bracket shall be welded to the locomotive chassis in the designated location.



13.4.5 RFID reader shall be re-fixed to the mounting bracket, using fasteners removed during step 13.4.3.

13.4.6 During installation, the bottom surface of the RFID reader shall be adjusted to be at a height of 450 ± 50mm from the rail head, and then fixed.



13.4.7 A safety chain shall be installed to prevent the RFID reader from falling down on the tracks.

- One end of the safety chain shall be welded to the locomotive chassis, away from the weld joint of mounting bracket.
- The other end of the chain shall be secured to the RFID reader, using bolt supplied in the Loco Kavach Installation Kit.

13.4.8 A mud guard, supplied in the Loco Kavach Installation Kit, shall be fixed to the RFID reader mounting bracket, in front of each RFID reader (on the cattle guard side), using bolts and washers supplied in the Loco Kavach Installation Kit.

13.5 RF Communication & GPS / GSM Antennae

13.5.1 Each Loco Kavach has four RF antennae and two GPS/GSM antennae, which shall be installed on the roof top, in their designated locations, as indicated in the document “Loco Kavach Installation Locations in various locomotives” [Ref: 1].

13.5.2 RF and GPS/GSM Antennae are supplied with mounting brackets from factory.

13.5.3 However, due to the curvature of the loco roof, RF antenna brackets cannot be directly mounted on the roof top. One edge of the mounting bracket shall be welded to the loco roof top. Extension plate shall be welded to the other edge, to suit the curvature of the loco roof, as shown in the picture. After welding, the top of the mounting bracket shall be perfectly horizontal (to be verified with spirit level).

13.5.4 GPS/GSM antenna mounting bracket also shall be, similarly, extended on one side to accommodate the curvature of the loco roof top.

13.5.5 Each RF antenna has to be connected to the Loco Kavach through an RF cable, supplied from factory. Rx and TX antennas and cables are clearly labelled. Care shall be exercised to ensure that Rx cable is connected to Rx antenna and Tx cable is connected to Tx antenna.

13.5.6 GPS and GSM cables are also labelled clearly. GPS cable shall be connected to GPS antenna and GSM cable shall be connected to GSM antenna, on each side of the locomotive.

13.5.7 Cables from the two RF antennae and GPS/GSM antenna shall be routed through a 2” steel-reinforced conduit. The conduit shall be secured to the roof, using clamps welded to the roof top, as shown in the picture. The conduit shall be routed into the loco cabin through an elbow pipe installed in the flasher unit on the roof top. Conduit pipe and elbow are supplied in the Loco Kavach Installation Kit.

13.5.8 The conduit pipe and cable entry through the conduit pipe shall be secured to prevent ingress of dust, water etc. This is achieved by applying a coat of RTV Silicone compound (supplied in the Loco Kavach Installation Kit) around all open joints.

13.6 Pulse Generators

13.6.1 Each Loco Kavach requires two pulse generators to be installed on two different axles of the loco. The axle numbers and installation location differ from one loco to another loco, and are given in the document “Loco Kavach Installation Locations in various locomotives” [Ref: 1]

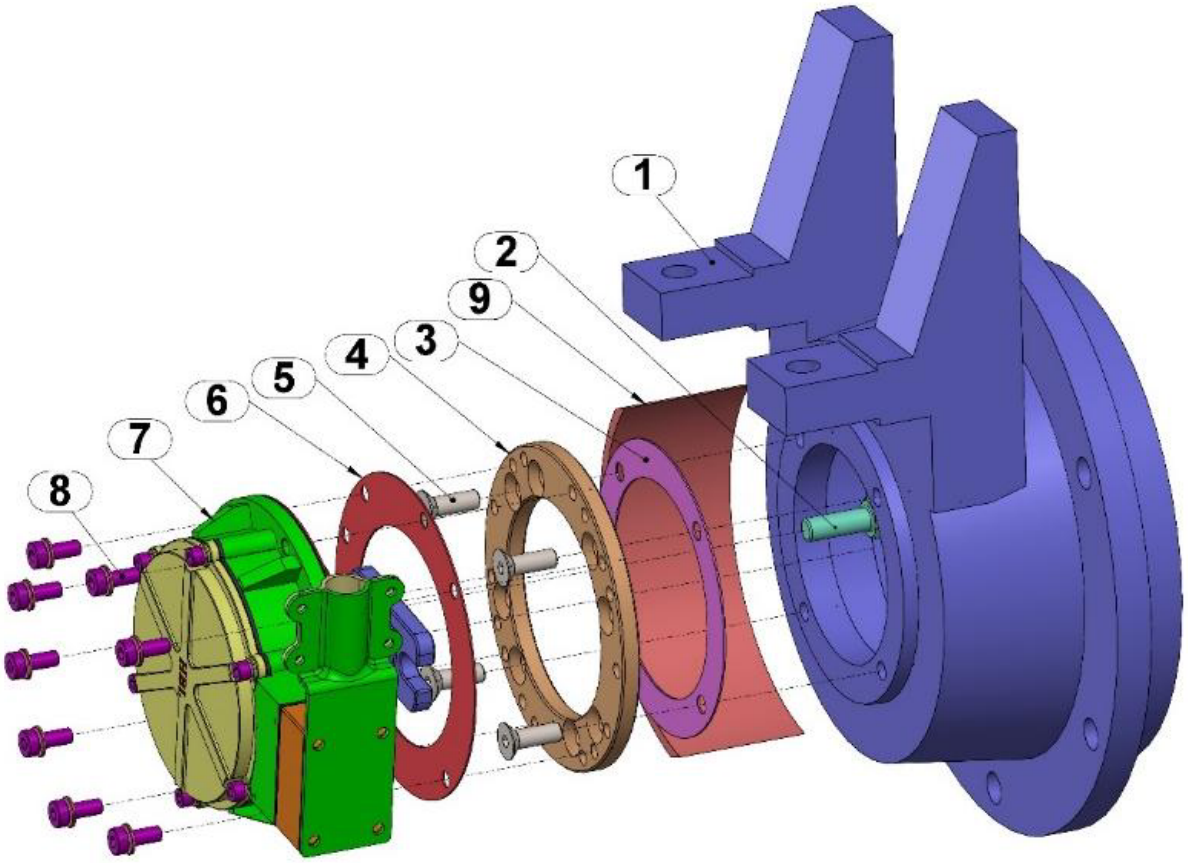
13.6.2 Pulse Generators are referred to as PG1 and PG2.

13.6.2.1 PG1 is the pulse generator installed on the left side of the locomotive, looking in the direction of travel from CAB-I.

13.6.2.2 Out of the two pulse generators supplied from the factory, PG1 is the one in which the cable harness is assembled pointing in PG1 direction.

13.6.2.3 Pulse generator with cable assembled pointing in PG2 direction is PG2.

13.6.3 Description of Pulse Generator assembly:



13.6.3.1 Pulse Generator assembly consists of 8 parts, which are assembled to the axle box (identified as 1 in the above picture) in the locomotive. The 3D exploded view illustrates these parts, numbered from 2 to 9. These parts are listed in the following table.

Item #	SAP Part #	Description	QTY.
1		AXLE BOX (Part of locomotive)	1
2	1000075945	DRIVE PIN	1
3	1000086706	GASKET	1
4	1000083394	LOCK PLATE	1
5	1000089983	SCREW CSK HEXA SOCKET TYPE M10X30MM SS	4
6	1000086707	GASKET	1
7	6000043882	PULSE GENERATOR UNIT	1
8	1000083436	SOCKET HEAD SCREW DIN 912 M8 X 25	8
9	1000113472	Protective Plate	1

13.6.4 Installation of Pulse Generator1 (PG1)

13.6.4.1 Identify the location of the axle where PG1 to be installed.

13.6.4.2 Remove axle box cover.

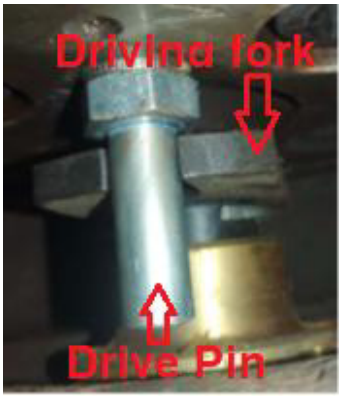
13.6.4.3 Place the drive pin (item 2) in available threaded (M12) hole with plain and spring washers and apply the specified torque.

13.6.4.4 Place the gasket (item 3) between axle box and the lock plate.

13.6.4.5 Fix the lock plate (item 4) to the axle box with 4 x M10 bolts (item 5). Tighten the bolts with specified torque.

13.6.4.6 Place the gasket (item 6) between lock plate (item 4) and pulse generator (item 7).

13.6.4.7 Assemble the pulse generator on axle box such that the drive pin is aligned with the driving fork.



13.6.4.8 Fix the pulse generator with 8 x M8 bolts (item 8). Apply the specified torque.

13.6.5 Installation of Pulse Generator2 (PG2)

13.6.5.1 PG2 shall be installed on the right side of the locomotive, looking in the direction of travel from CAB-I

13.6.5.2 Repeat steps explained in 13.6.4 for fixing PG2.

13.6.5.3 PG2 assembly appears as shown below.

13.6.6 For both pulse generators, a protective plate, supplied by factory, is welded to the axle box, as shown in the above picture.

13.6.7 Cables from the PGs shall be secured to the locomotive frame, either using cable clamps or cable ties. Cables shall not be left hanging in the air.

13.7 Speedometer Interface Unit

13.7.1 Each pulse generator is connected to a Speedometer Interface Unit, which is connected to the Loco Kavach Unit. The Speedometer Interface Units are unique to each pulse generator and cannot be interchanged.

Pulse Generator to be connected	Speedometer Interface Unit part number
PG1	6400044349
PG2	6400044350

13.7.2 Each Speedometer Interface Unit shall be mounted to the loco chassis, at a location close to the connected pulse generator.

13.7.3 Each Speedometer Interface Unit is supplied with a mounting plate. The mounting shall be removed from the Speedometer Interface Unit and shall be welded to the locomotive chassis.

13.7.4 After welding and painting, the Speedometer Interface Unit shall be re-fixed to the mounting plate, using the same screws and washers removed during step 13.7.3.

13.7.5 Speedometer Interface Unit shall be fixed on the mounting plate, with an orientation that allows the cables to be connected to pulse generator on one side and Loco Kavach Unit on the other side, without crisscrossing.

13.8 Brake Interface System

13.8.1 Three types of braking interface units are available, based on the braking system of the locomotive. These are

- BIU for E-70 braking system
- BIU for CCB braking system
- BIU for IRAB braking system

13.9 Installation of braking interface for E-70 braking system

13.9.1 List of Items required for installation of braking interface for E-70 braking system

#	Description	SAP Part #	Qty
1	Kavach Brake Interface System E-70 (Faively) consisting of a) Interface Relay Unit (IRU) – 2 each b) Emergency EP relay valve with Micro switch and bracket – 2 each c) ½" Isolating cock with drain and Micro switch – 2 each d) Light Engine Braking Kit – 1 each e) 10 Way-Free Connector Assy – 2 each	1000065566	1
2	Loco Kavach E-70 Interface Unit	6000044546	1

13.9.2 E-70 Braking interface system installation kit

Each E-70 braking interface system is supplied with an installation kit from the factory, which contains the following items.

#	SAP Part Number	Description	QTY	Unit	Used for assembly of	Purpose
1	1000119433	TRANSDUCER_16-BAR_GEMS : 3100B0016G01B000	1.00	PC	Sensors (MR, BP, BC1 & BC2)	MR Sensor
2	1000029331	TRANSDUCER_MAKE: GEMS_P:G-3100B0007G01B00	3.00	PC		BP, BC1 & BC2 sensors
3	1000117255	FEMALE_BRANCH_TEE_8-4_STBF-RXB	1.00	PC		MR
4	1000102599	FEMALE_BRANCH_TEE_3/8"X1/4"-6-4STBF-N	3.00	PC		BP, BC1 & BC2
5	1000128867	Sensor Isolating Cock - 1/4"	4.00	PC		
6	1000128868	MALE CONNECTOR_1/4"X1/4"_4SCM-N	4.00	PC		
7	1000031544	CHAMPION TEPLON TAPE	1.00	PC		
8	1000102940	CU_PIPE_1/2”_OD 1.245MM_WT_CLW/MS/3/030	10.00	Mtrs	EP Valve & Cock	
9	1000102490	UNION T-JOINT_1/2"_8ST	4.00	PC		
10	1000102495	ELBOW_MALE_1/2"X1/2"_8 SEM-Rx	4.00	PC		
11	1000102496	MALE CONNECTOR_1/2"X1/2"_8SCM-N	4.00	PC		
12	1000102497	REDUCER_UNION_1/2"X1/4"_8-4SCR	2.00	PC		
13	1000102504	PIPE_SS_1/2"_2MM_150MM	2.00	PC		
14	1000102941	CU_PIPE_3/8”_OD 1.245MM_WT_CLW/MS/3/030	9.00	Mtrs	Auto Horn Circuit	
15	1000102498	UNION T-JOINT_3/8"_6ST	4.00	PC		
16	1000102499	ELBOW_MALE_3/8"X3/8"_6SEM-Rx	4.00	PC		
17	1000102500	MALE CONNECTOR_3/8"X3/8"_6SCM-N	4.00	PC		
18	1000102501	BALL_VALVE_FEMALE_3/8"_0402	2.00	PC		
19	1000025216	2/2_NORM_CLOSED_3/8"_SOLENOID_VALVE_24V	2.00	PC		
20	1000032840	SOCKETHEAD_CAP_SCREW_M6X20 DIN-912	8.00	PC	IRU1 & IRU2 fixing	
21	1000012029	NUT(HEX)_SS_M6	8.00	PC		
22	1000020905	SPRING_WASHER_SS_M6	8.00	PC		
23	1000020837	WASHER_PLAIN_M6_SS	8.00	PC		

#	SAP Part Number	Description	QTY	Unit	Used for assembly of	Purpose
24	1000056407	CABLE_10SQMM_CU_MT_ST_1C_Y/G_IS:694	2.00	Mtrs	Earthing IRU1 & IRU2	
25	1000010075	LUG_10SQ MM_CU_RING TYPE_M6	4.00	PC		
26	1000012029	NUT(HEX)_SS_M6	6.00	PC		
27	1000020905	SPRING_WASHER_SS_M6	6.00	PC		
28	1000020837	WASHER_PLAIN_M6_SS	12.00	PC		
29	1000001382	BOLT(HEX)_MS_M6x35mm	2.00	PC		
30	1000082017	SLEEVE_NYLON BRAIDED_12MM	2.00	Mtrs		
31	1000015683	SCREW_HEX_SOCKET HEAD CAP_SS_M8x35MM	4.00	PC	EP1 & EP2 Valve fixing	
32	1000012019	NUT(HEX)_M8_SS	4.00	PC		
33	1000020908	WASHER_SPRING_M8_SS	4.00	PC		
34	1000020840	WASHER_PLAIN_M8_SS	8.00	PC		
35	1000114840	SOCKETHEAD_CAP_SCREW_M8X75 DIN-912	4.00	PC	EP Isolation Cocks	
36	1000012019	NUT(HEX)_M8_SS	4.00	PC		
37	1000020908	WASHER_SPRING_M8_SS	4.00	PC		
38	1000020840	WASHER_PLAIN_M8_SS	8.00	PC		
39	1000032840	SCREW_SOC HD_DIN 912ISO 4762 A2-70_M6X20	4.00	PC	Fixing Auto Horn Valve	
40	1000012029	NUT(HEX)_SS_M6	4.00	PC		
41	1000020905	SPRING_WASHER_SS_M6	8.00	PC		
42	1000020837	WASHER_PLAIN_M6_SS	16.00	PC		
43	1000056591	SCREW_ALLEN_SS_M6x16MM	4.00	PC		
44	6000054475	HARNS_ASSY_RIB EXTNL_E70 BRAKE_516490505	1.00	PC	RIB External	
45	6000055690	HARNS_ASSY_CAB IP_EXTRNAL_E-70_516490520	1.00	PC	CAB Termination external	

13.9.3 Installation of Loco Kavach E-70 Interface Unit

13.9.3.1 The Interface unit is supplied by factory with a mounting bracket.

13.9.3.2 This unit is installed on a mounting frame, custom-fabricated, as described below. This mounting frame can vary from one loco to another and from one loco type to another. Customization may be needed for every loco. The mounting frame shall be fabricated using 50x50X5 mm galvanized steel angle. The frame shall be welded to the tubular structure on locomotive side wall, in a specified location, near the traction converter.

13.9.3.3 After the mounting frame is welded to the locomotive side wall, it shall be painted. Following pictures illustrate the frame for one type of loco. The frame may appear different in other locomotive types.

13.9.3.4 Holes shall be drilled on the mounting frame, to suit the mounting locations of the brake interface unit, using the unit as template for marking the hole positions.

13.9.3.5 This Interface Unit is supplied with integral mounting bracket. Bolts, nuts and washers for fixing these unit to the mounting frame are in the brake interface Installation Kit.

13.9.3.6 This Interface Unit shall be fixed to the mounting frame with the supplied bolts, nuts and washers.

13.9.3.7 Please see section 13.9.8 for making electrical connections to the Interface Unit.

13.9.4 Installation of IRU

13.9.4.1 Two IRUs are supplied from factory. One IRU shall be installed in CAB-I and the second one in CAB-II, following the instructions given below.

13.9.4.2 These units are installed on a mounting frame, custom-fabricated, as described below. This mounting frame can vary from one loco to another and from one loco type to another. Customization may be needed for every loco. The mounting frame shall be fabricated using 50x50X5 mm galvanized steel tube or angle. The frame shall be welded to chassis under A9-Driver Brake Controller (DBC) of each CAB.

13.9.4.3 After the mounting frame is welded to the chassis, it shall be painted. Following pictures illustrate the frame for one type of loco. The frame may appear different in other locomotive types.

13.9.4.4 Holes shall be drilled on the mounting frame, to suit the mounting locations of these unit, using the units as template for marking the hole positions.

13.9.4.5 Bolts, nuts and washers for fixing these unit to the mounting frame are in the brake interface Installation Kit.

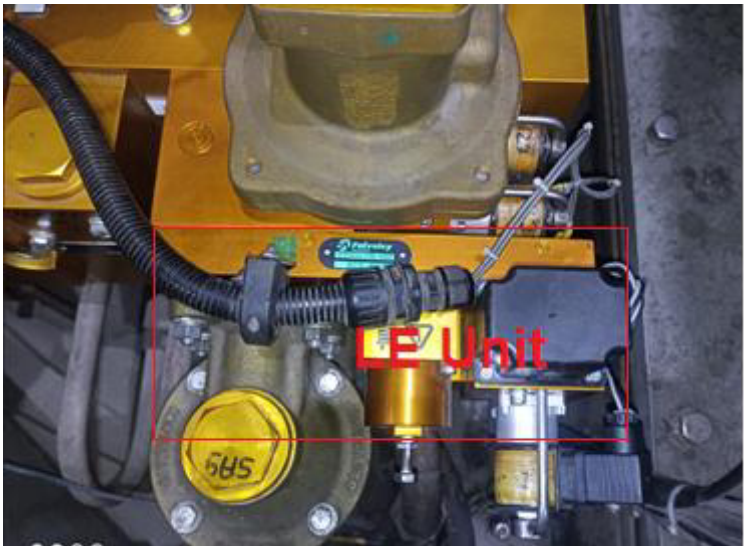
13.9.4.6 All these units and valves shall be fixed to the mounting frame with the supplied bolts, nuts and washers.

13.9.4.7 Please see section 13.9.8 for making electrical connections to IRUs.

13.9.5 Installation of Light Engine (LE) Unit

13.9.5.1 D2 relay valve and existing manifold unit shall be removed from E-70 brake panel.

13.9.5.2 LE unit, supplied by factory, shall be installed in place of manifold unit, using the removed hardware. The removed manifold shall be handed over to the Loco Shed officials.



13.9.5.3 D2 relay valve shall be installed on LE unit.

13.9.5.4 Please see section 13.9.8 for making electrical connections to LE Unit.

13.9.6 Installation of Pressure Sensors (MR, BP, BC1 & BC2) at CAB-I

13.9.6.1 All these pressure sensors shall be installed under CAB-I driver desk.

13.9.6.2 T-Joint, supplied from factory, shall be installed on MR gauge pipe (Red) under the driver desk. 16-bar pressure sensor shall be installed on this T-joint.

13.9.6.3 T-Joint, supplied from factory, shall be installed on BP gauge pipe (Green). 7-bar pressure sensor shall be installed on this T-joint.

13.9.6.4 T-Joints, supplied from factory, shall be installed on BC1 & BC2 gauge pipes (Yellow). Two 7-bar pressure sensors shall be installed on these T-joints.

13.9.6.5 Please see section 13.9.8 for making electrical connections to the installed pressure sensors.

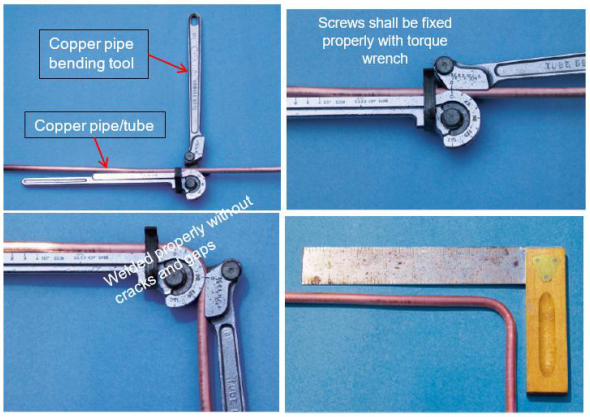
13.9.7 Installation of EP Valve & Isolation Cock:

13.9.7.1 Two EP Valves and two Isolation Cocks are supplied from factory. One set shall be installed in CAB-I and the other set in CAB-II, below the driver desk.

13.9.7.2 EP Valve and Isolation Cock are installed on the pneumatic lines. EP Valve is installed in the BP line and Isolation Cock shall be installed in series between BP line and EP Valve. The pilot port on EP Valve shall be connected to MR line. Please refer to Arrangement of Kavach Interfacing with E70 Brake System in WAP-5/WAP-7/WAG-9 locomotives [Ref: 12] for details.

13.9.7.3 Pipes and fittings supplied from factory, in the E-70 Brake Interface System Installation kit, shall be used.

13.9.7.4 Copper pipes shall be bent using appropriate bending tool, ensuring that there are no kinks or sharp bends in the pipe.

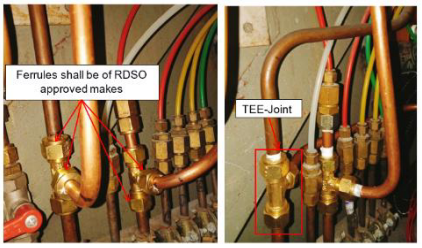


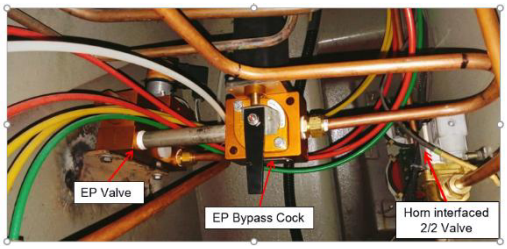
13.9.7.5 Copper tube lengths shall be measured based on locations of EP Valve, BP cock, Horn cock and valve arrangements, to their respective connecting locations, as shown in Arrangement of Kavach Interfacing with E70 Brake System in WAP-5/WAP-7/WAG-9 locomotives [Ref: 12].

13.9.7.6 Copper pipe connections shall be made properly with approved make (Ex.Fluid Control) ferrules and TEE-joints, supplied in the Installation Kit.

13.9.7.7 All threaded connections shall be sealed with Loctite 567 (**NOT A TEFLON TAPE**), which is supplied in the I&C kit.

13.9.7.8 Ensure that there are no loose connections in the pneumatic lines, by checking with soap solution. No air bubbles shall be seen when soap solution is applied at the joints. After the test, the soap solution shall be wiped clean.





13.9.8 Installation of external cable harness for E70 Interface Unit and interconnection:

13.9.8.1 Cable HARNS_ASSY_RIB EXTNL_E70 BRAKE_516490505 (SAP Part # 6000054475), supplied in the E-70 Installation Kit shall be used for these connections. This consists of five individual cables, described in the following table. Cables shall be laid along the paths shown in Loco Kavach Cable Routing Plan for WAP-7/WAP-5/WAG-9 locomotives with E-70 braking system [Ref: 8]. Most connections are made on either side using plug-in connectors.

13.9.8.2 For serial # 2, 3 & 5, connections are made using screw terminals on the respective devices.

#	Label on the cable	Connection from Loco Kavach - E-70 Interface Unit		Connection to	
		Connector number	Connector type	Unit	Connector type
1	E-70 Power & Traction Cable	MC18	12Pin Female	CAB Termination Unit	1) 4 Pin Male 2) Phoenix rectangular connector
2	Pressure Sensor & ISO Cock Cable	MC26	19pin Female	Sensors & ISO Cocks	Loose wires
3	CAB-I & LE Signal cable	MILB-1	14pin Male	1) IRU1 2) LE Unit	1) 10pin Female 2) Loose wires
4	CAB-II Signal Cable	MILB-2	14pin Male	IRU2	10pin Female
5	EP Valve Power Cable	MILB-3	12pin Male	CAB-I & CAB-II Valves	Loose wires with ferrule lugs

13.9.8.3 **Connecting IRU to DBC and E70 Interface Unit:**

Please refer to Arrangement of Kavach Interfacing with E70 Brake System in WAP-5/WAP-7/WAG-9 locomotives [Ref: 12] for making the following electrical connections.

a) 19-way connector shall be disconnected from DBC. In its place, the cable with 19-way connector from IRU, shall be connected to DBC. Similar connection shall be done for IRU in the second cab.

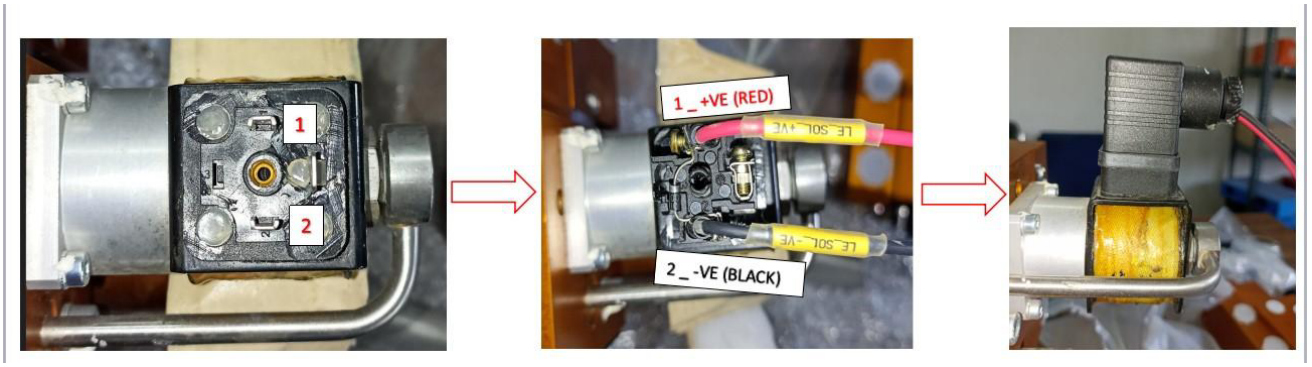
b) The cable disconnected from DBC shall be connected to the 19-way connector on IRU. Similar connection shall be done for IRU in the second cab.

c) Two cables with 10-way connectors on both sides, are supplied in the Installation Kit. One cable shall be connected between the E-70 Interface Unit, MILB1 to IRU installed in Cab-I. The second cable shall be connected from MILB2 connector to IRU installed in Cab-II.

13.9.8.4 **Connection of LE Unit:**

Part of Cable # 3 (red and black loose wires) in the table in section 13.9.8.2 is used for connecting LE Unit to E70 Interface Unit.

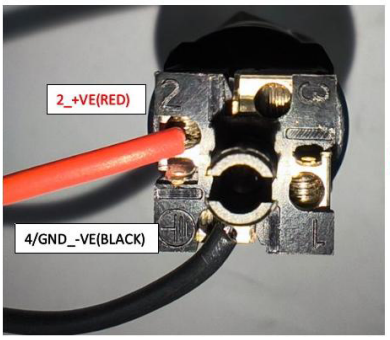
Connections to the solenoid valve are done by opening the cover on the solenoid valve and connecting red wire to terminal 1 and black wire to terminal 2. Connections are shown in the following pictures.



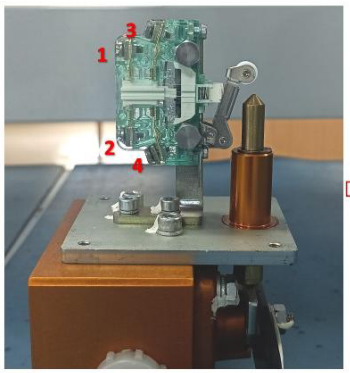
13.9.8.5 **Connections of Pressure Sensors & Isolation Cocks:**

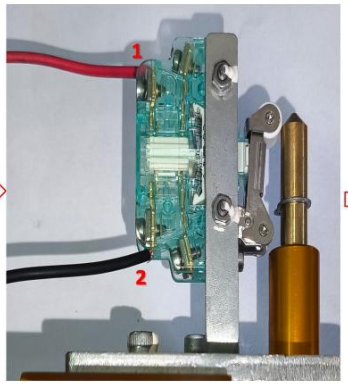
All four sensors (MR, BP, BC1 & BC2, installed in Cab-I) and the two isolation cocks (one in Cab-I and another in Cab-II) shall be connected to Loco Kavach E-70 Interface Unit, through a cable harness (# 2 in the table of section 13.9.8.2) connecting to MC26 connector.

This cable harness has six branches – each branch clearly labelled with the name of the sensor or isolation cock, to which it shall be connected.



Each branch has two wires – one red and one black. To connect these wires to the sensor, the sensor cap shall be removed. Two terminals marked 2 & 4 will be seen. Red wire shall be connected to terminal 2. Black wire shall be connected to terminal 4. The sensor cap shall be re-fixed to sensor. This shall be repeated for the remaining three sensors.





Connections to the isolation cock are made to the microswitch on each isolation cock. Each isolation cock has a plastic cover, which shall be removed to access the screw terminals of the microswitch.

A printed circuit board is seen when the plastic cover is opened. The terminals marked 1 & 2, in the above picture, shall be identified on the PCB. Please note that these numbers are not printed on the PCB. Red wire from the cable shall be connected to terminal 1 and black wire to terminal 2. The wires shall be passed through the cable entry hole in the plastic cover, before making the connections. After the connections are made, the plastic cover shall be re-fixed with the original screws.

13.9.8.6 **Connection of EP Valve:**

Cable #5 in the table of section 13.9.8.2 shall be used to connect the two EP valves to the E70 Interface Unit. This cable has two branches – one for EP valve in Cab-I and another for EP valve in Cab-II.

Connections to the solenoid valve are done by opening the cover on the solenoid valve and connecting red wire to terminal 1 and black wire to terminal 2. Connections are shown in the following pictures.

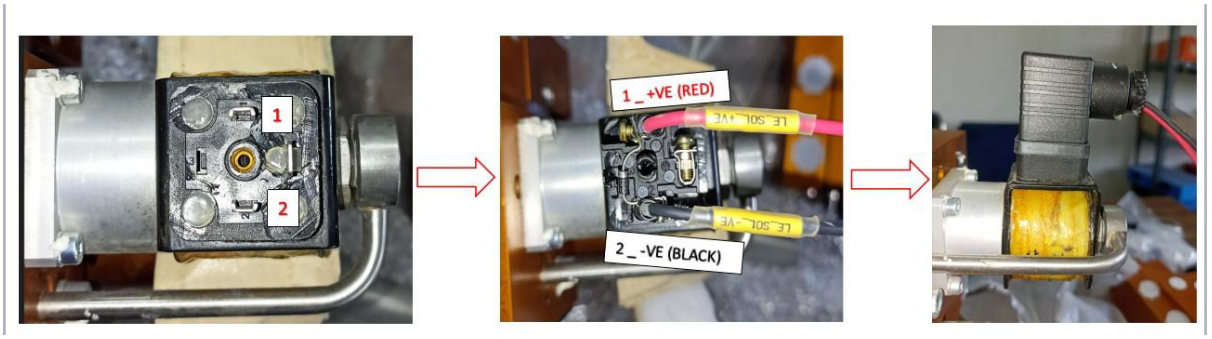


Illustration for connection of EP Valve

13.9.9 Installation of external cable harness for Cab Input Box and interconnection:

13.9.9.1 Cable HARNS_ASSY_CAB IP_EXTRNAL_E-70_516490520 (SAP part # 6000055690), supplied in the E-70 Installation Kit, shall be used for these connections.

13.9.9.2 The cable shall be laid along the path shown in Loco Kavach Cable Routing Plan for WAP-7/WAP-5/WAG-9 locomotives with E-70 braking system [Ref: 8]. Most connections are made on either side using plug-in connectors.

13.9.9.3 This cable connects Cab Input Box to SB1 and SB2 panels. It has a 24-pin Phoenix rectangular connector on one end and loose wires on the other end.

13.9.9.4 Phoenix rectangular connector shall be connected to the Cab Input Unit. Loose wires shall be terminated in the terminals in SB1 and SB2 panels, as indicated in the drawing Inter-connection drawing from Cab Termination Unit and SB Panels (E-70 Brake System) [Ref: 15].

13.10 Installation of braking interface for CCB Braking system

13.10.1 List of Items required for installation of braking interface for CCB braking system

#	Description	Part #	Qty
1	TCAS_BRAKE_INTERFACE_SYS_CCB-II_ELEC_KBI consisting of 1) Train Protection Module (TPM) - 1 2) Power Supply Junction Box (PSJB) - 1 3) SIFA Valve with Isolating Cock and Micro-switch - 1	1000091220	1
2	Loco Kavach – CCB Interface Unit	6000047585	1

13.10.2 Installation kit, supplied from factory, consists of parts listed in the following table.

#	Part Number	Description	QTY	Unit	Used for assembly of	Purpose
1	1000119433	TRANSDUCER_16-BAR_GEMS: 3100B0016G01B000	1.00	PC	Sensors (MR, BP, BC1 & BC2)	MR Sensor
2	1000029331	TRANSDUCER_MAKE: GEMS_P:G-3100B0007G01B00	3.00	PC		BP, BC1 & BC2 sensors
3	1000117255	FEMALE_BRANCH_TEE_8-4_STBF-RXB	1.00	PC		MR
4	1000102599	FEMALE_BRANCH_TEE_3/8"X1/4"-6-4STBF-N	3.00	PC		BP, BC1 & BC2
5	1000128867	SENSOR_ISOLATING_COCK_1/4"	4.00	PC		
6	1000128868	MALE_CONNECTOR_1/4"X1/4"_4SCM-N	4.00	PC		
7	2000005794	LOCTITE_567PST	2.00	PC		
8	1000102940	CU_PIPE_1/2”_OD 1.245MM_WT_CLW/MS/3/030	1.00	Mtrs	SIFA Valve & Cock	
9	1000102490	UNION T-JOINT_1/2"_8ST	1.00	PC		
10	1000102495	ELBOW_MALE_1/2"X1/2"_8 SEM-Rx	1.00	PC		
11	1000102941	CU_PIPE_3/8”_OD 1.245MM_WT_CLW/MS/3/030	9.00	Mtrs	Auto Horn Circuit	
12	1000102498	UNION T-JOINT_3/8"_6ST	4.00	PC		
13	1000102499	ELBOW_MALE_3/8"X3/8"_6SEM-Rx	4.00	PC		
14	1000102500	MALE CONNECTOR_3/8"X3/8"_6SCM-N	4.00	PC		
15	1000102501	BALL_VALVE_FEMALE_3/8"_0402	2.00	PC		
16	1000025216	2/2_NORM_CLOSED_3/8"_SOLENOID_VALVE_24V	2.00	PC		
17	1000032840	SCREW_SOC HD_DIN 912ISO 4762 A2-70_M6X20	4.00	PC	Fixing Auto Horn Valve	
18	1000012029	NUT(HEX)_SS_M6	4.00	PC		
19	1000020905	SPRING_WASHER_SS_M6	8.00	PC		
20	1000020837	WASHER_PLAIN_M6_SS	16.00	PC		
21	1000056591	SCREW_ALLEN_SS_M6x16MM	4.00	PC		
22	6000054476	HARNS_ASSY_RIB EXTNL_CCB BRAKE_ 516490506	1.00	PC	RIB External	
23	6000057995	HARNS_ASSY_CABIP_EXTERNAL_ CCB_516490592	1.00	PC	CAB Termination external	

13.10.3 Installation of Loco Kavach CCB Interface Unit

13.10.3.1 The procedure for installation of Loco Kavach CCB Interface Unit is the same as that of Loco Kavach E-70 Interface Unit, described in section 13.9.3.

13.10.3.2 Cables to Brake Interface Unit shall be connected and routed, as illustrated in Loco Kavach Cable Routing Plan for WAP-7/WAP-5/WAG-9 locomotives with CCB braking system [Ref: 9]

13.10.4 Installation of PSJB, Train Protection Module (TPM) and SIFA Valve

These operations shall only be conducted in presence of officials from the Loco Shed and / or representative of Knorr Bremse.

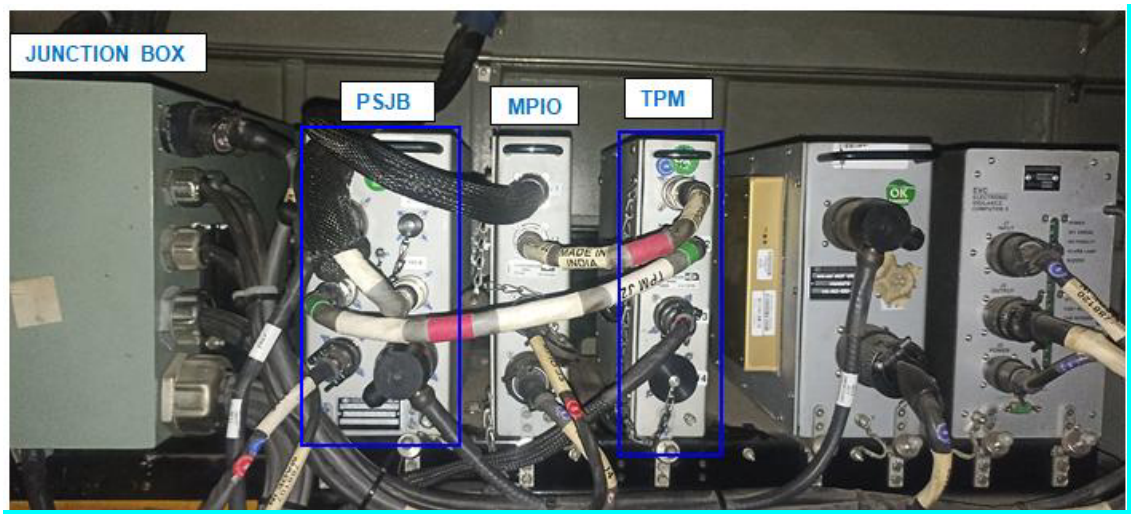
13.10.4.1 The CCB Brake panel, already installed in the locomotive, has three sub-assemblies called Junction Box, PSJB Box and MPIO module, as shown in the following picture.

13.10.4.2 The PSJB Box shall be replaced with a new one, if the already installed PSJB has a date code of 2020-03 or earlier. The date code is on the name plate fixed to the front of the PSJB box. The first four digits engraved in the last row,

represent the year and month of manufacture. In the picture shown below, the PSJB was manufactured in Jan 2020, and so, shall have to be replaced with a new one.

13.10.4.3 If the PSJB Box has to be replaced, the original PSJB Box shall be removed, and the new PSJB Box (supplied in the Installation Kit) shall be installed in its place.

13.10.4.4 TPM module, supplied in the Installation Kit shall be installed on the right side of the existing MPIO module as shown in the following figure.



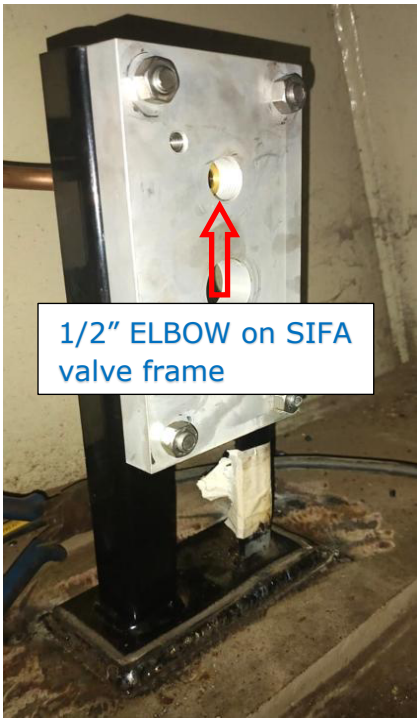
13.10.4.5 The removed modules shall be handed over to the Loco Shed officials.

13.10.5 Installation of SIFA Valve

13.10.5.1 The SIFA valve, included in the Installation Kit, is supplied along with a mounting frame, which shall be welded under A9-DBC (Driver Brake Controller) on CAB-I side. The mounting frame shall be installed such that the SIFA valve can be maintained and operated easily.

13.10.5.2 A 1/2" elbow fitting, supplied in the Installation Kit, shall be fixed at IN port of SIFA valve. Teflon paste shall be applied to the threads on the fitting, before it is installed.

13.10.5.3 SIFA valve manifold shall be fixed to mounting frame by using hardware provided in the installation Kit.

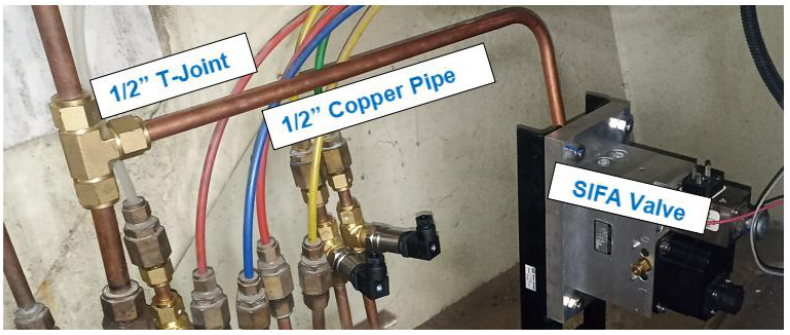


13.10.5.4 Isolation cock shall be fixed to SIFA valve manifold as shown in the below fig.

13.10.5.5 SIFA Valve IN port shall be connected to BP line. To make this connection,

- A ½" T-joint shall be fitted in the BP line, as shown in the following picture.
- A ½" elbow fitting shall be fitted to the IN port of SIFA valve.
- Length of copper pipe required to connect from the BP line T-joint to the SIFA Valve elbow fitting, shall be measured, cut, bent and installed, as shown in the following picture.

Proper bending tools shall be used for bending the copper pipe, to avoid kinks or pin holes.



13.10.6 Installation of Pressure Sensors (MR, BP, BC1 & BC2) at CAB-I

13.10.6.1 The procedure for installation of pressure sensors for CCB interface is the same as that for E-70 interface, described in section 13.9.6.

13.10.7 Installation of cable harness for Junction Box, PSJB, TPM and MPIO modules

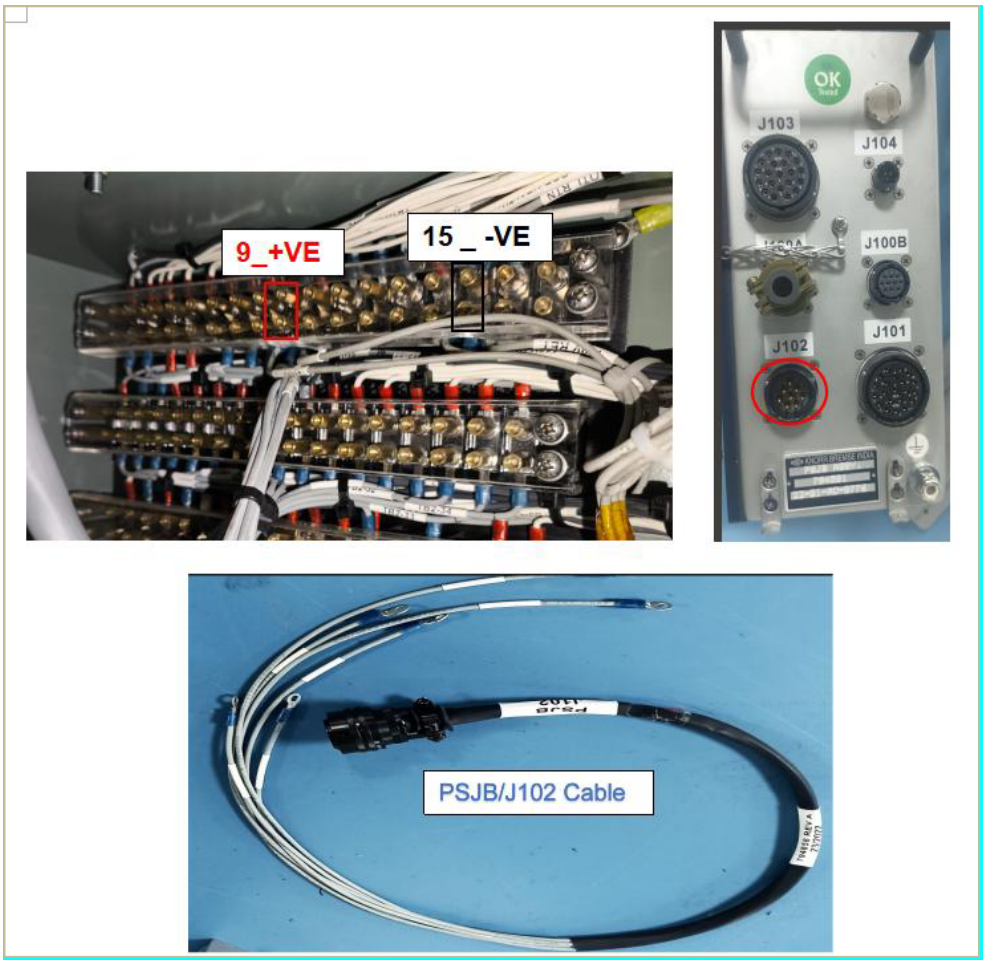
13.10.7.1 Cable harness interconnections between Junction box, PSJB, TPM and MPIO modules are illustrated in the following table. The cables are supplied along with the modules in installation kit.

#	Connection from	Connector / Terminal number	Connector type	Connection to	Connector / Terminal number	Connecto r type
1	Junction Box	a) Terminal - **9** (110V_+VE) b) Terminal -**15** (110V_-VE)	Loose wires	PSJB Box	**J102**	8pin Female
2	PSJB Box	**J100A**	10pin male	TPM	**J2**	10pin female
3	TPM	**J1**	10pin male	MPIO	**J2**	10pin female
Note: *If the PSJB Box is replaced with a new one, all other original connections of PSJB Box shall be made, per the original connections.*						

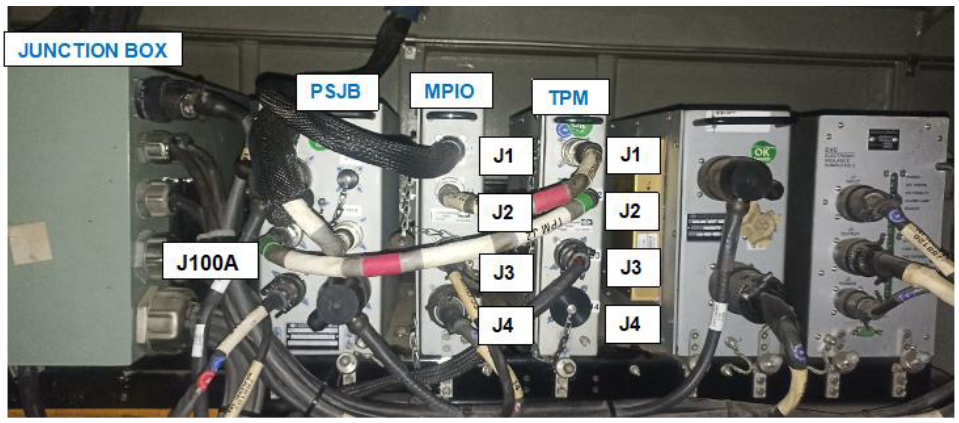
13.10.7.2 Interface cable (PSJB/J102) is supplied along with PSJB box. This cable consists of 6 independent wires with two wires labelled **'110V_+VE'**, and two other wires labelled as '**110V_-VE**'. The remaining two wires are spare.

13.10.7.3 The two '110V_+VE' wires shall be connected to terminal '9' in junction box and the other two '110V_-VE' wires shall be connected to terminal '15' in junction box as shown in figure below.

13.10.7.4 Other end of the cable (PSJB/J102) shall be connected to J102 connector on PSJB box. Connector details from junction box to PSJB box are shown below.



13.10.7.5 Complete installation of PSJB, TPM modules, along with cable harnesses, is shown below.



13.10.8 Connections of Pressure Sensors & Isolation Cocks:

13.10.8.1 Cable HARNS_ASSY_RIB EXTNL_CCB BRAKE_ 516490506 (SAP Part # 6000054476), supplied in the CCB Installation Kit shall be used for these connections. This consists of four individual cables, described in the following table.

13.10.8.2 Cables shall be laid along the paths shown in Loco Kavach Cable Routing Plan for WAP-7/WAP-5/WAG-9 locomotives with CCB braking system [Ref: 9]. Most connections are made on either side using plug-in connectors.

13.10.8.3 For serial # 2 connections are made using screw terminals for all sensors, similar to how it is explained in section 13.9.8.5.

#	Label on the cable	From Loco Kavach - CCB Interface Unit		Connection to		
		Connector number	**Connector type**	**Unit**	**Connector Number**	**Connector type**
1	CCB Power & Traction Cable	**MC18**	12pin Female	CAB Termination Unit	**CN1 & CN2**	1) 4-pin Male 2) 24-pin Phoenix connector
2	Pressure Sensor & ISO Cock Cable	**MC26**	19pin Female	Sensors & SIFA ISO Cock	**MR, BP, BC1, BC2 & SIFA Cock**	Loose wires & 7-pin Female
3	TPM module signal cable	**MILB-1**	14pin Male	TPM module	**J3**	10pin Female
4	SIFA Valve Power Cable	**MILB-3**	12pin Male	SIFA Valve	-	4-Terminal Valve connector

13.10.9 Installation of external cable harness for Cab Input Box and interconnection:

13.10.9.1 Cable HARNS_ASSY_CABIP_EXTERNAL_ CCB_516490592 (SAP part # 6000057995), supplied in the CCB Installation Kit, shall be used for these connections.

13.10.9.2 The cable shall be laid along the path shown in Loco Kavach Cable Routing Plan for WAP-7/WAP-5/WAG-9 locomotives with CCB braking system [Ref: 9]. Most connections are made on either side using plug-in connectors.

13.10.9.3 This cable connects Cab Input Box to SB1 and SB2 panels. It has a 24-pin Phoenix rectangular connector on one end and loose wires on the other end.

13.10.9.4 Phoenix rectangular connector shall be connected to the Cab Input Unit. Loose wires shall be terminated in the terminals in SB1 and SB2 panels, as indicated in the drawing Inter-connection drawing from Cab Termination Unit and SB Panels (CCB Brake System) [Ref: 16].

13.11 Installation of BIU for IRAB braking system

13.11.1 BIU for IRAB braking system is different for diesel and electric locomotives. Part numbers for applicable BIUs are indicated in the following table.

#	Description	Part #	Used for locomotive	Qty
1	Brake Interface Elect Unit Assembly	6000033629	WAG-7 & WAP-4	1
2	Brake Interface Diesel Unit Assembly	6000033734	WDM & WDG	1

13.11.2 For installing the BIU, an installation kit is supplied by the factory, which consists of parts listed in the following table.

BIU ASSY ELECTRIC KIT (SAP Part # 6000036360)														
#	Part Number	Part description	QTY	Unit	For installation of pneumatic connection									Other purpose
					MR1 line	MR2 line	MU2B-2 line	MU2B-3 line	SA9 – 20 line	A9-5 line	BP line	Addnl C2 A8-IN line	Addnl C2 A8-OUT line	
1	1000129978	PIPE_SEAMLESS_3/4"_SS	1.00	MTR							✓			
2	1000129979	EQUAL ELBOW 3/4" SS_12SE	10.00	PC							✓			
3	1000129980	EQUAL UNION 3/4" SS_12 SC	3.00	PC							✓			
4	1000129981	HEX NIPPLE_3/4"(M) x 3/4"(M) SS_12 HNRx	12.00	PC							✓			
5	1000129982	EQUAL TEE 3/4" OD SS_ 12 S	2.00	PC							✓			
6	1000102940	CU_PIPE_1/2"_OD 1.245MM_WT_CLW/MS/3/030	15.00	MTR			✓	✓	✓	✓	✓			
7	1000129983	MALE CONNECTOR_1/2"X3/8"_8-6 SCM-Rx	6.00	PC	✓		✓	✓	✓	✓				
8	1000102496	MALE CONNECTOR_1/2"X1/2"_8SCM-N	14.00	PC	✓		✓	✓						
9	1000117255	FEMALE_BRANCH_TEE_8-4_STBF-FRP	1.00	PC										BC Sensor
10	1000129984	UNION ELBOW_MALE_1/2"X1/2"_8 SE	5.00	PC	✓		✓	✓						
11	1000102490	UNION T-JOINT_1/2"_8ST	1.00	PC	✓									
12	1000102941	CU_PIPE_3/8"_OD 1.245MM_WT_CLW/MS/3/030	10.00	MTR	✓									Horn
13	1000102498	UNION T-JOINT_3/8"_6ST	2.00	PC	✓									BC
14	1000102500	MALE CONNECTOR_3/8"X3/8"_6SCM-N	10.00	PC	✓		✓	✓						
15	1000129985	COUPLING_CAP_FLUID_6Sn	6.00	PC	✓		✓	✓						
16	1000129986	FRONT FERRULE_FLUID_6ff	6.00	PC	✓		✓	✓						
17	1000129987	BACK FERRULE_FLUID_6fb	6.00	PC										
18	1000129988	UNION ELBOW_MALE_3/8"X3/8"_6 SE	7.00	PC	✓		✓	✓						
19	1000056112	BALL_VALVE_LIMIT_SWITCH_20 MM_SS304_AIAR	2.00	PC	✓						✓			
20	1000029331	TRANSDUCER_MAKE: GEMS_P:G-3100B0007G01B00	1.00	PC										BC
21	2000005794	LOCTITE_567PST	3.00	PC	✓		✓	✓			✓			
22	6000060103	HARNS_ASSY_BIU EXTERNAL_IRAB_516490627	1.00	PC										Harness
23	6000060112	HARNS_ASSY_CABIP_EXTRNL_ IRAB_516490629	1.00	PC										Harness

13.11.3 Installation of BIU unit

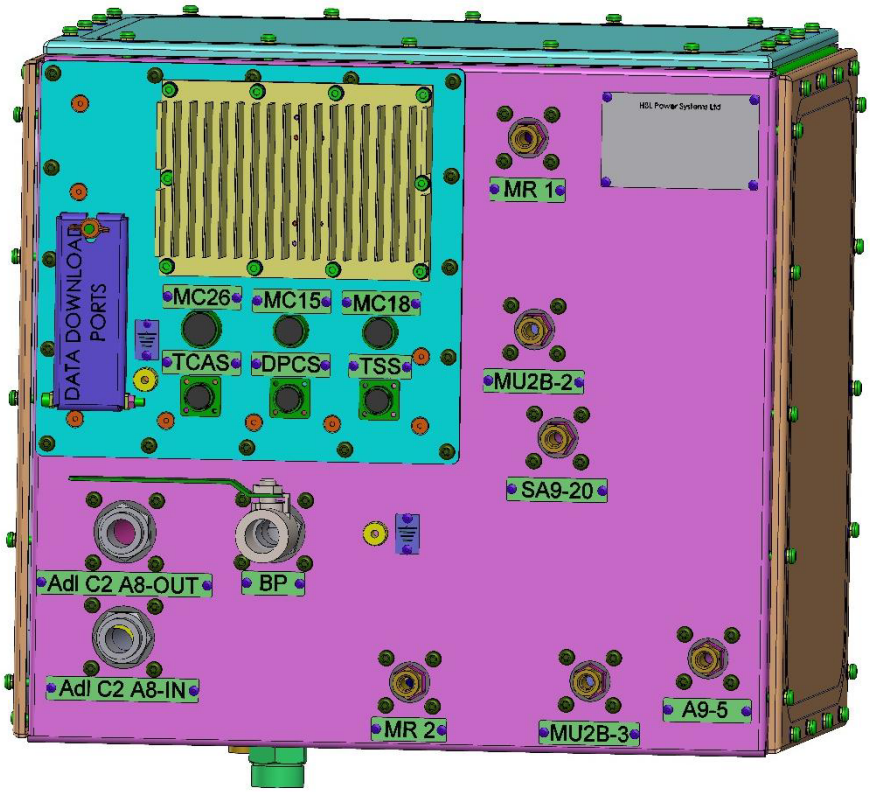
13.11.3.1 The BIU is supplied with a stand. The stand shall be welded to the locomotive floor, in the designated location. While placing the stand on the floor, it shall be ensured that there is adequate free space between the rear of the BIU and the any other equipment in the locomotive. This is required for making pneumatic and electrical connections during installation and subsequent maintenance.

13.11.3.2 BIU shall be fixed to the stand, using vibration isolating rubber pads and fasteners supplied in the BIU Installation Kit.

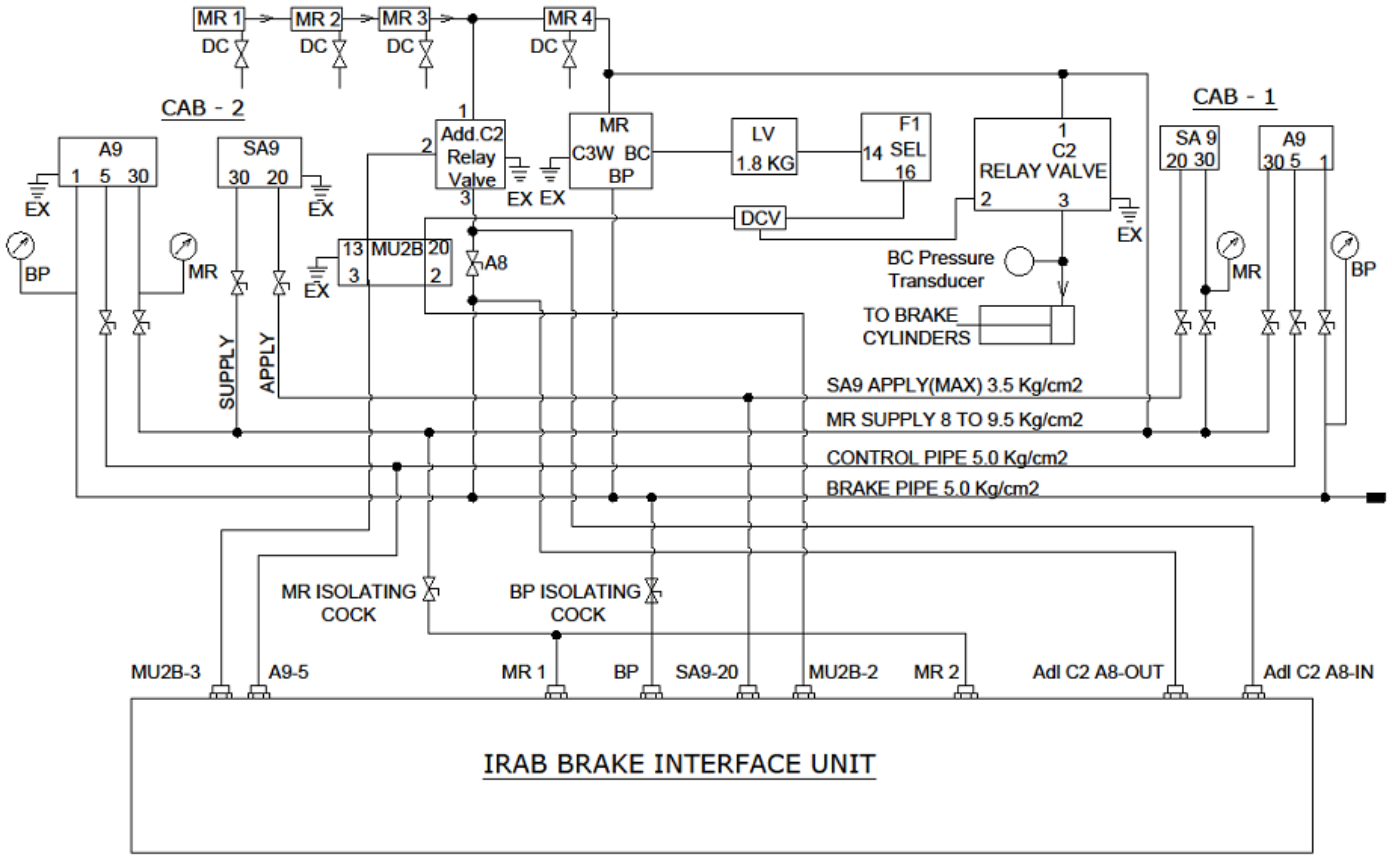
13.11.4 Brief details of pneumatic connections to BIU Unit

13.11.4.1 BIU unit has several pneumatic connections to be made to the existing braking system of the locomotive. All these connections shall be made to the pneumatic ports on the rear side of the BIU.

13.11.4.2 The pneumatic connections are illustrated in the following picture, and drawing.



IRAB PNEUMATIC INTERFACE WITH BIU



13.11.5 Pneumatic connections between BIU and Locomotive braking system:

13.11.5.1 All pneumatic connections to the locomotive braking system are made at the Triplate pneumatic panel.

13.11.5.2 A9 and SA9 piping shall be connected to Tri-plate panel at MU2B3 and MU2B2.

13.11.5.3 MR pneumatic piping shall be done from loco MR pipe to BIU unit. In this pneumatic piping path, one ON/OFF isolating cock shall be installed as per details shown in the pneumatic circuit diagram. The isolation cock shall be easily accessible for the Loco Pilot to operate and shall be clearly labelled for night-time visibility.

13.11.5.4 BP pneumatic piping shall be done from loco BP pipe to BIU unit. In this pneumatic piping path, one ON/OFF isolating cock shall be installed as per details shown in the pneumatic circuit diagram above. The isolation cock shall be easily accessible for the Loco Pilot to operate and shall be clearly labelled for night-time visibility.

13.11.5.5 In BC pneumatic piping path, one pressure sensor shall be installed as per details shown in the drawing.

13.11.5.6 A9 pneumatic connection given to Tri-plate panel shall be removed and connected to BIU unit.

13.11.5.7 MU2B-3 is the output of BIU unit and shall be connected to Tri-plate panel at port 5 of A9.

13.11.5.8 SA9 pneumatic connection given to Tri-plate panel shall be removed and connected to BIU unit.

13.11.5.9 MU2B-2 is the output of BIU and shall be connected to Tri-plate panel at port 20 of SA9.

13.11.5.10 All pneumatic connections shall be made using parts supplied in the IRAB BIU Installation Kit.

13.11.5.11 After making the pneumatic connections, air leakage shall be checked by spraying soap water over each joint.

13.11.5.12 While making the pneumatic connections, care shall be exercised not to damage original loco pneumatic pipes of MR, BP, BC, A9, SA9, MU2B-2 & MU2B3.

13.11.6 Installation of external cable harness for IRAB (BIU) Interface Unit and interconnection:

13.11.6.1 HARNS_ASSY_BIU EXTERNAL_IRAB_516490627 (SAP Part # 6000060103), supplied in the BIU Installation Kit, shall be used for these connections. This consists of two individual cables, described in the following table. Cables shall be laid along the paths shown in Loco Kavach Cable Routing Plan for WAG-7/WAP-4 & Loco Kavach Cable Routing Plan for WDG/WDM locomotives with IRAB braking system [Ref: 10&11].

13.11.6.2 For serial # 2 connections are made using screw terminals on the respective devices, similar to how it is explained in section 13.9.8.5.

#	Label on the cable	Connection from Loco Kavach - BIU Unit		Connection to	
		Connector number	Connector type	Unit	Connector type
1	BIU Power & Traction Cable	MC18	12Pin Female	CAB Termination Unit	a. 4 Pin Male b. Phoenix rectangular connector
2	Pressure Sensor & ISO Cock Cable	MC26	19pin Female	BC Sensor & MR, BP ISO Cocks	Loose wires

13.11.7 Installation of external cable harness for Cab Input Box and interconnection:

13.11.7.1 Cable HARNS_ASSY_CABIP_EXTRNL_ IRAB_516490629 (SAP part # 6000060112), supplied in the IRAB BIU Installation Kit, shall be used for these connections.

13.11.7.2 The cable shall be laid along the path shown in Loco Kavach Loco Kavach Cable Routing Plan for WAG-7/WAP-4 & Loco Kavach Cable Routing Plan for WDG/WDM [Ref: 10 & 11]. Most connections are made on either side using plug-in connectors.

13.11.7.3 This cable connects Cab Input Box to SB panel. It has a 24-pin Phoenix rectangular connector on one end and loose wires on the other end.

13.11.7.4 Phoenix rectangular connector shall be connected to the Cab Input Unit. Loose wires shall be terminated in the terminals in SB panel, as indicated in the drawing Inter-connection drawing

from Cab Termination Unit and SB Panels IRAB [Ref: 17].

13.12 Other equipment:

13.12.1 Other equipment to be installed includes EMI Filter Box, Cab Input Box, RFID Power Reader Power Supply Units and Radio Unit.

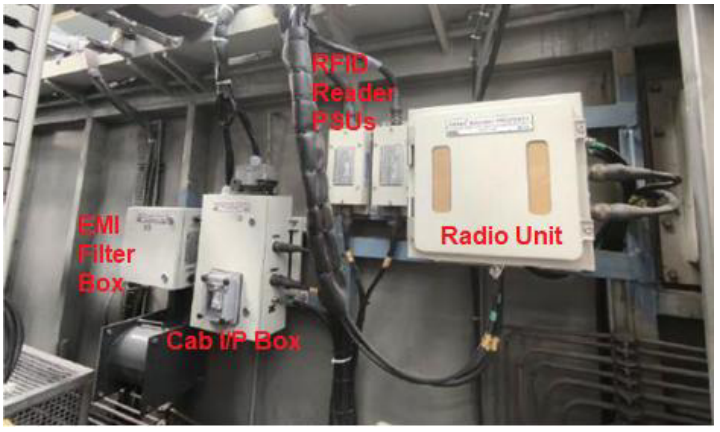
13.12.2 All these units are installed on a mounting frame, custom-fabricated, as described below. This mounting frame can vary from one loco to another and from one loco type to another. Customization may be needed for every loco. The mounting frame shall be fabricated using 50x5 mm galvanized steel plate. The frame shall be welded to the tubular structure on locomotive side wall, in a location close to the Loco Kavach Unit.

13.12.3 After the mounting frame is welded to the locomotive side wall, it shall be painted. Following pictures illustrate the frame for one type of loco. The frame may appear different in other locomotive types.

13.12.4 Holes shall be drilled on the mounting frame, to suit the mounting locations of all four units, using the units as templates for marking the hole positions.

13.12.5 All four units are supplied with integral mounting brackets. Bolts, nuts and washers for fixing these units to the mounting frame are in the Loco Kavach Installation Kit.

13.12.6 All four units shall be fixed to the mounting frame with the supplied bolts, nuts and washers.



13.13 Power supply arrangement:

13.13.1 Two MCBs, of 32A rating, are installed in the Switch Board Panel of the locomotive. One MCB is for supplying power to Loco Kavach Unit and another for brake interface system.

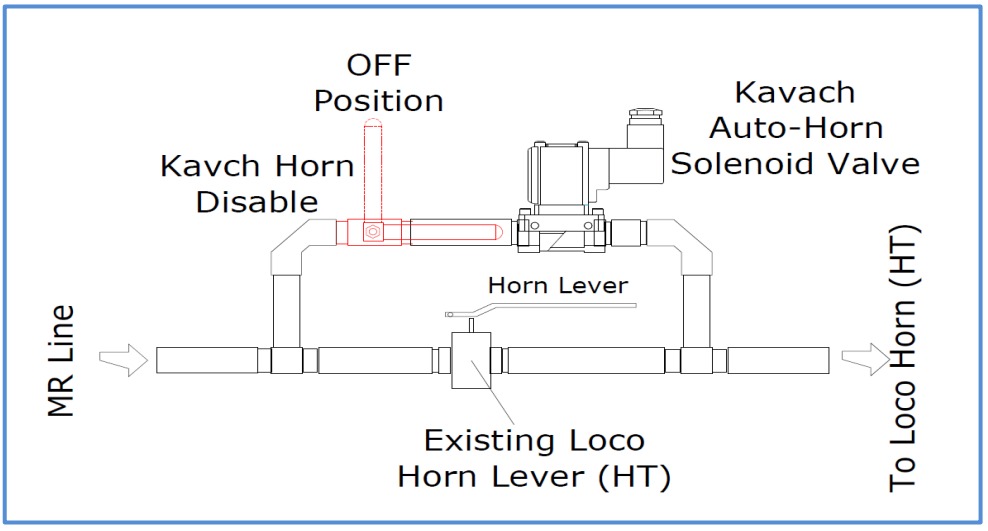
13.13.2 The input terminals of the MCB are wired to locomotive battery supply available in the Switch Board Panel. This connection is given by the Loco Shed officials.

13.13.3 The output terminals of the MCBs are wired to the EMI Filter Unit and Cab Input Box. Please refer to Loco Kavach Power Supply Connectivity Drawing [Ref: 4], for details of connections to be made and wires to be used. Wires and conduit are included in the Loco Kavach Installation Kit.

13.14 Auto-horn interface:

13.14.1 Auto-horn interface is installed in both CAB-I and CAB-II. This is same for E-70, CCB and IRAB for Electric Loco braking systems. In each cab, this requires the installation of a solenoid valve and a bypass cock and connecting them to the loco horn pneumatic line.

13.14.2 The pneumatic connections are shown in the following picture, as extracted from the document Arrangement of Kavach Interfacing with E70 Brake System in WAP-5/WAP-7/WAG-9 locomotives [Ref: 12] or Arrangement of Kavach Interfacing with CCB Brake System in WAP-5/WAP-7/WAG-9 locomotives [Ref: 13].



13.14.3 A bypass line shall be installed to the existing Loco Horn Lever. The 2/2 solenoid valve, supplied in the Brake Interface Unit Installation kit shall be installed in this bypass line through a Horn Bypass cock, also supplied in the Brake Interface Installation Kit.

13.15 Inter-connection Cable Assembly

13.15.1 After all sub-systems of Loco Kavach are installed in the locomotive, they shall be connected together using suitable cables. These cables are supplied as one set from factory, with part description "HARNS_ASY_LOCO_KAVACH_4.0_EXTE_516490458" in the Loco Kavach Installation Kit.

13.15.2 This cable assembly set consists of 19 separate cables, as listed in the following table.

#	Label on the cable	Connection from		Connection to	
		Sub-assembly	Connector	Sub-assembly	Connector
1	Kavach I/P PS CABLE	EMI Filter	Loose Wires	Kavach	MC10, 4Pin - Female
2	LPOCIP-A CABLE	Kavach	MC1, 12Pin -Male	LPOCIP	MC11, 12Pin - Female
3	LPOCIP-B CABLE	Kavach	MC3, 12Pin -Male	LPOCIP	MC13, 12Pin - Female
4	RFID PS1 CABLE	Kavach	MC6, 12Pin -Male	RFID PS1	MC19, 12Pin - Female
5	RFID PS2 CABLE	Kavach	MC7, 12Pin -Male	RFID PS2	MC20, 12Pin - Female
6	RFID-A CABLE	RFID PS1	CN1, 12Pin -Male	RFID Reader-A	CN2, 12Pin - Female
7	RFID-B CABLE	RFID PS2	CN1, 12Pin -Male	RFID Reader-B	CN2, 12Pin - Female
8	SPD MTR-1 CABLE	Kavach	MC8, 14Pin -Male	SPD Mtr-1	MC21, 14Pin - Female
9	SPD MTR-2 CABLE	Kavach	MC22, 14Pin -Male	SPD Mtr-2	MC23, 14Pin - Female
10	CAB SIGNALS CABLE	Kavach	MC9, 12Pin - Female	CAB I/P Box	MC24, 12Pin - Male
11	BIU SIGNAL CABLE	Kavach	MC5, 14Pin -Male	BIU	MC15, 14Pin - Female
12	RADIO-1 TX1 CABLE	Radio Unit	Tx1 – TNC	Radio1-Tx Antenna	TNC
13	RADIO-1 RX1 CABLE	Radio Unit	Rx1 – TNC	Radio1-Rx Antenna	TNC
14	RADIO-2 TX2 CABLE	Radio Unit	Tx2 – TNC	Radio2-Tx Antenna	TNC
15	RADIO-2 RX2 CABLE	Radio Unit	Rx2 – TNC	Radio2-Rx Antenna	TNC
16	GPS-1 ANTENNA CABLE	Kavach	SMC- on PPC1	GPS_GSM_Unit	GPS - TNC
17	GSM-1 ANTENNA CABLE	Kavach	SMC- on VGW1	GPS_GSM_Unit	GSM - TNC
18	GPS-2 ANTENNA CABLE	Kavach	SMC- on PPC2	GPS_GSM_Unit	GPS - TNC
19	GSM-2 ANTENNA CABLE	Kavach	SMC- on VGW2	GPS_GSM_Unit	GSM - TNC

13.15.3 The cables shall be laid in existing cable trays or any other path, as shown in the Loco Kavach Cable Routing Plan drawings [Ref: 8, 9,10 or 11], as applicable to the type of locomotive.

13.15.4 Care shall be exercised to ensure that cables do not get twisted and entangled while they are being laid. Wherever cables are exposed to sharp edges in cable trays (for example at turning locations), they shall be protected by wrapping a piece of EPDM gasket (supplied in the Installation Kit as EPDM_GASKET_2MM_THICKNESS_1MTRX1MTR).

13.15.5 After all the cables are laid, as indicated in the Cable Routing Plan drawings, they shall be connected to the respective sub-assemblies as indicated in the table above. Loco Kavach Inter-connectivity Diagrams [Ref: 5/6/7].

14.0 Loco Kavach Configuration Request Form:

14.1 Installation activity of Loco Kavach is now complete.

14.2 As indicated in section 8.4 and 8.5, workflow steps required for generation of Loco Kavach Configuration File should have been executed. After this, Loco Kavach is ready for commissioning.

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Title: DGM Service

Signature: 
Email: subrahmanyam.yadavalli@hbl.in
Title: GM - Engineering

Signature: 
Email: hemant.sagade@hbl.in
Title: Safet Manager

Signature: Rajasekhar K
Rajasekhar K (Nov 25, 2024 08:31 GMT+5.5)
Email: kvrajasekhar@hbl.in
Title: Dy.General Manager

5 53 76 0014 Loco Kavach V2.0 Installation_Manual 20-11-2024

Final Audit Report 2024-11-25

Created:	2024-11-20 (India Standard Time)
By:	Subrahmanyam Y (subrahmanyam.yadavalli@hbl.in)
Status:	Signed
Transaction ID:	CBJCHBCAABAA837gJzChFANwN6B-S_Z3FW4NacITBRlP

"5 53 76 0014 Loco Kavach V2.0 Installation_Manual 20-11-2024" History

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Signer suresh.jaluka@hbl.in entered name at signing as Suresh Jaluka
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Signature Date: 2024-11-25 - 8:27:09 AM GMT+5.5 - Time Source: server- IP address: 49.43.235.148

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2024-11-25 - 8:27:11 AM GMT+5.5

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2024-11-25 - 8:30:29 AM GMT+5.5- IP address: 103.206.113.126

Signer Rajasekhar Kolla (kvrajasekhar@hbl.in) entered name at signing as Rajasekhar K
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