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भारत सरकार GOVERNMENT OF INDIA
रेल मंत्रालय MINISTRY OF RAILWAYS

VANDE BHARAT EXPRESS TRAINSET (T-18) MAINTENANCE MANUAL



VOLUME - 2

System Documentation

IRCAMTECH/GWL/2020-21/T-18/MM/1.0
August, 2020



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Volume 2

System Documentation



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Amendments and Revisions

The correction slips to be issued in future for this report will be numbered as follows:

IRCAMTECH/GWL/2020-21/T-18/MM/1.0# XX date

Where “XX” is the serial number of the concerned correction slip (starting from 01 onwards).

Version	Date	Corrections	Remarks
1.00	31/08/2020	First Release	--

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- 1 Technical Description**
- 2 Cleaning**
- 3 Maintenance Schedules**
- 4 Tools and Accessories**
- 5 Maintenance**
- 6 Drawing Index**
- 7 General Information**
- 8 Troubleshooting**

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1. TECHNICAL DESCRIPTION

Version :

1.00



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List of Amendments

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1.1. TECHNICAL DESCRIPTION - DRIVING TRAILER COACH (DTC)

1.1.1. GENERAL

New air conditioned light weight coach for service up to 160 km / h on special high speed lines of Indian Railways.

1.1.2. COACH DESCRIPTION

DTC is a non-powered vehicle with a driver cab at one end. The driver cab is furnished with a pre-fabricated driver desk. All driving operations are possible from this driver desk. Feedback from the system in all the coaches/basic units is available for viewing by motor man on the driver desk. In this regard, CCU aggregates the information from all the coaches and a 10.4 " TFT driver display screen provides information to motor man. Further an illuminated indication panel is provided for important driving related information for quick viewing by motor man. Various gauges are also provided for viewing MR, BP, BC pressure. Motor man can also control the passenger information system from the driver desk DTC. Apart from the driver cab is called as passenger saloon area. Passenger saloon area is similar to trailer coach, except the space occupied by driver cab.

DTC also consists of battery box, battery charger, compressor, water tank, main reservoir, air supply unit, end pneumatic panel which are mounted under-slung. Rest of the DTC apart from the driver cab is passenger saloon area which consists of pantry, RMPU control unit, mono block pump controller, CRW, GCRW panel and various end wall panels. It is a air-conditioned coach. All passenger comfort related load is controlled by driver from driver cab.

1.1.3. TECHNICAL DATA

Designation	Value
Track gauge	1,676 mm
Speed	Max. 160 km/h
Length of car-body (Over Coupler)	24000 mm
Width of car-body	3240 mm
Car height above top of rail	4140 mm
Wheels	952 mm dia.
Distance between center pivots	14900 mm
Number of Toilets	1
Number of Seats- (Chair Car)	44

1.1.4. CARBODY PART

1.1.4.1. CARBODY SHELL

Economical light weight steel construction.

1.1.4.2. DRAW AND BUFFER GEAR

Tight lock center buffer coupler type AAR - H. Provided on driver cabin side of coach.

1.1.4.3. SEMI PERMANENT COUPLER

The Front Driving Coaches (DTCs) has CBC couplers and the in between coaches have permanently coupled with Semi-permanent couplers.

1.1.4.4. PLUG DOORS (ENTRY DOORS)

Automatic plug door includes locking and opening mechanism is a sophisticated system in which the coach doors shall remain closed whenever the train starts from Railway station. Similarly, these doors remain closed till the train stops at the next station and eliminate chances of passengers detraining from the moving train.

1.1.4.5. SLIDING DOORS (TRANSIT DOORS)

Interior sliding doors serve to separate the boarding area of the carriage from the seating area with advantages of the solution: reliability and comfort of operation. The interior door can be controlled either by a radar signal when the person approaches or by pressing a button on the door. In case of power failure, the doors are freely movable manually or in case of emergency, the door is disconnected from the power supply when emergency button is pressed and is freely movable manually.

1.1.4.6. GANGWAYS

The gangway is the flexible part of the train, allowing the relative movements between the Coaches and offering passengers a secure and comfortable passageway.

1.1.5. WINDOWS

Double-pane insulating glass especially designed for air conditioned coaches with reflective laminated glass on the outside and tempered safety glass on the inside.

1.1.6. INTERIOR EQUIPMENT**1.1.6.1. INTERIOR FITTING**

Saloon passenger area in the coach center, 2 plus 3 arrangement for the chair car separated via sliding doors from the entrance area. Seats designed in light weight construction especially for the new coach type. Continuous luggage rack above the seats with halogen reading lamps for each seat. Pantry compartment for storing, preparing and serving of precooked meals with equipment like freezer, heating furnace, soup warmer, water boiler and serving trolley.

1.1.6.2. INTERIOR PANELLING

Side walls and ceilings in the passenger area made of modular glass-fiber reinforced polyester parts. The floor is made of sound absorbing multiplex plates on special noise damping rubber profiles. PVC floor covering provided with carpet in the executive class (passenger area).

1.1.7. LIGHTING

Lighting by means of a centrally arranged LED luminous band. Illumination of entrance area and toilets with LED lamps. LED reading lamps above each seat. Diffused lighting system.

1.1.8. TOILET SYSTEMS

FRP modular toilet module at the coach end. Train-18 contains vacuum assisted bio-toilet system. Water tank (1100 liters) under-slung.

1.1.9. BRAKE

Pneumatic disc brake type, anti-skid device, electro-pneumatic control system and regenerative braking.

1.1.10. ELECTRICAL EQUIPMENT

1.1.10.1. EQUIPMENT IN DRIVING TRAILER COACH

Battery Charging System (Battery Charger), Battery and Battery box, Inter-Vehicular (IV) couplers, Isolation (pantry) transformer- 20 kVA, Master Controller, Driver console (left-driver, right-Guard), Cabin control, driving control, door control switches, DDU (TFT driver display screen), Gauges, Speed Recorder, Indication lamps, Man Machine Interface(MMI), Brake controller, Signal bell, Horn switch, VCD reset switch, Emergency brake handle, Buzzers, Connector and TB panel.CRW (cab rear wall) panel, it consists CCU'S, LRMS, TPWS, ECN Switches, MCB's, Relays & contactors, GCRW (Guard cab rear wall) panel, it consists PCU'S, EBCU's, CCTV NVRs, CCTV Ethernet Switches MCB's, Relays &contactors, EWP (End wall panel)- TBs, MCBs, MPCB, Reading lights, mono block pump controller, Passenger information system (HCD,ICD, SDB, speaker, ANM, PECU,MMI), CCTV, Saloon & Gangway Lights, Roof Mounted AC Package Unit (RMPU), RMPU control unit, LED Marker Lights, LED Flasher Lights and control unit, Wiper, Driver's Cab Air Conditioning Unit, Earth return ground contact (ERCU), Mini Pantry Items, Power supply socket junction box for external 415 V AC, Speedometer, Frequency Generator Unit, Pump controller, Mono block pump.

1.1.10.2. PASSENGER INFORMATION SYSTEM & CCTV

Train-18 is fitted with GPS based passenger information system. This train has CCTV system for monitoring and security purpose.

1.1.11. AIR CONDITIONING SYSTEM

1.1.11.1. AIR CONDITIONING UNITS

Two microprocessor-controlled roof-mounted package units. Supply of conditioned air via perforated ceiling in the passenger room. Separate Cab air conditioning unit for driver cabin.

1.1.12. BOGIES

Bolster less bogie for semi high speed operation.

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1.2. TECHNICAL DESCRIPTION -TRAILER COACH(TC)

1.2.1. GENERAL

New air conditioned light weight coach for service up to 160 km / h on special high speed lines of Indian Railways.

1.2.2. COACH DESCRIPTION

TC is a non-powered vehicle with only a passenger saloon area. The passenger saloon area includes lights, fans, emergency lights, air handling unit (for ventilation), and passenger information system consisting of LED displays and speakers (for announcements). TC consists of a pantograph, vacuum circuit breaker and HV isolator on roof. It also consists of auxiliary converter unit and power transformer mounted under-slung. Power to LTC units of both motor coaches is distributed from same power transformer.

1.2.3. TECHNICAL DATA

Designation	Value
Track gauge	1,676 mm
Speed	Max. 160 km/h
Length of car-body (Over Coupler)	24000 mm
Width of car-body	3240 mm
Car height above top of rail	4140 mm
Wheels	952 mm dia.
Distance between center pivots	14900 mm
Number of Toilets	2
Number of Seats- (Chair Car)	78

1.2.4. CARBODY PART

1.2.4.1. CARBODY SHELL

Economical light weight steel construction.

1.2.4.2. SEMI PERMANENT COUPLER

Provides rigid connection on both sides and minimizes both draft and buff forces (600kN draft / 1000kN buff).

1.2.4.3. PLUG DOORS (ENTRY DOORS)

Automatic plug door includes locking and opening mechanism is a sophisticated system in which the coach doors shall remain closed whenever the train starts from Railway station. Similarly, these doors remain closed till the train stops at the next station and eliminate chances of passengers detraining from the moving train.

1.2.4.4. SLIDING DOORS (TRANSIT DOORS)

Interior sliding doors serve to separate the boarding area of the carriage from the seating area with advantages of the solution: reliability and comfort of operation. The interior door can be controlled either by a radar signal when the person approaches or by pressing a button on the door. In case of power failure, the doors are freely movable manually or in case of emergency, the door is

disconnected from the power supply when emergency button is pressed and is freely movable manually.

1.2.4.5. GANGWAYS

The gangway is the flexible part of the train, allowing the relative movements between the Coaches and offering passengers a secure and comfortable passageway.

1.2.5. WINDOWS

Double-pane insulating glass especially designed for air conditioned coaches with reflective laminated glass on the outside and tempered safety glass on the inside.

1.2.6. INTERIOR EQUIPMENT

1.2.6.1. INTERIOR FITTING

Saloon passenger area in the coach center, 2 plus 3 arrangement for the chair car separated via sliding doors from the entrance area. Seats designed in light weight construction especially for the new coach type. Continuous luggage rack above the seats with halogen reading lamps for each seat. Pantry compartment for storing, preparing and serving of precooked meals with equipment like freezer, heating furnace, soup warmer, water boiler and serving trolley.

1.2.6.2. INTERIOR PANELLING

Side walls and ceilings in the passenger area made of modular glass-fiber reinforced polyester parts. The floor is made of sound absorbing multiplex plates on special noise damping rubber profiles. PVC floor covering provided with carpet in the executive class (passenger area).

1.2.7. LIGHTING

Lighting by means of a centrally arranged LED luminous band. Illumination of entrance area and toilets with LED lamps. LED reading lamps above each seat. Diffused lighting system.

1.2.8. TOILET SYSTEMS

FRP modular toilet module of European and Indian (squatting) style at the coach end. Train-18 contains vacuum assisted bio-toilet system. Fresh water tank (1100 liters) under-slung.

1.2.9. BRAKE

Pneumatic disc brake type, anti-skid device, electro-pneumatic control system and regenerative braking.

1.2.10. ELECTRICAL EQUIPMENT

1.2.10.1. EQUIPMENT IN TRAILER COACH

Auxiliary Converter Unit (ACU), Pantograph with insulator, Vacuum Circuit Breaker (VCB), Earthing switch for VCB (Roof), AC Surge Arrester / Lightning arrester, Main transformer (Traction), Jumper Couplers (Power Couplers), Power Coupler Junction Box, Inter-Vehicular (IV) couplers, Isolation (pantry) transformer- 20 kVA, ECC (Electrical cubical)-It consists EPCU'S, EBCU'S, MCB's, Relays & contactors, EWP (End wall panel) - Terminal Blocks & MCBs, TBs, MCBs, MPCB, Reading lights mono block pump controller, Passenger information system (ICD, SDB, speaker, ANM, PECU), CCTV, Saloon & Gangway Lights, Roof Mounted AC Package Unit (RMPU), RMPU control unit, Return Current Transformer, Primary Current

Transformer, Voltage Transformer, Earth return ground contact (ERCU), Mini Pantry Items, Power supply socket junction box for external 415 V AC, HT cable, Pump controller, Mono block pump.

1.2.11. AIR CONDITIONING SYSTEM

1.2.11.1. AIR CONDITIONING UNITS

Two microprocessor-controlled roof-mounted package units. Supply of conditioned air via perforated ceiling in the passenger room. Separate Cab air conditioning unit for driver cabin.

1.2.12. BOGIES

Bolster less bogie for semi high speed operation.

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1.3. TECHNICAL DESCRIPTION - NON DRIVING TRAILER COACH (NDTC)

1.3.1. GENERAL

New air conditioned light weight coach for service up to 160 km / h on special high speed lines of Indian Railways.

1.3.2. COACH DESCRIPTION

NDTC consists of passenger saloon area, pantry, RMPU, mono block pump controller, electrical cabinet and various End wall panels. It is an air-conditioned coach. Non Driving Trailer Coach (NDTC) is similar to DTC except driver related interface. It also consists of battery box, battery charger and compressor mounted under-slung. It also consists of passenger saloon area which consists of pantry, RMPU control unit, mono block pump controller, and various end wall panels.

1.3.3. TECHNICAL DATA

Designation	Value
Track gauge	1,676 mm
Speed	Max. 160 km/h
Length of car-body (Over Coupler)	24000 mm
Width of car-body	3240 mm
Car height above top of rail	4140 mm
Wheels	952 mm dia.
Distance between center pivots	14900 mm
Number of Toilets	2
Number of Seats- (Chair Car)	78
Number of Seats- (Executive Class)	52

1.3.4. CARBODY PART

1.3.4.1. CARBODY SHELL

Economical light weight steel construction.

1.3.4.2. SEMI PERMANENT COUPLER

Provides rigid connection on both sides and minimizes both draft and buff forces (600kN draft / 1000kN buff).

1.3.4.3. PLUG DOORS (ENTRY DOORS)

Automatic plug door include locking and opening mechanism is a sophisticated system in which the coach doors shall remain closed whenever the train starts from Railway station. Similarly, these doors remain closed till the train stops at the next station and eliminate chances of passengers detraining from the moving train.

1.3.4.4. SLIDING DOORS (TRANSIT DOORS)

Interior sliding doors serve to separate the boarding area of the carriage from the seating area with advantages of the solution: reliability and comfort of operation. The interior door can be controlled either by a radar signal when the person approaches or by pressing a button on the door. In case of power failure, the doors are freely movable manually or in case of emergency, the door is

disconnected from the power supply when emergency button is pressed and is freely movable manually.

1.3.4.5. GANGWAYS

The gangway is the flexible part of the train, allowing the relative movements between the Coaches and offering passengers a secure and comfortable passageway.

1.3.5. WINDOWS

Double-pane insulating glass especially designed for air conditioned coaches with reflective laminated glass on the outside and tempered safety glass on the inside.

1.3.6. INTERIOR EQUIPMENT

1.3.6.1. INTERIOR FITTING

Saloon passenger area in the coach center, 2 plus 2 arrangement for the executive class and 2 plus 3 arrangement for the chair car separated via sliding doors from the entrance area. Seats designed in light weight construction especially for the new coach type. Continuous luggage rack above the seats with halogen reading lamps for each seat. Pantry compartment for storing, preparing and serving of precooked meals with equipment like freezer, heating furnace, soup warmer, water boiler and serving trolley.

1.3.6.2. INTERIOR PANELLING

Side walls and ceilings in the passenger area made of modular glass-fiber reinforced polyester parts. The floor is made of sound absorbing multiplex plates on special noise damping rubber profiles. PVC floor covering provided with carpet in the executive class (passenger area).

1.3.7. LIGHTING

Lighting by means of a centrally arranged LED luminous band. Illumination of entrance area and toilets with LED lamps. LED reading lamps above each seat. Diffused lighting system.

1.3.8. TOILET SYSTEMS

FRP modular toilet module of European and Indian(squatting) style at the coach end. Train-18 contains vacuum assisted bio-toilet system. Fresh water tank (1100 liters) under-slung.

1.3.9. BRAKE

Pneumatic disc brake type, anti-skid device, electro-pneumatic control system and regenerative braking.

1.3.10. ELECTRICAL EQUIPMENT

1.3.10.1. EQUIPMENT IN NDTC

Battery Charging System (Battery Charger), Battery and Battery box, Inter-Vehicular (IV) couplers, Isolation (pantry) transformer- 20 kVA, Passenger information system (ICD, SDB, speaker, ANM, PECU), CCTV, Saloon & Gangway Lights, Roof Mounted AC Package Unit (RMPU), RMPU control unit, Earth return ground contact (ERCU), Mini Pantry Items, Power supply socket junction box for external 415 V AC, Shunting Panel, Pump controller, Mono block pump.

1.3.11. AIR CONDITIONING SYSTEM

1.3.11.1. AIR CONDITIONING UNITS

Two microprocessor-controlled roof-mounted package units. Supply of conditioned air via perforated ceiling in the passenger room. Separate Cab air conditioning unit for driver cabin.

1.3.12. BOGIES

Bolster less bogie for semi high speed operation.

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1.4. TECHNICAL DESCRIPTION - MOTOR COACH (MC)

1.4.1. GENERAL

New air conditioned light weight coach for service up to 160 km / h on special high speed lines of Indian Railways.

1.4.2. COACH DESCRIPTION

MC is a powered vehicle with one traction motor driving each axle. The motor coach consists Line and Traction Converter Unit (LTC) for each Bogie mounted under-slung. Also Brake chopper resister is mounted under-slung. Transformer secondary cable for both LTC unit from power transformer come from Trailer Coach through under-slung mounted IV Coupler. It also consists of passenger saloon area, pantry, RMPU, mono block pump controller, electrical cabinet and various end wall panels. It is air-conditioned coach. The passenger saloon area is similar to trailer coach.

MC with electrical changeover switch is known as MC2 and 180 degree rotated is MC3.

1.4.3. TECHNICAL DATA

Designation	Value
Track gauge	1,676 mm
Speed	Max. 160 km/h
Length of car-body (Over Coupler)	24000 mm
Width of car-body	3240 mm
Car height above top of rail	4140 mm
Wheels	952 mm dia.
Distance between center pivots	14900 mm
Number of Toilets	2
Number of Seats- (Chair Car)	78
Number of Seats- (Executive Class)	52

1.4.4. CARBODY PART

1.4.4.1. CARBODY SHELL

Economical light weight steel construction.

1.4.4.2. SEMI PERMANENT COUPLER

Provides rigid connection on both sides and minimizes both draft and buff forces (600kN draft / 1000kN buff).

1.4.4.3. PLUG DOORS (ENTRY DOORS)

Automatic plug door include locking and opening mechanism is a sophisticated system in which the coach doors shall remain closed whenever the train starts from Railway station. Similarly, these doors remain closed till the train stops at the next station and eliminate chances of passengers detraining from the moving train.

1.4.4.4. SLIDING DOORS (TRANSIT DOORS)

Interior sliding doors serve to separate the boarding area of the carriage from the seating area with advantages of the solution: reliability and comfort of operation. The interior door can be controlled either by a radar signal when the person approaches or by pressing a button on the door. In case of power failure, the doors are freely movable manually or in case of emergency, the door is disconnected from the power supply when emergency button is pressed and is freely movable manually.

1.4.4.5. GANGWAYS

The gangway is the flexible part of the train, allowing the relative movements between the Coaches and offering passengers a secure and comfortable passageway.

1.4.5. CARBODY PART

1.4.5.1. CARBODY SHELL

Economical light weight steel construction.

1.4.5.2. SEMI PERMANENT COUPLER

Provides rigid connection on both sides and minimizes both draft and buff forces (600kN draft / 1000kN buff).

1.4.5.3. PLUG DOORS (ENTRY DOORS)

Automatic plug door include locking and opening mechanism is a sophisticated system in which the coach doors shall remain closed whenever the train starts from Railway station. Similarly, these doors remain closed till the train stops at the next station and eliminate chances of passengers detraining from the moving train.

1.4.5.4. SLIDING DOORS (TRANSIT DOORS)

Interior sliding doors serve to separate the boarding area of the carriage from the seating area with advantages of the solution: reliability and comfort of operation. The interior door can be controlled either by a radar signal when the person approaches or by pressing a button on the door. In case of power failure, the doors are freely movable manually or in case of emergency, the door is disconnected from the power supply when emergency button is pressed and is freely movable manually.

1.4.5.5. GANGWAYS

The gangway is the flexible part of the train, allowing the relative movements between the Coaches and offering passengers a secure and comfortable passageway.

1.4.6. WINDOWS

Double-pane insulating glass especially designed for air conditioned coaches with reflective laminated glass on the outside and tempered safety glass on the inside.

1.4.7. INTERIOR EQUIPMENT

1.4.7.1. INTERIOR FITTING

Saloon passenger area in the coach center, 2 plus 2 arrangement for the executive class and 2 plus 3 arrangement for the chair car separated via sliding doors from the entrance area. Seats designed in light weight construction especially for the new coach type. Continuous luggage rack above the seats with halogen reading lamps for each seat. Pantry compartment for storing, preparing and serving of precooked meals with equipment like freezer, heating furnace, soup warmer, water boiler and serving trolley.

1.4.7.2. INTERIOR PANELLING

Side walls and ceilings in the passenger area made of modular glass-fiber reinforced polyester parts. The floor is made of sound absorbing multiplex plates on special noise damping rubber profiles. PVC floor covering provided with carpet in the executive class (passenger area).

1.4.8. LIGHTING

Lighting by means of a centrally arranged LED luminous band. Illumination of entrance area and toilets with LED lamps. LED reading lamps above each seat. Diffused lighting system.

1.4.9. TOILET SYSTEMS

FRP modular toilet module of European and Indian(squatting) style at the coach end. Train-18 contains vacuum assisted bio-toilet system. Fresh water tank (1100 liters) under-slung.

1.4.10. BRAKE

Pneumatic disc brake type, anti skid device, electro-pneumatic control system and regenerative braking.

1.4.11. ELECTRICAL EQUIPMENT**1.4.11.1. EQUIPMENTS IN MOTOR COACH**

Line and Traction Converter (LTC), Brake Chopper Resistor, DC Link Earthing Switch, TM Cable Junction Box, Jumper Couplers (Power Couplers), Power Coupler Junction Box, Inter-Vehicular (IV) couplers, Isolation (pantry) transformer, ECC (Electrical cubical)-It consists MCUS, EBCUS, MCB, Relays & contactor, EWP (End wall panel)- Terminal Blocks & MCBs, TBs, MCBs, MPCB, Reading lights mono block pump controller, Passenger information system (ICD,SDB,speaker,ANM,PECU), CCTV, Saloon & Gangway Lights, Roof Mounted AC Package Unit (RMPU),RMPU control unit, Earth return ground contact (ERCU),Mini Pantry Items, Power supply socket junction box for external 415 V AC, Pump controller, Mono block pump.

1.4.12. AIR CONDITIONING SYSTEM**1.4.12.1. AIR CONDITIONING UNITS**

Two microprocessor-controlled roof-mounted package units. Supply of conditioned air via perforated ceiling in the passenger room. Separate Cab air conditioning unit for driver cabin.

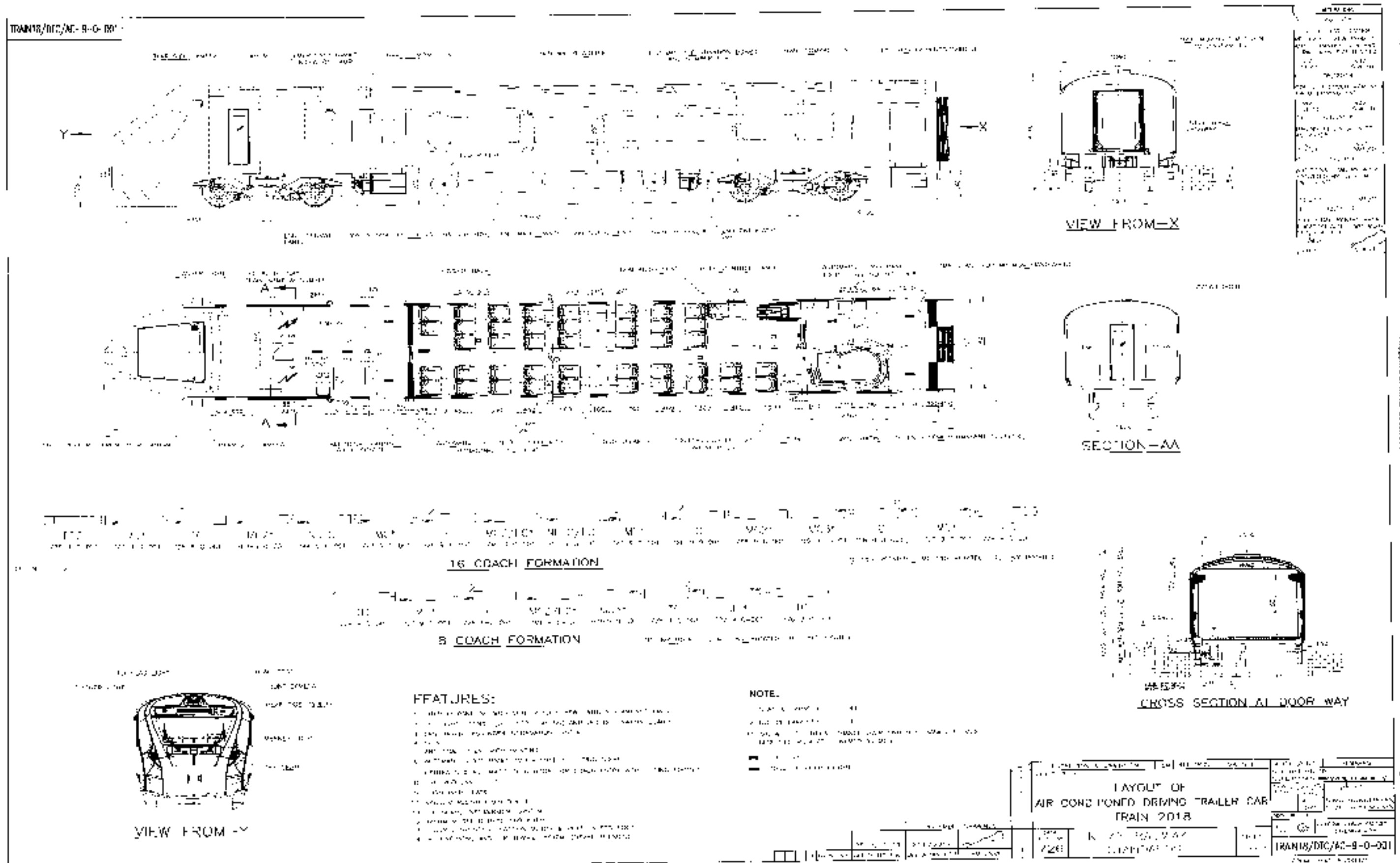
1.4.13. BOGIES

Fully suspended traction motor and bolster less bogie for semi high speed operation. Traction motor and drive gear unit in motor coaches only.

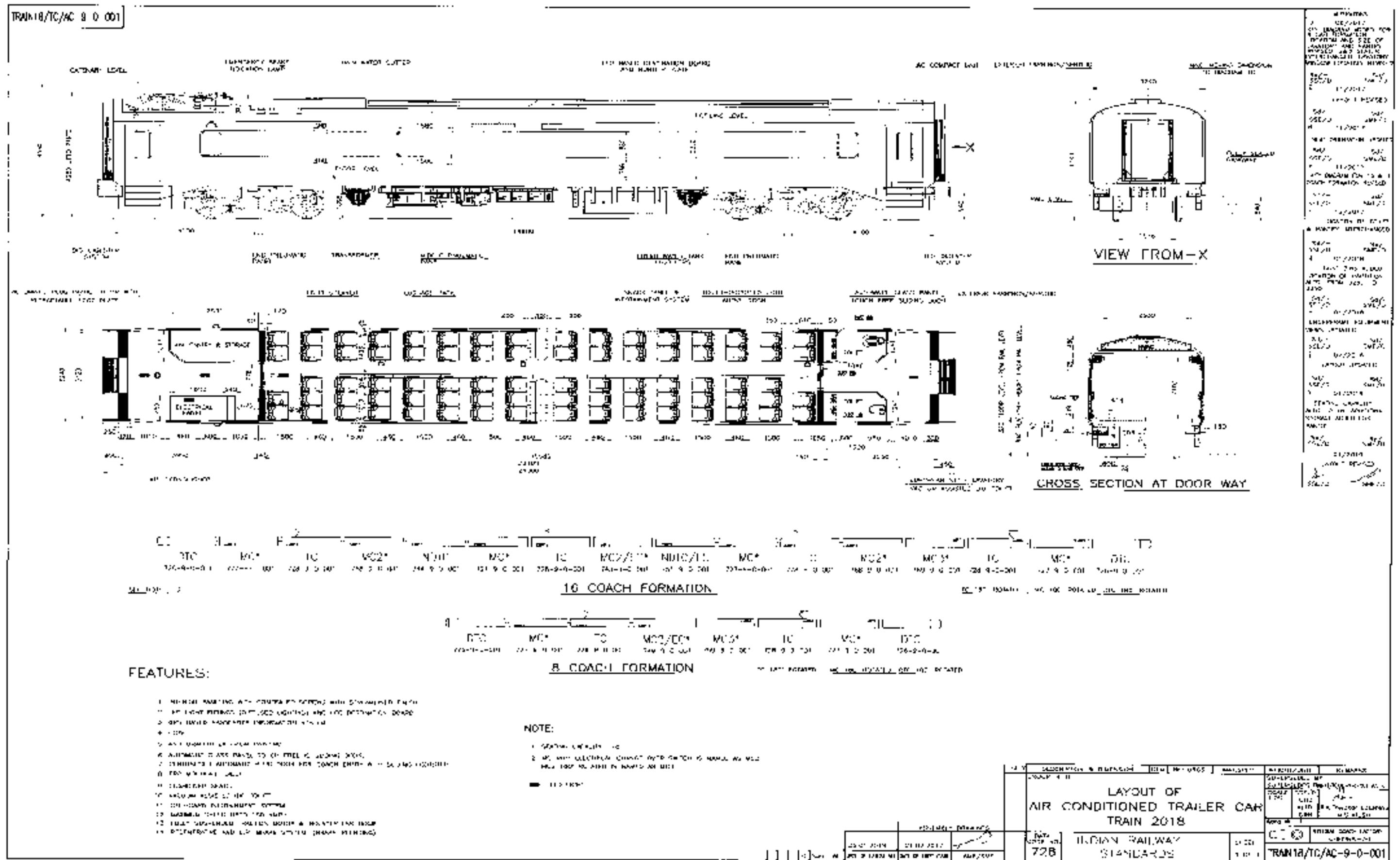
1.5. LAYOUTS

- 1.5.1. LAYOUT OF AIR CONDITIONED DTC
- 1.5.2. LAYOUT OF AIR CONDITIONED TC
- 1.5.3. LAYOUT OF AIR CONDITIONED NDTC
- 1.5.4. LAYOUT OF EXECUTIVE AIR CONDITIONED NDTC
- 1.5.5. LAYOUT OF AIR CONDITIONED MC
- 1.5.6. LAYOUT OF EXECUTIVE AIR CONDITIONED MC

Layout of Air Conditioned DTC

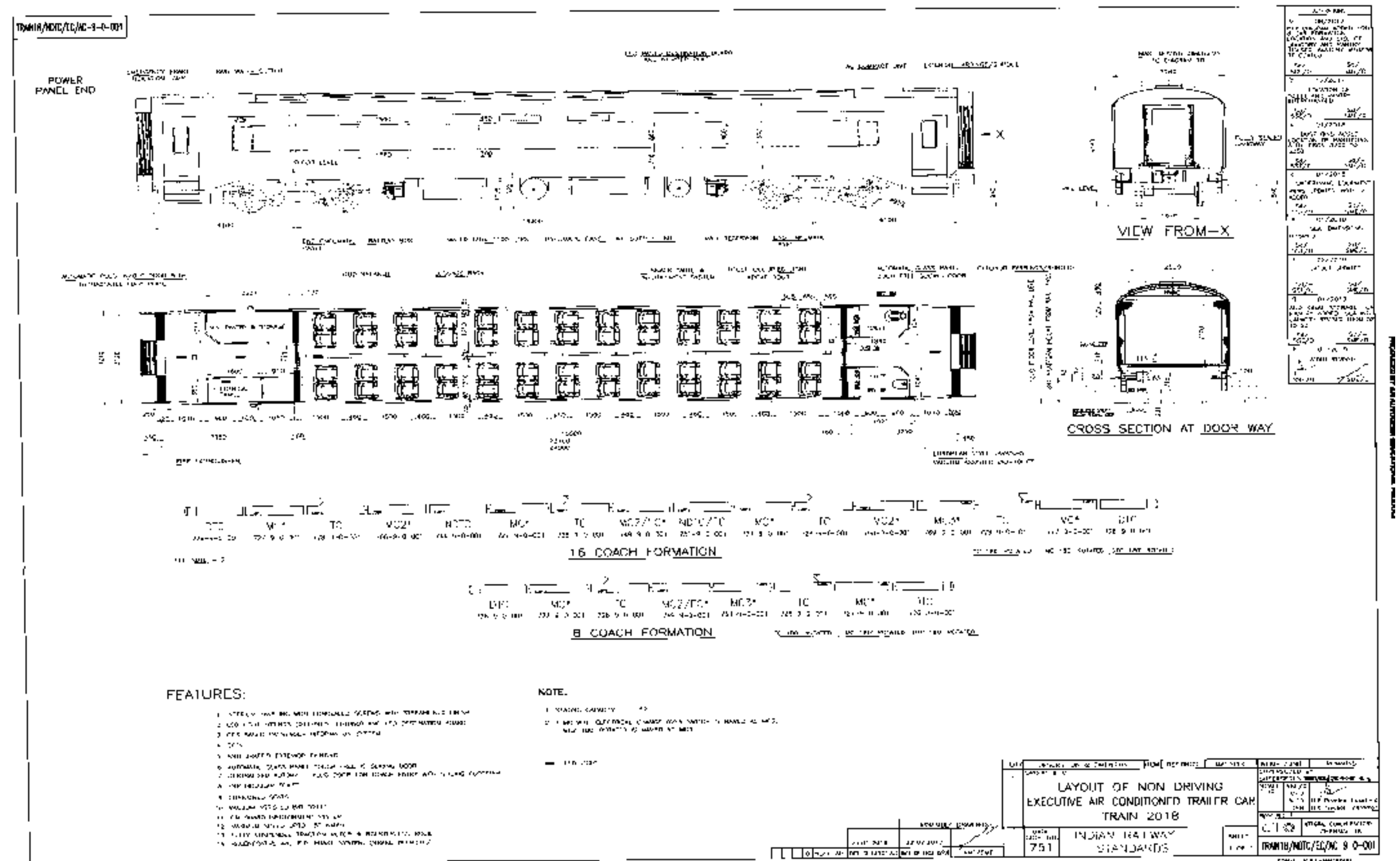


Layout of Air Conditioned TC

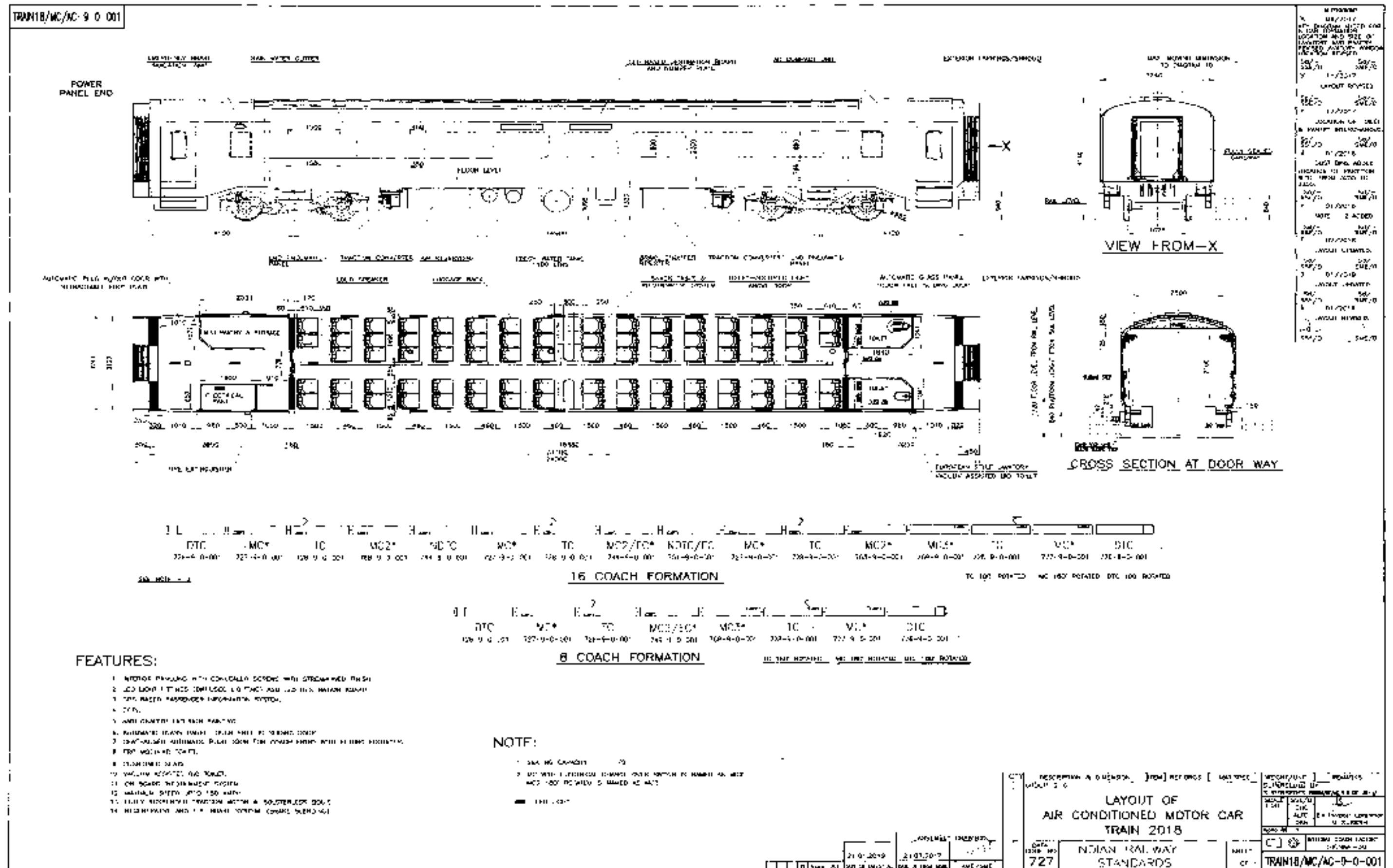


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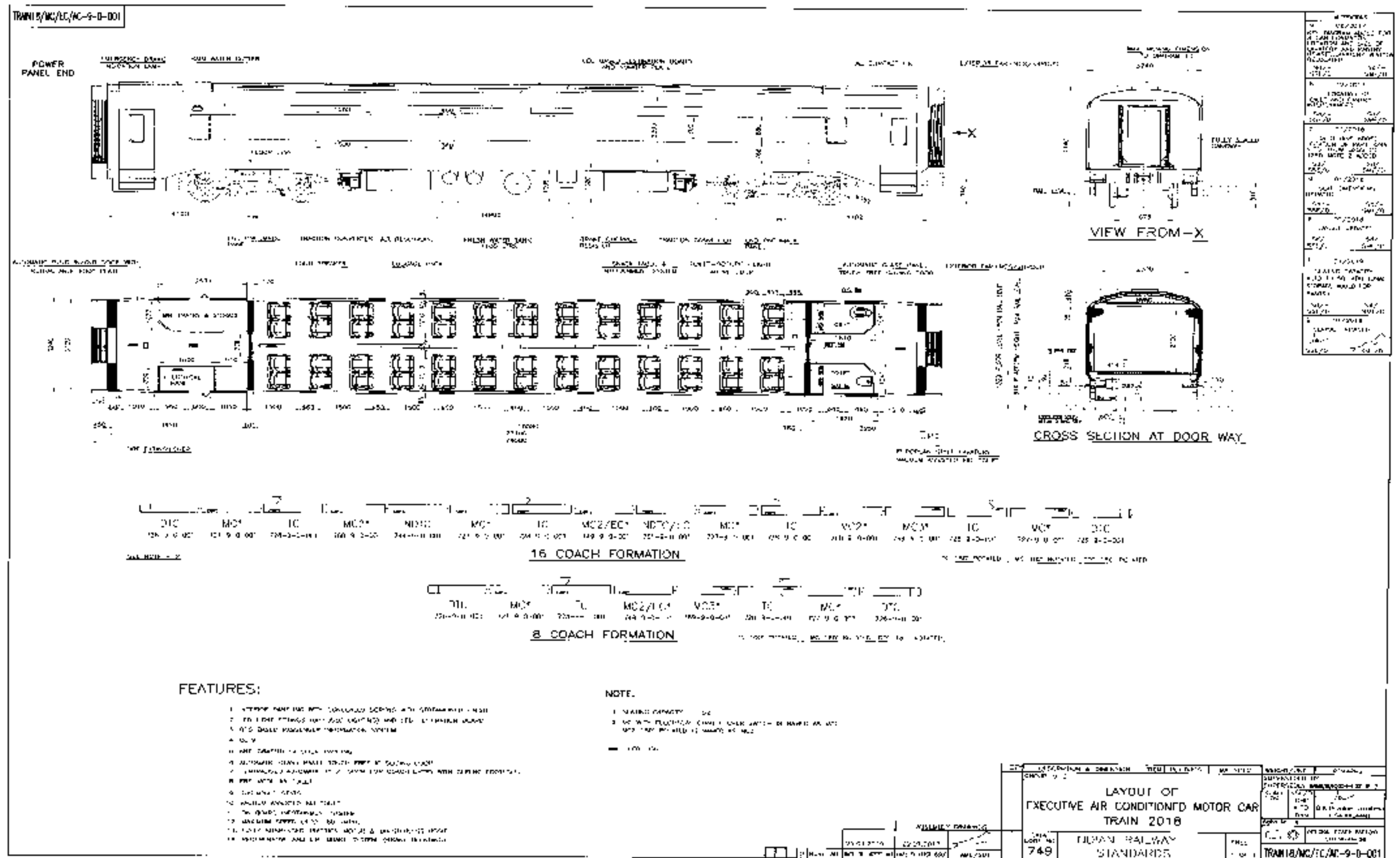
Layout of Executive Air Conditioned NDTC



Layout of Air Conditioned MC



Layout of Executive Air Conditioned MC



2. CLEANING

Version :

1.00



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Content in this document is compiled with the inputs provided by ICF, RDSO and OEMs

Amendment and Revisions

Version	Date	Corrections	Remarks
1.00	31/08/2020	First Release	--

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2.1. INTERNAL CLEANING

2.1.1. GENERAL

It is to be noted that the cleaning instruction to be followed during the internal and external cleaning of Train-18.

2.1.2. DEFINATION

Clean: Re-create clean external and internal conditions

Damp wipe: For “damp wipe”, all work must be undertaken with a damp cloth without the addition of any cleaning agent.

Wash: All following work designated "wash" must be undertaken with a cloth dampened with a non- aggressive cleaning solution.

Wash over and wipe clean: Cleaning glass surfaces with the aid of water, cleaning agent and cleaning implements.

Take up loose dirt from the floor: Use dustpan and brush, broom or similar equipment to sweep up general loose dirt from the floor, collecting larger items manually.

Unusual contaminants: All troublesome soiling, requiring use of special cleaning agents or methods for removal

Emptying: All rubbish, including any wedged-in.

Clean up: Waste-bins, ash-trays and similar equipment, returning them to their places.

2.1.3. INTERIOR CLEANING (NORMAL)

Complete Vehicle

Collect all rubbish, if possible dividing according to type, using plastic sacks in the same operation, rubbish bins and similar containers.

Sweep up dirt on the floor with dustpan and brush, causing as little dust to fly as possible.

Replace seats, rubbish bins and similar containers in their appointed places

Warning:

1. *When cleaning areas which cannot be reached from the floor, steps must be used.*
2. *Never stand on the seats*
3. *Guideline to be followed as per Railway Board's letter, reference no: 2016/EnHM/06/09 Dated 23/08/2018*

2.1.4. INTERIOR CLEANING (INTENSIVE)

Complete Vehicle

Damp wipe luggage racks, handrails and covers with light wiping-cloth.

Marks to be removed from ceilings, walls, doors, visible surfaces of containers, trim-panels, covers, light-fittings.

Dirty marks on mirrors and windows to be sprayed with glass cleaner and wiped with a clean recommended cloth.

Clean the floor. Remove troublesome, loose dirt (e.g. crumbs, sand) from upholstery with either an recommended brush or a vacuum cleaner.

Damp-wipe handrails, door-handles, door-pushes and emergency handles.

Note: *List of chemical used in cleaning of coaches as per Railway Board's letter, reference*

letter : 2016/EnHM/06/09 Dated 23/08/2018.

Warning:

1. *The cleaning staff should take necessary precautions. Personal protective equipment must be used.*
2. *The toilet used in this train is vacuum assisted bio-toilet. Only approved cleaning agent as per Compendium on bio-toilet issued by IRCAMTECH to be used.*
3. *CARE MUST BE TAKEN that no water is allowed to get into the ventilation slits, partitions, at the seats and hand-holds, floor-plates, articulation joints and surrounding areas or in the corridor connection.*

2.1.4.1. FRP PANELS**Cleaning of FRP Surface from (Soil, Oil and Contaminate):**

- Clean soiled, oil and contaminate FRP surfaces with pressure water.
- To remove surface contaminants such as grease, soil and oils use a 5-10% diluted household liquid dishwasher cleaning agent. Wipe contamination with a sponge, soft brush, or cotton pad as necessary or use pressure washers.
- Thoroughly clean contaminated surface with water. Be sure all detergent residues is rinsed from the surface.
- Wipe with cotton cloth to remove water from FRP surface and allow for drying.
- Apply a single wipe of carnauba wax with cotton cloth or buffing machine. Allow for drying 2-3hours at room temperature.
- If required apply Ethanol or Iso-propanol based sanitizer for interior and allow for drying.
- FRP is ready for use.

Removal minor burns or scratches from FRP surface:

- Clean soiled, oil and contaminate FRP surfaces with pressure water.
- To remove surface contaminants such as grease, soil and oils use a 5-10% diluted household liquid dishwasher detergent. Gently scrub with a sponge, soft brush, or cotton pad as necessary or alternatively use pressure washers.
- Thoroughly clean contaminated surface with water. Be sure all detergent residues is rinsed from the surface. Wipe with cotton cloth to remove water from FRP surface and allow for drying.
- Minor burns or scratches can be removed by careful, localized wet sanding to remove the stain and scratches renewing the gel coat finish with polishing.
- Start wet sanding with #240 grit and progressing with finer grits: #320; #600; #800; #1200 and then polish with a polishing compound-1000, 2000 by buffing machine.
- Apply a single wipe of carnauba wax with cotton cloth and rub with dry cotton. Allow for drying 2-3hours at room temperature. Apply Ethanol or Iso-propanol based sanitizer for interior and allow for drying.
- FRP is ready for use.

2.1.4.2. GLASSES**Cleaning of Glass Surface from (Soil, Oil and Contaminate):**

- Clean soiled, oil and contaminate FRP surfaces with pressure water.
- Use pressure washers with low pressure to wet glass surface. To remove surface contaminants such as grease, soil and oils from glass gently wipe with a sponge, soft brush, or cotton pad as necessary and rings with pressure washer.

- Again clean with glass cleaning agent to remove deep grease and contamination. Allow for drying and it is ready for use.

Note: Details should be taken into account from the below mentioned documents.–

1. Railway Board's letter, reference no: 2016/EnHM/06/09 Dated 23/08/2018
2. Details from OEMs manual for equipment/component such as Vacuum bio-toilet, automatic sliding and plug doors, chairs etc.

2.1.4.3. PASSENGER SEATS

Cleaning Upholstery leather

- In the event of a stain, the most important thing is to clean immediately
- The stain must be removed with circular movements from outside towards the center of the stain without rubbing strongly
- Once the operation is done, it is advisable to dry the area on which we have worked with a clean cloth.
- In the case of not disappearing a spot replace the cover

Cleaning Upholstery Moquette

To clean moquette type fabric, simply shake the surface to remove the dust, so that it is pushed to the external surface, where it can be easily removed with a vacuum cleaner or soft brush

I. Brushing the seat covers

- Remove all dust off the upholstery with a vacuum cleaner.
- If no vacuum cleaner is available, press on the seats so that the dust is pushed upwards to the surface, where it can be easily cleaned off with a brush, brushing it in the direction of the fabric at all times

II. Full cleaning of the upholstery

- Remove the assemblies with upholstery that must be cleaned (seats and seat backs).
- Replace the seat covers of these assemblies with clean seat covers.
- Take the seat covers that have been removed to a place where they can be cleaned with dry cleaning or industrial procedures.

III. Cleaning stains on the moquette

- **Method-1:** Apply non-flammable solvent (certified stain remover) with the use of a clean and absorbent cloth, starting on small surfaces and moving outwards, towards the inside of the stain. Dry often with a dry cloth to prevent the formation of rings around the stain.
- **Method-2:** Remove the stain with a sponge impregnated in a detergent solution and lukewarm water. DO NOT DAMPEN TOO MUCH: Rub the surface with a damp cloth and rinse the cloth after each application.

Warning:

1. Do not use ammonia, caustic soda, decolouring agents or other products that could contain these elements.
2. Ventilate or open doors and windows, to make sure that all vapours are driven out of the area.

Alcoholic beverages	Clean with water, following the instructions described in method 2.
Other beverage stains	Use method 1. Try to remove the stain with methyl alcohol if it cannot be removed with this method.
Burns	Scrape off the burnt area with a scraper and treat by following method 2. Larger burns must be treated by a specialist.
Cosmetic products	Use method 1 first and then apply method 2.
Ballpoint pen ink	Treat with methyl alcohol, pressing on the stain often with a dry cloth to make sure that the ink is not spread over the surface. Complete the treatment with method 2.
Marking ink (felt-tip pens)	Remove with methyl ketone and apply method 2.
Stains: Oil, Grease, Paint	Remove the excess material with a scraper or spoon. Next, treat with method 2.
Urine	Use method 2.
Vomit	Use method 2.
Lipstick, Glitter, Oil and Shoe Polish	Apply a small quantity of commercial stain remover with a cloth and immediately press on the stain with blotting paper. Repeat this process, making sure that only the clean surface of the blotting paper is used, until there is no dirt or signs of the stain on its surface.
Candy, Ice cream, Fruit, Liquor, Wine and soft drinks	Use clean lukewarm water and a clean cloth to soften the stain. Scrape the stain with a blunt scraper. If the stain remains, rub with a cloth or sponge dampened in lukewarm cleaning foam. Remove the foam with a damp cloth. When the stain is dry, use a sponge dampened with cleaning solvent to clean the stain and dry with a dry and clean cloth.
Blood	Rub the stain with a clean cloth, dampened with cold water. If the stain cannot be removed, repeat the process using homemade ammonia and rub with a dry clean cloth. Do not use hot water or soap on the bloodstain, since this would make the stain further penetrate into the fabric.
Ink	Different types of ink have different compositions, so that it is impossible to find a stain remover that works on all

	types of ink stains. Different methods should be tried in most cases. Rub the stain with alcohol and acetone. Next, rub glycerine with alcohol on the stain and rinse with solvent. If the stain cannot be removed, let it dry and dampen with water, rubbing a synthetic detergent on the stain to help soften it. Use lukewarm soap with 4 large spoonful of ammonia per litre of water and leave to dry.
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Cleaning the paint coated metallic parts

This section is applicable to the cleaning of the chassis, frames, arm supports, fixing elements and legs.

- Use a cloth dampened with Isopropyl alcohol to clean these parts.
- Next, rinse these parts with a cloth dampened with water and dry with a dry cloth.

Cleaning of covers

In covers, when stains of grease or dirt are observed, in general they can be cleaned with Isopropyl Alcohol.

Repair of lateral covers

- Locate the damaged area.
- - Lightly sand the damaged point.
- - Remove the dust, and clean with a vacuum cleaner.
- - Apply the filling with a spatula.
- - Allow the filling to dry following the commercial instructions of the product.
- - Once the padded surface is dry, sand the excess so that it is smooth.
- - Repeat the filling operation if there are still empty areas on the surface.
- - Repaint the area covered with a paint gun.
- - Allow the paint to dry at a temperature of 94°F - 97°F for 8 hours.
- - To repair larger cracks or scratches, a filler that is more difficult to manipulate must be used, so an expert should do it.

2.2. EXTERNAL CLEANING

Exterior cleaning to be done as per below mentioned documents

1. Railway Board's letter, reference no: 2016/EnHM/06/09 Dated 23/08/2018

Caution: The exterior of the coach is painted with anti-graffiti paint. Necessary precautions to be observed.

3. MAINTENANCE SCHEDULE

Version :

1.00



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The schedule activities have been prepared with input from ICF, RDSO, NR and OEMs. Activities may be updated as per experienced gained by field units and other related agencies.

Amendment and Revisions

Version	Date	Corrections	Remarks
1.00	31/08/2020	First Release	--

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3.1. ASSUMPTION FOR TRAIN-18

Kilometres per day: 1500 km

3.2. MAINTENANCE INTERVAL

Schedule	Periodicity
Daily	Every Day
Trip	Every 3 Days or 5000 kms (Whichever is earlier)
Monthly	30 Days \pm 2 Days
Quarterly	90 Days \pm 3 Days
Nine Monthly	270 Days \pm 3 Days
Shop Schedule-1 (SS-1)	18 Months \pm 5 Days
Shop Schedule-2 (SS-2)	36 Months \pm 5 Days
Shop Schedule-3 (SS-3)	72 Months \pm 5 Days

The interval to be observed is always the first reached by the vehicle.

Tolerance must not be allowed to exceed.

Annexure G to J to be referred for the Functional Tests under different maintenance schedules.

3.3. FREQUENCIES – PERIODIC WORK

3.3.1. SCHEDULE ACTIVITIES FOR MECHANICAL EQUIPMENT

S.No	Equipment / Sub-Assy.	Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
1	Bogie									
1.1	Bogie Frame(DTC,NDTC,MC,TC)									
		1 Visually inspect the bogie frame and their components for crack, loose, missing and leakage etc. and check whether all equipment is secure.	✓	✓	✓	✓	✓	✓	✓	✓
		2 Perform careful visual check on longitudinal beams, cross beams for cracks, damages and corrosion.		✓	✓	✓	✓	✓	✓	✓
		3 Perform careful visual check on brake supports, damper supports, traction center supports and stabilizer assembly supports for cracks, damages and corrosion.		✓	✓	✓	✓	✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		4	Carefully check bogie brackets visually for cracks, damages and corrosion.		✓	✓	✓	✓	✓	✓	✓
		5	Carefully check safety cables visually for damages, cracks and corrosion.		✓	✓	✓	✓	✓	✓	✓
		6	Clean the bogie frame thoroughly with high Pressure Air Jet in washing line. Remove dust, mud & oil deposit in all parts, on the bogie frame by wet wiping.			✓	✓	✓			
		7	Thoroughly check bogie parts for loose, missing and leakage of oil.			✓	✓	✓	✓	✓	✓
		8	Visually inspect the all bogie frame components (longitudinal beams, cross beams etc.) for crack, corrosion / damages/dent, especially at critical locations.				✓	✓	✓	✓	✓
		9	Clean the bogie frame thoroughly with high Pressure Air/water Jet & Remove dust, mud & oil deposit in all parts, on the bogie frame.						✓	✓	✓
		10	Thoroughly check all weld joint of bogie frame.						✓	✓	✓
		11	Clearance of center pivot bottom from traction center base plate to be ensured.						✓	✓	✓
		12	Condition of stabilizer bearing to be checked. A thin layer of oil should be applied to prevent corrosion (self-lubricated bearing).						✓	✓	✓
1.2	Axle Box CTRB(DTC,NDTC,MC,TC)										

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		1	Visual Inspection for general condition	✓	✓	✓	✓	✓	✓	✓	✓
		2	Check the bearing for any sign of over heating or detection of hot bearing.		✓	✓	✓	✓	✓	✓	✓
		3	Check bearings for grease leakage or any abnormal sound		✓	✓	✓	✓	✓	✓	✓
		4	Rotate the bearing assembly to detect any abnormal condition. Check the bearing mounted end play. If end play is beyond permissible limit or if any roughness is detected while rotating the bearing, dismount the bearing and send for reconditioning.						✓	✓	✓
		5	Replacement of CTRB as per mileage earned by train set and as recommended by OEM						✓	✓	✓
		6	Mounting of axle speed sensor, condition of phonic wheel and gap between sensor and Gap between sensor and phonic wheel to be ensured.						✓	✓	✓
		7	NOTE: 1. Bearing reconditioning is to be carried out whenever bearing is removed from axle due to wheel-shelling / bearing failure or other reasons. 2. If the wheel sets are sent for re-profiling without dismounting bearings, lubricate the lathe centers with heavy grease and cover the bearings during re-profiling. 3. For reconditioning of bearings, please refer to OEM's instructions.						✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
1.3	Primary Springs(DTC,NDTC,MC,TC)										
		1	Visual Inspection for general condition	✓	✓	✓	✓	✓	✓	✓	✓
		2	Visually check springs for cracks, damages, corrosion or foreign objects presence		✓	✓	✓	✓			
		3	Check primary spring pads for cracks, damages and ageing.		✓	✓	✓	✓			
		4	The split pin installed in pin for primary suspension may be checked for any visible damage and may be replaced if required..		✓	✓	✓	✓			
		5	Clean the primary springs thoroughly with suitable detergent water jet in disassembled condition.						✓	✓	✓
		6	Inspect for cracks/damages and in case found any, the primary spring may be replaced.						✓	✓	✓
		7	Clean the contact line on the end coils of primary springs and repaint the paint damaged areas duly following the proper paint procedure.						✓	✓	✓
		8	Any damage to coating (paint) in locations other than the contact line may also be repaired. In case the paint damage is extensive, the spring may be taken for complete overhauling.						✓	✓	✓
		9	Check spring pad plates and pins of the primary suspension for corrosion, crack and damage. Remove signs of corrosion and repaint wherever required						✓	✓	✓
		10	Replace spring pad and other rubber parts of primary suspension.						✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		11	Install the springs properly duly ensuring proper spring orientation as per relevant spring orientation instruction.						✓	✓	✓
1.4	Air Spring Systems(DTC,NDTC,MC,TC)										
		1	Visual Inspection for general condition	✓	✓	✓	✓	✓	✓	✓	✓
		2	Visually check the air spring rubber bellow in inflated condition for any external damage, cracks, air leakage ,bulging and infringement of any fittings		✓	✓	✓	✓	✓	✓	✓
		3	Deflate the suspension, if any signs of damage are visible and if required carefully probe the damage/crack with a blunt edged instrument.			✓	✓	✓	✓	✓	✓
		4	Visually inspect the outer layer; if only the outer layer is marked and the textile reinforcement is not visible then the airbag is serviceable.			✓	✓	✓			
		5	Visually inspect the textile reinforcement , if the textile reinforcement is seen or felt, replace the air spring.			✓	✓	✓	✓	✓	✓
		6	Check the air spring for oil or organic solvent adhered on the surface of rubber. If found, wipe it off with clean cloth immediately.			✓	✓	✓			
		7	Checking of installation lever with inflated air spring for normal function.			✓	✓	✓			
		8	Thorough checking of square platform provided on bogie frame for any crack and deformation.					✓			

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		9	Tightening of air spring bottom plate bolts and nuts.					✓			
		10	Measure and ensure the bump stops clearances in primary & secondary stage.					✓			
		11	Air suspension pipe leakage check by using soap water.						✓	✓	✓
		12	Thorough visual check of air spring after dismantling from bogie.						✓	✓	✓
		13	Clean the Exhaust port of air spring systems.						✓	✓	✓
		14	Leakage test of air springs should be done by pressure drop test : the drop should not be more than 1% of test pressure (6 kgf/cm ²) in 15 minutes.						✓	✓	✓
		15	Inspect air spring seating area and spigot ID on body bolster. Remove corrosion if any and apply a thin layer of grease (IOC-Servogem.RR3 or BPC Make RR grade-3 or BL-BALMERA multi grease LL3)						✓	✓	✓
		16	Remove all valves and carry out external cleaning, overhauling and function test.						✓	✓	✓
		17	Cleaning of air filter provided in pneumatic pipe line for air spring assembly system.						✓	✓	✓
		18	Checking securing arrangement of pneumatic pipeline.						✓	✓	✓
		19	Tightening of installation lever nuts.						✓	✓	✓
		20	Installation lever						✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
			adjustment.								
		21	Measurement of bogie clearances related to air spring. (after assembly)						✓	✓	✓
		22	Checking of spring height & maintained as per requirement.						✓	✓	✓
1.5	Wheels and Axles(DTC,NDTC,MC,TC)										
		1	Visual Inspection for general condition	✓	✓	✓	✓	✓	✓	✓	✓
		2	Perform a visual check on wheels for cracks, damages and defects.		✓	✓	✓	✓	✓	✓	✓
		3	Check by wheel profile gauge, the wheel flange thickness and profile.		✓	✓	✓	✓	✓	✓	✓
		4	Visually inspect the axle for cracks and signs of corrosion, if any.		✓	✓	✓	✓	✓	✓	✓
		5	Check treads diameter and wear of wheel profile. If necessary, perform re-profiling.			✓	✓	✓	✓	✓	✓
		6	Perform wheel profiling and wheel balancing (for Speed \geq 130 Kmph). Refer to RCF Specification no. MDTs – 168 for balancing procedure.						✓	✓	✓
		7	Perform a general overhaul of the axle, remove signs of corrosion, renew corrosion protection and re-paint the axle.						✓	✓	✓
		8	Check wear of wheels, if necessary, replace them.						✓	✓	✓
		9	Perform an ultrasonic test on the axle to verify absence of internal cracks and damages.						✓	✓	✓
		10	Wheel profiles of all wheels to be recorded.						✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		11	Wheel condition to be checked for spalling, thermal cracks, rolling contact fatigue etc.						✓	✓	✓
		12	Ensure that no debris is lodged between traction motor and powered axle.						✓	✓	✓
		13	Marking on wheel set to be checked for any sign of movement between wheel and axle, for evidence of wheel overheating or derailment damage.						✓	✓	✓
		14	Maintenance of wheel and Axle to be done as per Annexure-A.	✓	✓	✓	✓	✓	✓	✓	✓
1.6	Primary vertical /Secondary vertical and Lateral /Yaw dampers(DTC,NDTC,MC,TC)										
		1	Visual Inspection for general condition	✓	✓	✓	✓	✓	✓	✓	✓
		2	Perform a visual check on dampers for damage, cracks and oil leakage.		✓	✓	✓	✓	✓	✓	✓
		3	Perform a visual check on all fixings for loosening and/or missing components		✓	✓	✓	✓	✓	✓	✓
		4	Perform a visual check on rubber elements for cracks and ageing.		✓	✓	✓	✓	✓	✓	✓
		5	Damper should be tested during SS-I (or early in case of oil leakages) as per parameters given in respective drawings/ specification of particular type of damper.						✓	✓	✓
		6	Examine the bogie frame for corrosion at damper bracket and surrounding area.						✓	✓	✓
		7	Check dampers for correct functionality, absence of						✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
			deformations and oil leakages.								
		8	During installation, ensure proper orientation of dampers.						✓	✓	✓
		9	Replace fixings/fasteners, if necessary.						✓	✓	✓
		10	Note: 1. Damper fitting misalignment & pre angular twist in end fasteners due to level difference should not be there and proper torque to be ensured during the fitment of dampers. 2. Dampers to be cleaned properly before testing and fitment.						✓	✓	✓
1.7	Stabilizer assembly(DTC,NDTC,MC,TC)										
		1	Visual Inspection for general condition	✓	✓	✓	✓	✓	✓	✓	✓
		2	Perform a visual check on torsion bar, stabilizer links and brackets for cracks, damages and corrosion		✓	✓	✓	✓	✓	✓	✓
		3	Perform a visual check on rubber joints for cracks, damage and ageing		✓	✓	✓	✓	✓	✓	✓
		4	Visually inspect for grease oozing out of stabilizer assembly bearings, which may result in bearing failure.		✓	✓	✓	✓	✓	✓	✓
		5	Perform visual check on all fixings for loose/missing fittings		✓	✓	✓	✓	✓	✓	✓
		6	Stabilizer Bearing to be checked			✓	✓	✓	✓	✓	✓
		7	Length to be checked and adjusted as per drawing.			✓	✓	✓	✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		8	Check the sub assembly clamp which is mounted at both ends and tightened at specified amount of torque. If found loose should be tightened correctly.				✓	✓	✓	✓	✓
		9	Visually inspect the stabilizer assembly for rusting on metallic parts. Clean foreign articles/dust and apply suitable rust preventive oil.					✓	✓	✓	✓
		10	Check the rubber surfaces for any damage, foreign article hitting or contact during service or application. If yes, please ensure no external object/article getting contact to rubber surface, in case major damages observed on rubber may need to replace.					✓	✓	✓	✓
		11	Check the ball joint of stabilizer assembly (rubber to metal bonded) which is assembled at both ends. If any damage in Ball joint to be replaced.					✓	✓	✓	✓
		12	The stabilizer link is assembled at 600mm, if required it can be adjusted from 590 to 640mm by opening both ends. To adjust the length, loosen the clamp assembly, one side of end is having LH thread and another side is bearing RH thread. After adjustment to desired length clamp assembly shall be tightened to specified torque with positioning					✓	✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
			mark.								
		13	Clean the grease nipples.						✓	✓	✓
		14	Remove the end covers, clean the bearings and re-grease (BECHEM high -LUB SW2 of M/s Carl BECHEM Lubricants or SYNTHOX (HS-NS) Non staining high speed synthetic grease of M/s STANVAC chemicals (India) Ltd. (Same grease of FIAT bogies)						✓	✓	✓
1.8	Traction rod and traction Centre (DTC,NDTC,MC,TC)										
		1	Visual Inspection for general condition	✓	✓	✓	✓	✓	✓	✓	✓
		2	Perform a visual check on the traction center housing and bars for cracks, damages and corrosion.		✓	✓	✓	✓	✓	✓	✓
		3	The assembly should be free to move, and not blocked by any foreign objects.		✓	✓	✓	✓	✓	✓	✓
		4	Perform a visual check on all fixings for loosening and the ball joints.		✓	✓	✓	✓	✓	✓	✓
		5	Perform a visual check on rubber joints for cracks/damages.		✓	✓	✓	✓	✓	✓	✓
		6	Visually inspect the lateral damper as per specification		✓	✓	✓	✓	✓	✓	✓
		7	Visually inspect the lateral bump stop for loosening, missing and damages etc.		✓	✓	✓	✓	✓	✓	✓
		8	Check the rust on metallic parts and clean foreign articles/dust and apply suitable rust preventive oil.					✓	✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		9	Check any damage on rubber surfaces foreign article hitting or contact during service or application. If yes, please ensure no external object/article getting contact to rubber surface, in case major damages observed on rubber may need to replace.					✓	✓	✓	✓
		10	Check the lateral bump stop bolt and should be tightened correctly.					✓	✓	✓	✓
1.9	Control Arm and other components on primary suspension(DTC,NDTC,MC,TC)										
		1	Visual Inspection for general condition	✓	✓	✓	✓	✓	✓	✓	✓
		2	Visually check control arm parts for damages, cracks or corrosion marks.		✓	✓	✓	✓	✓	✓	✓
		3	Perform a visual check on all fixings for loosening and / or missing components		✓	✓	✓	✓	✓	✓	✓
		4	Inspect the rubber joint for cracks, damages and ageing		✓	✓	✓	✓	✓	✓	✓
1.10	All Rubber metal bonded parts on bogie. (DTC,NDTC,MC,TC)										
		1	Visual Inspection for general condition	✓	✓	✓	✓	✓	✓	✓	✓
		2	Perform a visual check for cracks, damages, peeling, bulging, looseness etc.		✓	✓	✓	✓	✓	✓	✓
		3	Elastomer components to be checked after installation (Thereafter 6 months at least)				✓	✓	✓	✓	✓
		4	Clean and wipe dry.						✓	✓	✓
1.11	Center Pivot Bearing (DTC,NDTC,MC,TC)										
		1	Clean foreign particle / dust and apply preventive oil. In case of any damage						✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
			observed on rubber, the same should be replaced immediately								
2	Brakes and Air Supply										
2.1	Main Air Compressor(DTC/NDTC)										
		1	Visual check for loose/damage/missing parts or abnormal sound	✓	✓	✓	✓	✓	✓	✓	✓
		2	Check Main air Compressor running on TCMS.	✓	✓	✓	✓	✓	✓	✓	✓
		3	Vacuum indicator inspection – Check the functionality of indicator plunger (red). The indicator plunger appears entirely and latches once the maximum acceptable negative pressure (OEM recommendation) is reached. The plunger remains fully in view even when the compressors shut down. Replace the filter element of dry type air filter if the indicator plunger appears entirely and latches		✓	✓	✓	✓	✓	✓	✓
		4	Check the functioning of compressor for loading/unloading.		✓	✓	✓	✓	✓	✓	✓
		5	Check for damage; Clean Air inlet filter and electric motor.			✓	✓	✓	✓	✓	✓
		6	Check mounting tightness.			✓	✓	✓	✓	✓	✓
		7	Check the Earthing Cable tightness			✓	✓	✓	✓	✓	✓
		8	Compressor cut-in & cut-out test.				✓	✓	✓	✓	✓
		9	Compressor Set Annual Inspection & Servicing and Function Test:					✓	✓	✓	✓
		10	Vacuum indicator inspection – check for red					✓	✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
			indicator, if the plunger is out, exchange the filter.								
		11	Switch off the compressor set motor, wait until the compressor comes to a standstill. Slight-check the resilient mounting. Exchange the spring wire shock absorbers in case any of the wire strands are fractured. Exchange rubber shock absorbers in case of cracking or embrittlement.					✓	✓	✓	✓
		12	Pneumatic and Air Distribution System(Leakage Test- The test run is needed after the unit has been assembled or installed on board to the vehicle. The unit and its downstream components must be tested for leakage and functionality.					✓	✓	✓	✓
		13	Air pressure build up test may be done for individual compressors (format enclosed at Annexure-B)						✓	✓	✓
2.2	MR & BP pressurized system(DTC,NDTC,MC,TC)										
		1	Visual Inspection for general condition & sound of leakage	✓	✓	✓	✓	✓	✓	✓	✓
		2	MR and BP leakage test to be done(format enclosed at Annexure-C)						✓	✓	✓
2.3	Auxiliary Compressor(TC)										
		1	Visual check for loose/damage/missing parts or abnormal sound	✓	✓	✓	✓	✓	✓	✓	✓
		2	Check the oil level		✓	✓	✓	✓	✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		3	Check for any damage		✓	✓	✓	✓	✓	✓	✓
		4	Clean air inlet filter and electric motor		✓	✓	✓	✓	✓	✓	✓
		5	Check oil inlet filter for any damage		✓	✓	✓	✓	✓	✓	✓
		6	Check for any abnormal sound		✓	✓	✓	✓	✓	✓	✓
		7	Check earthing cable tightness.		✓	✓	✓	✓	✓	✓	✓
		8	Clean the cooling fins using compressed air and cotton cloth.			✓	✓	✓	✓	✓	✓
		9	<i>Functional check:-</i> when Aux Compressor is running pantograph must raise and touch to OHE.				✓	✓	✓	✓	✓
		10	Filter element to be changed. After replacement test the pipe connections for leakage at the maximum acceptable working pressure. Air bubbling is unacceptable.					✓	✓	✓	✓
2.4	Brake System(DTC,NDTC,MC,TC)										
		1	Inspect MR Pressure (8 to 10 bar), BP pressure (5 bar) and BC/AR pressure (8 to 10 bar)from dual pressure gauges in the Cab.	✓	✓	✓	✓	✓	✓	✓	✓
		2	Check the Brake page on TCMS monitor by visual for Brake cylinder pressure on applying and releasing brake : 1. Service brake through Master controller 2. Emergency brake through master controller. 3. Emergency brake through Driver's brake valve.	✓	✓	✓	✓	✓	✓	✓	✓
		3	Parking brake to be tested by pressing apply and	✓	✓	✓	✓	✓	✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
			release command from CRW panel.								
		4	Brake pipe continuity test applying brake through DBV for BP drop in last coach.	✓	✓	✓	✓	✓	✓	✓	✓
		5	Self-test of BECU from TCMS (brake + WSP).	✓	✓	✓	✓	✓	✓	✓	✓
		6	Emergency brake by Assistant. Emergency brake handle.	✓	✓	✓	✓	✓	✓	✓	✓
		7	Check error free state for all coaches either by self-test or by IST software provided by M/s KBIL								
2.5	Brake Control System(DTC,NDTC,MC,TC)										
		1	Visual Inspection for general condition, any sound of leakage	✓	✓	✓	✓	✓	✓	✓	✓
		2	Automatic Load Braking Function Test (Including Suspension Equipment)					✓	✓	✓	✓
		3	Simulated T pressure as empty (train is in tare weight) condition in all car.					✓	✓	✓	✓
		4	Move master controller to full service braking position. Check that the BC pressure increases as per KBIL (OEM) recommendation and the BP pressure gauge is about 5.0 bars.					✓	✓	✓	✓
		5	Move master controller to "COAST" position. Ensure that the BC pressure decreases.					✓	✓	✓	✓
		6	Move master controller to emergency brake "EB" position. Check that the BC pressure increases as per KBIL recommendation and the BP pressure gauge					✓	✓	✓	✓

S.No	Equipment / Sub-Assy.	Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		is about 5.0 bar.								
		7 Move master controller to "COAST" position. Ensure that the BC pressure decreases.					✓	✓	✓	✓
		8 Note : 1. Parking brake application or suitable protection against rolling down to be ensured before any testing. 2. Status update of isolating cocks and wire connectors may be checked in case of no status update.	✓	✓	✓	✓	✓	✓	✓	✓
		9 BC pressure in various brake position like FSB, Holding brake, EB may be recorded (format at Annexure D)						✓	✓	✓
2.6	Air Horn-Tyfon (DTC,NDTC)									
	1	Visual Inspection for general condition	✓	✓	✓	✓	✓	✓	✓	✓
	2	Check functioning of horn	✓	✓	✓	✓	✓	✓	✓	✓
2.7	Under Frame Brake components(DTC,NDTC,MC,TC)									
	1	Visual Inspection for general condition, any sound of leakage.	✓	✓	✓	✓	✓	✓	✓	✓
	2	Check operation of automatic drain (correct drainage) of main reservoir.	✓	✓	✓	✓	✓	✓	✓	✓
	3	Check for noticeable air leakages in compressed air system.	✓	✓	✓	✓	✓	✓	✓	✓
	4	Inter-unit air hose couplings visual check for open/damage.	✓	✓	✓	✓	✓	✓	✓	✓
	5	Hose pipe of caliper visual check open/ damage/ missing.	✓	✓	✓	✓	✓	✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		6	Brake Caliper, disc & pad visual check for loose/damage/missing .	✓	✓	✓	✓	✓	✓	✓	✓
		7	Brake equipment box cover in position.	✓	✓	✓	✓	✓	✓	✓	✓
		8	Renew the worn-out brake pad (thickness < 8 mm) if necessary. Particular attention be paid to differential rate to wear between motor coaches & other type Coaches.		✓	✓	✓	✓	✓	✓	✓
		9	Speed sensor visual checks for any loose/ damage.		✓	✓	✓	✓	✓	✓	✓
2.8	Brake Disc and Caliper assembly(DTC,NDTC,MC,TC)										
		1	Visual Inspection for general condition, any damage/loose or missing part.	✓	✓	✓	✓	✓	✓	✓	✓
		2	Clean the brake discs and pads with compressed air. Push the breather hole plug provided in caliper assembly to remove the internal air.			✓	✓	✓	✓	✓	✓
		3	Check and verify the clearance between each pad and disc surface shall be within permissible limits.(2-4 mm)			✓	✓	✓	✓	✓	✓
		4	Check the wear of brake pads and brake discs. If groove depth is reached, it is necessary to replace the brake discs or pads.			✓	✓	✓	✓	✓	✓
		5	<i>Functional Check :</i> Application/release and slack adjuster functional check.				✓	✓	✓	✓	✓
2.9	Air Dryer Unit (DTC,NDTC)										
		1	Visual Inspection for general condition, any	✓	✓	✓	✓	✓	✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
			damage/loose or missing part.								
		2	<i>Functional Check:</i> The valve magnet must shuttle audibly every two minutes. A blast of air must briefly be discharged from exhaust port at every changeover.			✓	✓	✓	✓	✓	✓
		3	Pressure Dew Point Measurement using dew point meter. The dew point reading must be below the boundary curve of 35% relative humidity at the prevailing ambient temperature.					✓	✓	✓	✓
		4	Do a check of the drainage port on the silencer for obstructions.					✓	✓	✓	✓
		5	Check whether the socket and the screw holding the pressure switch are firm. The machine screw used to assemble the socket should not be over tightened, as the cabling and insulation inside the socket might otherwise be damaged.					✓	✓	✓	✓
		6	Test pressure switch for correct operation with a continuity tester. The tower must be placed under pressure. The pressure switch must operate at 2.7 ± 0.5 bar.					✓	✓	✓	✓
2.10	Micromesh Filter(DTC)										
		1	Visual Inspection for general condition	✓	✓	✓	✓	✓	✓	✓	✓
		2	Micromesh Filter Venting and Draining through drain plug must be done. Remove the oil precipitate			✓	✓	✓	✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
			from the unit.								
		3	Filter element to be changed. After replacement test the pipe connections for leakage at the maximum acceptable working pressure. Air bubbling is unacceptable.					✓	✓	✓	✓
2.11	Air Reservoirs(DTC,NDTC,MC,TC)										
	1	1	Visual Inspection for general condition, any sound of leakage	✓	✓	✓	✓	✓	✓	✓	✓
		2	Visual check and Drain condensate water through drain valve/cock, if any.			✓	✓	✓	✓	✓	✓
2.12	B01Panel(DTC,NDTC,MC,TC)										
		1	Fault checking only if appears in TCMS event log.			✓	✓	✓	✓	✓	✓
		2	<i>Functional test:</i> 1. For BO1 panel, check application/release of parking brake through push button. 2. Speed sensor check through TCMS if the failure is set because of the speed sensor 3. Fault checking only if appears in TCMS event log.				✓	✓	✓	✓	✓
		3	Filter element to be changed. After replacement test the pipe connections for leakage at the maximum acceptable working pressure. Air bubbling is unacceptable.					✓	✓	✓	✓
2.13	Ballcock with or without switch module or exhaust (DTC,NDTC,MC,TC)										
		1	Visual Inspection for general condition, any sound of leakage	✓	✓	✓	✓	✓	✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		2	Fault checking only if appears in TCMS event log.			✓	✓	✓	✓	✓	✓
		3	<i>Function test:</i> 1. Turn the ball cock handle to closed/open position. Make sure that the cock handle is easy to turn without jerking and the venting noise can be heard (Ballcock with exhaust). 2. Magnet valve Coil movement sound on energising and de-energising(Ballcock with switch module). 3. Fault checking based only on TCMS data during train operation (Ballcock with switch module).				✓	✓	✓	✓	✓
2.14	Magnet Valve(DTC,NDTC)										
		1	Observe for noticeable air leakages (sound).	✓	✓	✓	✓	✓	✓	✓	✓
		2	Fault checking only if appears in TCMS event log.			✓	✓	✓	✓	✓	✓
		3	<i>Function test:</i> 1. Turn the cock handle to closed/open position. Make sure that the cock handle is easy to turn without jerking and the venting noise can be heard 2. Magnet valve Coil movement sound on energising and de-energising. 3. Fault checking based only on TCMS data during train operation.				✓	✓	✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
2.15	Axle Speed Sensor(DTC,NDTC,MC,TC)										
		1	Visual check for looseness or any damage.	✓	✓	✓	✓	✓	✓	✓	✓
		2	Fault checking only if appears in TCMS event log.			✓	✓	✓	✓	✓	✓
		3	Speed sensor check through TCMS if the failure is set because of the speed sensor.				✓	✓	✓	✓	✓
		4	Mounting of axle speed sensor, condition of phonic wheel and gap between sensor and phonic wheel to be ensured						✓	✓	✓
2.16	Pressure Sensor(DTC,NDTC,MC,TC)										
		1	Fault checking only if appears in TCMS event log.			✓	✓	✓	✓	✓	✓
2.17	Pressure Governors(DTC,NDTC,TC)										
		1	Fault checking only if appears in TCMS event log.			✓	✓	✓	✓	✓	✓
		2	Check for pressure governor connections for any leakages					✓	✓	✓	✓
2.18	Check and Drain valve-All(DTC,NDTC,MC,TC)										
		1	Observe for noticeable air leakages (sound).	✓	✓	✓	✓	✓	✓	✓	✓
2.19	Brake Control Unit (DTC,MC,TC)										
		1	Self-test of BECU from TCMS (brake + WSP).	✓	✓	✓	✓	✓	✓	✓	✓
		2	Function check (Fault checking based only on TCMS data during train operation).			✓	✓	✓	✓	✓	✓
2.20	Safety Valves(DTC,TC)										
		1	Observe for noticeable air leakages(sound).	✓	✓	✓	✓	✓	✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		2	<i>Function test:</i> Safety valves to operate as per their desired setting (opening/Closing pressure, leakage, freedom of movement etc.) by overriding the compressor or cutting out CMS. Any dirt deposits lodged in the valve seat.					✓	✓	✓	✓
2.21	Drain Valves, Hose Couplings, Duplex Check Valve, MeanPress. Valve, Hose Pipes, Hose Connections (DTC,NDTC,MC,TC)										
		1	Observe for noticeable air leakages(sound).	✓	✓	✓	✓	✓	✓	✓	✓
2.22	Driver Desk Control, Driver Brake Valve(DTC)										
		1	Observe for noticeable air leakages(sound).	✓	✓	✓	✓	✓	✓	✓	✓
		2	<i>Function test:</i> Driver desk control (DBV) check by application and release of brake.					✓	✓	✓	✓
2.23	Dual Gauges (MR/BP), Dual gauge (BC/BR), BP Gauge(DTC)										
		1	Observe for noticeable air leakages(sound).	✓	✓	✓	✓	✓	✓	✓	✓
		2	<i>Function test:</i> Air pressure Gauges: Test the compressed air connection to unions for leakage by applying a liquid leakage testing substance. Air bubbling is unacceptable. Check Gauges for correct reading. If the pressure gauge is thought to be working incorrectly, it must be removed and tested on a separate test bench.					✓	✓	✓	✓
2.24	B02 Panel,BCU-Bogie1&2(DTC,NDTC,MC,TC)										

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		1	Check B02 /BCU panel by application of direct and indirect brake. Also visual check for any abnormality					✓	✓	✓	✓
2.25	Traction Cut-Out Panel										
		1	Traction cut out panel check by indirect braking (DBV) to emergency application.					✓	✓	✓	✓
2.26	LB Panels(DTC,NDTC,MC,TC)										
		1	LB panel check for pressure governor connections and isolation cock.					✓	✓	✓	✓
2.27	Anti-Skid Valve (Dump valve)(DTC,NDTC,MC,TC)										
		1	Observe for noticeable air leakages(sound).				✓	✓	✓	✓	✓
		2	Anti-skid valve by brake self-test through TCMS.					✓	✓	✓	✓
		3	Functioning of axle speed sensor on both channels and anti-skid valves to be checked using pole wheel apparatus and available/OEM software.						✓	✓	✓
2.28	Levelling Valve(DTC,NDTC,MC,TC)										
		1	Observe for noticeable air leakages(sound).				✓	✓	✓	✓	✓
		2	Check air suspension pressures on TCMS.					✓	✓	✓	✓
3	Shell and Under-Frame										
3.1	Underframe/Car-body(DTC,NDTC,MC,TC)										
		1	Visual inspection of coach underframe and its components.	✓	✓	✓	✓	✓	✓	✓	✓
		2	Check visually the following for any damages/defects/deficiencies: Condition of head stock, sole bar and other under frame members.		✓	✓	✓	✓	✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		3	Examine trough floor and other under frame members from underneath for any sign of damage/ cracks/ corrosion. If corrosion has just started and not significant, clean the surface to bare metal and inspect it, if found in order, immediately apply anticorrosive paint at the affected area.					✓	✓	✓	✓
		4	Under slung equipment fixing brackets and fasteners – Check for corrosion/breakage and replace if necessary.						✓	✓	✓
		5	Interior cleaning of lavatories, cleaning of coach floor, cleaning of passenger amenities, windows etc.	✓	✓	✓	✓	✓	✓	✓	✓
		6	Exterior coach cleaning with recommended cleaning solution as per latest RDSO specification no. M&C/PCN/101/2007 for Liquid Cleaning Composition for Exterior of Railway Coaches.	✓	✓	✓	✓	✓	✓	✓	✓
		7	Checking of hand rails, sliding doors, body side, lavatories and vestibule doors for proper functioning.	✓	✓	✓	✓	✓	✓	✓	✓
		8	Amenities fittings should be checked for proper functioning.	✓	✓	✓	✓	✓	✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		9	All missing passenger amenity fittings must be replaced and the rake must be turned out as 'Zero-Missing-Fitting' rake. Check visually the following for any damages/defects/deficiencies: 1. Destination board and brackets. 2. Body side walls 3. End walls 4. Windows, Body side doors, Lavatory doors, inter communication doors (vestibule doors) etc. for their functioning. 5. Fire Extinguishers.		✓	✓	✓	✓	✓	✓	✓
		10	Exterior panels & End panels" should be replaced with Exterior Body side walls and End walls.		✓	✓	✓	✓	✓	✓	✓
		11	External Cleaning Exterior coach cleaning with recommended cleaning solution as per latest RDSO specification no. M&C/PCN/101/2007 For the coaches with vinyl wrap instructions of ICF/ RDSO should be follow. Coach cleaning/washing should be done by Automatic Coach Washing Plant (ACWP).		✓	✓	✓	✓	✓	✓	✓
		12	However, where these plants are not available, external cleaning/washing of coaches can be done in following manner: 1. Place the rake/coaches on the washing pit provided with equipment		✓	✓	✓	✓	✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
			<p>required for washing and cleaning. It should be ensured that the rake/coach is protected with proper board/signal for safety of the staff working on washing/ cleaning job to prevent movement/ disturbance in the activity. Scotch blocks with locking arrangement should protect lines and keys should be kept with Engineer(C&W) till the time rake is under maintenance. In electrified section, C&W supervisor shall in addition, obtain power block from OHE before commencing work.</p> <p>2All VCBs may be grounded before commencing washing and isolation keys may be kept securely</p> <p>3. The cleaning solution should be spread/ rubbed with nylon brush or sponge brushes and then rubbed thoroughly to clean the panels. Extra attention should be given to oily and badly stained surfaces.</p> <p>4. Clean the external surface by high pressure jet where facilities are available.</p>								
		13	All exterior panels including end panels should be hosed with water and brushed with diluted soft soap		✓	✓	✓	✓	✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
			(detergent solution) the strength of the solution may be increased or decreased according to RDSO specification.								
		14	Internal Cleaning 1. Collect the newspaper from magazine bag and waste from dust bin. Sweep the whole coach with broom in sleeper coaches. Clean the floor of AC coaches with vacuum cleaner. 2. Remove dust from floor, berths/seat, magazine nylon wire mesh bag fitted on panels and fan guards with duster. Use of vacuum cleaner is excellent in such areas. 3. Also remove dust/dirt from under the berths, window sill, sliding door, railing corner and all corner & crevices of coach interior with vacuum cleaner if provided. 4. Aluminum frames, strips, and other metal fittings, etc. should be cleaned with recommended cleaning agent. 5. The coach flooring should be rubbed with hard coir brush and PVC flooring should be rubbed with nylon bristles/sponge brush and cleaned with recommended cleaning agent.		✓	✓	✓	✓	✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		15	<p>6. The amenity fittings and toilet fittings such as coat hanger, stools, arm rest, foot rest, towel hanger, etc. should be cleaned with duster. Stains on these items should be removed with recommended detergent solution.</p> <p>7. Spray recommended air freshener in the coach. No employee should be allowed to enter the coach for any purpose/work after complete cleaning.</p> <p>8. Precaution should be taken to prevent nuisance of cockroaches and rodents in AC coaches and pantry car.</p> <p>9. No repair works should generally be left to be carried out after washing and cleaning of the coach.</p>		✓	✓	✓	✓	✓	✓	✓
		16	Pest and rodent control should be done as per extant instructions issued by the Railway Board from time to time.		✓	✓	✓	✓	✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		17	<p>1. The compartment carpet should be cleaned with vacuum cleaner. Every month, the carpet should be cleaned thoroughly by taking it out from compartment and if necessary they should be dry cleaned in every three to four months. Before relaying the carpet, the compartment floor should be thoroughly cleaned.</p> <p>2. Ceiling panels, wall panels, cushion berths, fittings, table top, etc. should be cleaned with duster and stain marks on these should be removed by use of recommended soft detergent.</p> <p>3. Intensive cleaning and disinfection of the coach.</p>			✓					
		18	The carpet should be dry cleaned in every three to four months. Before relaying the carpet, the compartment floor should be thoroughly cleaned.				✓	✓	✓	✓	✓
		19	Perform intensive cleaning and disinfection of coaches.						✓	✓	✓
		20	Examine condition of exterior paint of coaches, if found scratches or minor damages at scattered locations, the paint touch up should be done as per recommendation as it has anti-graffiti paint.						✓	✓	✓
3.2	Roof(DTC,NDTC,MC,TC)										

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		1	Warning : Necessary precaution to be taken for OHE lines while working on roof	✓	✓	✓	✓	✓	✓	✓	✓
		2	Roof of Train 18 Coaches should be checked for corrosion. Special attention should be paid at location where gutter moldings are welded. Corroded roof should be repaired according to the instructions						✓	✓	✓
		3	Cleaning of rain gutter, drain holes and pipes must be ensured. Condition of pipe traveling from roof till exhaust near bogie to be checked.						✓	✓	✓
		4	Care to be taken that HT cables or jumpers should not be damaged on the roof.						✓	✓	✓
4	Interior and Furnishing										
4.1	Gangway(DTC,NDTC,MC,TC)										
		1	Visual inspection for Tears or Holes in bellows fabric.	✓	✓	✓	✓	✓	✓	✓	✓
		2	Visual inspection of Loosening of connection between Bellows and folding Wall.	✓	✓	✓	✓	✓	✓	✓	✓
		3	Intactness of all inter coach gangways to be ensured.	✓	✓	✓	✓	✓	✓	✓	✓
		4	Visual inspection of tears/holes in bellows .Fabric torn out of bellows frames, broken aluminum profiles, sealing of screw on frames worn/ damaged, no gap-free fit of screw-on frames at coach-interfaces, loose			✓	✓	✓	✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
			connection between bellows and folding wall& visual inspection/cleaning of dirt/garbage on bellows floor.								
		5	Visual and functional inspection of sliding ledges worn/damage.			✓	✓	✓	✓	✓	✓
		6	Visual inspection of Linking ceiling damage.			✓	✓	✓	✓	✓	✓
		7	Visual/functional inspection of Firm fit & tears in gap covering.			✓	✓	✓	✓	✓	✓
		8	Visual /functional inspection of dirt and rubbish on the bellows floor area (visual inspection through flipping-up the floor flaps of the bridge plates).					✓	✓	✓	✓
		9	Visual inspection for Tears/Holes in bellows fabric, Fabric torn out of bellows frames, broken aluminum profiles, sealing of screw-on frames worn/damaged, no gap-free fit of screw on frames at coach-interfaces, loose connection between bellows and folding wall & visual/functional inspection of dirt and rubbish on the bellows floor area (visual inspection through flipping-up the floor flaps of the bridge plates). Combination bridge: Visual and functional inspection of sliding ledges (bridge plates). Check for the flexibility of scissors arrangement. If						✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
			found defective, should be repaired/replaced. Linking ceiling: Visual inspection of Linking ceiling damage, if found defective, should be repaired/replaced. Side wall: Visual/functional inspection of Firm fit & tears in gap covering, if not proper, maintain it.								
4.2	Seat Assembly(DTC,NDTC,MC,TC)										
		1	Visual inspection for Tears/Holes in Upholstery & Foam sets.	✓	✓	✓	✓	✓	✓	✓	✓
		2	Cleaning of Sets, Grab Rail (Exec. Class) & Armrest for dust.	✓	✓	✓	✓	✓	✓	✓	✓
		3	Inspect Seats and check for completeness.		✓	✓	✓	✓	✓	✓	✓
		4	Visual inspection for loose screws/ nuts, tearing of covers, height loss of seat & back cushions and stains & dirt in general. Necessary remedial action to be taken.			✓	✓	✓	✓	✓	✓
		5	Note : Take remedial action as per Doc. No. ICF/IndianRailways-771 (Rev.-00) Oct- 2018 of M/s FAINSA.			✓	✓	✓	✓	✓	✓
		6	Cleaning of Upholstery leather and greasing to be done.(Refer Doc. No. ICF/Indian Railways-771 (Rev.-00) Oct- 2018 of M/s FAINSA Manual .)				✓	✓	✓	✓	✓
		7	First degree general revision.(Refer Doc. No. ICF/INDIANRAILWAYS-771 (Rev.-00) Oct-2018of M/s FAINSA.)					✓	✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		8	Upholstery- Check for worn out/ Peeling off/ shabby look/ torn/ stitch break (repair/ clean/ replace as necessary).						✓	✓	✓
		9	Cushion - Check for Permanent set(replace as necessary).						✓	✓	✓
		10	All internal panels are FRP panels and not painted. Repair procedures as per standard practice to be adopted.						✓	✓	✓
		11	Seat assembly should be maintained as per ICF/INDIAN RAILWAYS- 771 (Rev.-00) Oct-2018 of M/s FAINSA.						✓	✓	✓
4.3	Table (Executive Class) (DTC,NDTC,MC,TC)										
		1	Cleaning of Tables.	✓	✓	✓	✓	✓	✓	✓	✓
		2	Checking for loosened hinges and tightening (if any).	✓	✓	✓	✓	✓	✓	✓	✓
		3	Tightening of screws/nuts and cleaning should be done.			✓	✓	✓	✓	✓	✓
4.4	FloorMat/Cover(DTC,NDTC,MC,TC)										
		1	Cleaning of Floor Mat.	✓	✓	✓	✓	✓	✓	✓	✓
		2	Checking for peel off and repair, if any (using suitable adhesives/fasteners).	✓	✓	✓	✓	✓	✓	✓	✓
		3	Check for worn out/shabby look/ torn/ opened joints (repair/ clean/ replace as necessary).						✓	✓	✓
4.5	Window(DTC,NDTC,MC,TC)										
		1	Cleaning to be done.	✓	✓	✓	✓	✓	✓	✓	✓
		2	Intactness of windows to be ensured.	✓	✓	✓	✓	✓	✓	✓	✓
		3	Checking for cracks and breakage (replace immediately, if any)	✓	✓	✓	✓	✓	✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
			found).								
		4	Checking for cracks and breakage, moist, opaque, rubber profiles (replace immediately, if any found).						✓	✓	✓
		5	The windows glasses to be checked for air tightness.						✓	✓	✓
		6	Broken, cracked, defaced or scratched glass should be replaced and the window frame repaired as necessary. The rubber or felt lining between the glass and the FRP panel should be changed every time the glass is removed.						✓	✓	✓
		7	Check the adhesive used for bonding with the car body. If any crack or broken found, change the window						✓	✓	✓
4.6	Roller Blind(DTC,NDTC,MC,TC)										
		1	Cleaning of Roller Blind	✓	✓	✓	✓	✓	✓	✓	✓
		2	Checking for any tear of Blind Roll and Pull String. Repairing or replacing the same.	✓	✓	✓	✓	✓	✓	✓	✓
4.7	Luggage Rack(DTC,NDTC,MC,TC)										
		1	Cleaning of Luggage Rack.	✓	✓	✓	✓	✓	✓	✓	✓
		2	Checking of Fasteners for looseness and tightening (if any looseness found).	✓	✓	✓	✓	✓	✓	✓	✓
4.8	Side & Roof Panels(DTC,NDTC,MC,TC)										
		1	Visual inspection for general condition	✓	✓	✓	✓	✓	✓	✓	✓
		2	Checking side panels for crack, damage, condition of paint & shabby look. Apply putty/re-paint/replace the panels (if necessary).						✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		3	All internal panels are FRP panels and not painted. Repair procedures as per standard practice to be adopted.						✓	✓	✓
4.9	Fire Extinguisher(DTC,NDTC,MC,TC)										
		1	Confirm Fire Extinguisher is visible, unobstructed and at designated location	✓	✓	✓	✓	✓	✓	✓	✓
		2	Verify Locking Pin is intact and pressure gauge is indicator.	✓	✓	✓	✓	✓	✓	✓	✓
		3	Check for expiry date in label (Should not be overdue		✓	✓	✓	✓	✓	✓	✓
		4	Fire Extinguisher to be refilled					✓	✓	✓	✓
		5	Check for proper functioning of Fire Extinguishers. Condition of hose and nozzle. (repair/replace if necessary).						✓	✓	✓
5	Couplers										
5.1	CBC(DTC)										
		1	Visual Inspection for general condition	✓	✓	✓	✓	✓	✓	✓	✓
		2	Check visually for any crack/wear and missing of parts like knuckle, lock & external damage etc.			✓	✓	✓	✓	✓	✓
		3	Check tell tale of tight lock CBC coupler.					✓	✓	✓	✓
		4	Attend the Tight lock CBC as given in RDSO's CMI no. RDSO/2006/CG/CMI - 01					✓	✓	✓	✓
5.2	Semi-Permanent Coupler(DTC,NDTC,MC,TC)										
		1	Visual Inspection for general condition	✓	✓	✓	✓	✓	✓	✓	✓
		2	Check visually for any missing/loose parts like nut, bolt, screw etc.		✓	✓	✓	✓	✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		3	Check visually for any damage/ crack/ wear etc.		✓	✓	✓	✓	✓	✓	✓
		4	Visual check of torque marks on sleeve and wedges bolts. Torqueing to be done if necessary.		✓	✓	✓	✓	✓	✓	✓
		5	Visual inspection of complete coupler as per DELLNER Document No:130175				✓	✓	✓	✓	✓
		6	Lubrication as per para DELLNER Document No: 130175				✓	✓			
		7	Condition of draft gear pad for any crack/wear.					✓	✓	✓	✓
		8	Cleaning as per DELLNER document No. 130175 of preventive maintenance manual.					✓			
		9	Inspection of Elastomer spring package.						✓	✓	✓
		10	Check for sign of deformation, rust or damage.						✓	✓	✓
		11	After uncoupling inspect the guide cone and the guide cone interface with regards to wear, damages on structure and / or paint.						✓	✓	✓
		12	After uncoupling, inspecting socket joint, specially the insides and the socket joint interface on center section with regards to wear, damages on structure and / or paint.						✓	✓	✓
		13	Cleaning 1. Clean coupler thoroughly with water. 2. Dry coupler with clean lint free cloths. 3. Use a low aromatic						✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
			white spirit or equivalent to remove excessive grease from the coupler.								
		14	Lubrication. 1. Perform external greasing with LAGERMEISTER 3000+. Use a brush or similar to apply the grease to visual mounting interfaces on all socket joints.						✓	✓	✓
6	Doors										
6.1	Internal Sliding Door(DTC,NDTC,MC,TC)										
		1	Check the Entrance door glass for cracked, fixing with frame	✓	✓	✓	✓	✓	✓	✓	✓
		2	Check door leaf for any damage, crack.	✓	✓	✓	✓	✓	✓	✓	✓
		3	Check step for any damage crack.	✓	✓	✓	✓	✓	✓	✓	✓
		4	Checking the fluent opening & Closing of the door, noise, jerking motion and knocking.	✓	✓	✓	✓	✓	✓	✓	✓
		5	Check functioning of emergency isolation handle.	✓	✓	✓	✓	✓	✓	✓	✓
		6	Cleaning of all doors			✓	✓	✓	✓	✓	✓
		7	Checking fixation of bolts their looseness mechanical damage & corrosion			✓	✓	✓	✓	✓	✓
		8	Checking completeness of the mechanism, screwing up, binding cables, loose connections etc. Visually of internal sliding door			✓	✓	✓	✓	✓	✓
		9	Checking the door protection function-contact bar in the door leaf and over current protection.					✓	✓	✓	✓
		10	Lubricate Travel bearings-ball bushing with ISOFLEX					✓	✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
			18 SPECIAL A								
		11	Checking the drive screw system & replacing the plastic nut.						✓	✓	✓
		12	Check the end position sensors of the door & functionality, properly set switching.						✓	✓	✓
		13	Checking the bottom guides replacing the plastic slider, if necessary.						✓	✓	✓
		14	Checking the rubber sealing replacing, if necessary.						✓	✓	✓
		15	Lubricate the Motion Screw with dry lubricant spray with PTFE particles BERUCOAT AF 438 (BECHEM)						✓	✓	✓
		16	Note : 1. The motion screw is forbidden to lubricate any other than the BERUCOAT AF 438 dry lubricant. 2. The motion screw bearings have a permanent lubricating filling and do not require lubrication.						✓	✓	✓
6.2	Plug Doors(DTC,NDTC,MC,TC)										
		1	Check the Entrance door glass for cracked, fixing with frame	✓	✓	✓	✓	✓	✓	✓	✓
		2	Check door leaf for any damage, crack.	✓	✓	✓	✓	✓	✓	✓	✓
		3	Check step for any damage crack.	✓	✓	✓	✓	✓	✓	✓	✓
		4	Check the functioning of indication lamps.	✓	✓	✓	✓	✓	✓	✓	✓
		5	Check the functioning of emergency button	✓	✓	✓	✓	✓	✓	✓	✓
		6	Safety-Check-Safety-Checklist as per OEM Document-			✓	✓	✓	✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
			DDSTE11071E36								
		7	Check function of locking device of step.				✓	✓	✓	✓	✓
		8	Check painting in accordance OEM document DDSTE11071E01.					✓	✓	✓	✓
		9	Visually check for flats at rollers of roller swing arm, roller on the door leaf carrier, and roller from roller bracket on the bottom door leaf area. Exchange defective component if required.					✓	✓	✓	✓
		10	Clean door seals and re-grease in accordance with Lubrication instruction DDSTE11071E05.					✓	✓	✓	✓
		11	Visual check brush for wear out.					✓	✓	✓	✓
		12	Check visually the anti-slip coating.					✓	✓	✓	✓
		13	Check the bearings and the torsion spring at locking unit and locking bracket.					✓	✓	✓	✓
		14	Check visually the seals at maintenance cover at step, exchange if necessary.					✓	✓	✓	✓
		15	Check tension of toothed belt.					✓	✓	✓	✓
		16	Check corrosion protection for mechanical damage. Correct locally if required.					✓	✓	✓	✓
		17	Visual inspection for cracks in the radius area on the right and left trolley on drive unit and replace if necessary.					✓	✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		18	Clean all surroundings of door seals and foot step seals. All surroundings door seals, the finger protection rubber, the portal rubber and seals of the foot step front cover must be lubricated with – KLUEBER BARRIERTA L 25 DL – free of silicone.						✓	✓	✓
		19	After the finger protection rubber and the portal rubber have been greased, the need to be dried with a clean piece of cloth.						✓	✓	✓
7	Vacuum Bio-Toilet(DTC,NDTC,MC,TC)										
		1	Check the Operation of flush push button.	✓	✓	✓	✓	✓	✓	✓	✓
		2	Check for foul smell and clogging of toilet.	✓	✓	✓	✓	✓	✓	✓	✓
		3	Check the LCD screen for any fault code.	✓	✓	✓	✓	✓	✓	✓	✓
		4	Perform a visual check on WC seat and cover, toilet Bowl for damages and corrosion.		✓	✓	✓	✓	✓	✓	✓
		5	Check the bolts of fixation, toilet seat hinge for their looseness and condition.		✓	✓	✓	✓	✓	✓	✓
		6	Cleaning vacuum toilet.			✓	✓	✓	✓	✓	✓
		7	Cleaning spray nozzle.			✓	✓	✓	✓	✓	✓
		8	Cleaning liquid level guard.			✓	✓	✓	✓	✓	✓
		9	Check for leakage				✓	✓	✓	✓	✓
		10	Changing of Bio-culture if required (Based on test required.)				✓	✓	✓	✓	✓
		11	Cleaning filter pressure regulator					✓	✓	✓	✓
		12	Disinfection vacuum toilet					✓	✓	✓	✓
		13	Decalcification vacuum toilet					✓	✓	✓	✓

S.No	Equipment / Sub-Assy.		Activities	Daily	Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		14	Visual inspection of bio toilet system					✓	✓	✓	✓
		15	Proper & leak free connections in the complete system including air, water pipelines and interface piping up to retention tank.						✓	✓	✓
		16	Proper stench trap and no odor passing through to the toilet room from the bio digester tank.						✓	✓	✓
		17	Functional check of the flush cycle.						✓	✓	✓
		18	Proper functioning of the complete system including clean-ability & maintenance of hygiene.						✓	✓	✓
8	Traction Gearbox(MC)										
		1	Perform maintenance as per OEM and items mentioned in Annexure- E and Annexure - F .		✓	✓	✓	✓	✓	✓	✓

3.3.2. SCHEDULE ACTIVITIES FOR ELECTRICAL EQUIPMENT**DAILY SCHEDULE MAINTENANCE ACTIVITIES**

S.No.	Equipment	Maintenance Activity
1.	General	Carry out detailed checks in regard to any unusual occurrence reported by Crew in the logbook.
		Check all fasteners for under-slung equipment for tightness, check for any loose hanging parts.
2.	Cab Facilities	Read Driver Display Unit for any active fault and note down.
		Check general appearance of all buttons, indicators, switches, toggles.
		Check the functioning of all buttons by pressing lamp test button.
		Check console Light, Cab Light, Fire Extinguisher, Function of Horn etc.
		Check the condition of LP/ALP seat.
		Check the condition of DDU, MMI & CCTV screen.
		Check the functioning of BAL, ISO, Single unit operation, EOL bypass, EBL bypass, UVISO, ADCR bypass selector switches in normal position and EMY off switch in release position.
3.	Wiper	Check wiper blades for damages, torn or missing.
		Fill wash tank with washer fluid.
		Clean windscreen with methylated spirits (denatured alcohol).
		Do function test of wiper washer system in all positions.
4.	TCMS	Do all the self-tests.
5.	Speedometer	Check operation of indicating light of speedometer.
6.	IV Couplers, Jumper cables and receptacles	Check for coupler mounting properly and presence of corrosion.
		Check Jumper cables are not hanging with one end free, secure them if necessary.
		Check power couplers for the intactness.
7.	Isolation Transformer	Ensure that isolation transformer is bolted tightly to the vehicle.
		Check for any external damages.
		Check electrical connections and ground connections for corrosions to resolve and ensure all the connections are tight.
		Check components and cables for any damage.
		Do visual inspection for excessive temperature and arcing (voltage flash over) and resolve it.
8.	Driver Desk	Check operation & function of all switches & push buttons with their indications on Driver Desk and their stencilling.
		Check master controller in each driving cab.
		Check the operations from both the driver's cab and working of cab occupation functionality.
9.	Pantograph	Visually inspect the upper and lower arm and their components for any abnormality.
		Visually inspect carbon strips for break and wear.
		Check physically for any damage & loose fasteners.
		Check the Pantograph raising and lowering function.
10.	ERCU/ Ground	Visually inspect the ground contact for any damages after flow of a

S.No.	Equipment	Maintenance Activity
	Contact	shirt circuit current.
		Check earth cable for proper connection, lug for any looseness and condition of the insulating tape on lug.
11.	HV Potential Transformer	Check insulator surface for any sign of damage, crack or chipping/grazing.
		Check the earth cable for damage and loose connection.
12.	Lightning Arrester	Visually inspect the Insulator surface for any sign of damage, crack/punctures or chipping/grazing.
		Make sure that the line and ground terminals remain tight.
		Visually inspect and check the earth cable for any damage and ensure it is connected properly.
13.	Transformer	Check following visually for any abnormality/ damage:
		<ul style="list-style-type: none"> • Silica gel breather and silica gel condition. • H.T. cable (main bushing) and connection. • Transformer for any oil leakage from any point, coupling, joints etc. • Transformer oil level.
14.	Traction Motor and TM Cable Junction Box	Visual inspection of TM coupling and gear case etc.
		Check mounting bolts for their looseness.
		Ensure that TM Cable Junction Box is bolted tightly to the vehicle and check for any damage.
		Visual inspection of TM JB for all the manufacturing hardware for the doors for any slackness by seeing changes in torque marking.
		Check electrical connections and ground connections for corrosion to resolve and ensure all the connections are tight.
		Check components and cable for damage.
		Do visual inspection for excessive temperature and arcing (voltage flash over) and resolve it.
15.	VCB	Check insulators for crack & flash marks.
		Check for any air leakage in VCB.
		Check the sealing of connectors, flexible pipe, regulator, air tank etc.
		Check contact spring visually.
16.	Head light	Head light by operating.
17.	Flasher light	Flasher light by operating.
18.	Marker Light	Tail lights working by moving mode selector (MS) and TCMS display.
19.	Cab light and Driver console light	Working of cab light by operating cab light switch.
		Working of driver console light by operating driving console light switch.
20.	Saloon & Reading light	Working of compartment/saloon and reading lights.
21.	CCTV	Check operation of all inside and outside cameras on display unit at driver desk.
		Clean outdoor camera dome cover (glass) with microfiber cloth with gentle pressure.
22.	HVAC	Check function of HVAC system.

S.No.	Equipment	Maintenance Activity
	System(RMPU)	Check function of emergency blower by opening VCB after RMPU on command.
23.	CAB Air conditioner	Check function of cab air conditioner.
24.	PECU	Check function of PECU system from minimum two coaches.
25.	Passenger information system (PIS)	Clean & check function head code unit.
		Clean & check in coach display unit.
		Clean & check side destination code unit.
26.	Pantry Equipment	Do cavity cleaning of Hot case and check the complete unit for any damage or wire cut.
		Do cavity cleaning of refrigerating unit and check the complete unit for any damage, wire cut or abnormal sound.
		Do cavity cleaning of water boiler and check the complete unit for any damage or wire cut.
27.	On-board Functional Test	
27.1	For DTC	
		Cab Occupation in Key ON Mode-Cab Selector Switch in Normal Mode.
		Cab Occupation in RDM Mode-Cab Selector Switch in Normal Mode.
		Cab Occupation in Key ON Mode-Cab Selector Switch in High Priority Mode.
		Cab Occupation in RDM Mode-Cab Selector Switch in High Priority Mode.
		Check the Panto Rising & Lowering Observe the symbols on TCMS DDU.
		Check the VCB On & OFF Observe the symbols on TCMS DDU.
		Check Emergency Off Functionality by pressing Emergency Off button on Driver Desk.
		Check the Emergency Off Bypass switch functionality during Emergency Off button is in pressed condition.
		Check the TCMS Network Screen for any abnormalities.
		Check the High Voltage Screen for any abnormalities.
		Check the ACU Screen for any abnormalities or any Earth Faults.
		Check the Signal Bell Functionality from both driver and guard panels.
		Check the Emergency Bell Functionality by pressing SB2 button in driver and guard panel.
		Check Emergency bell by pressing EMY Stop button in passenger saloon area and observe the indication on TCMS DDU and also on SB2 Switch.
		Check the Train BN Battery voltage.
27.2	For all cars	
		Check the 100 % Saloon Lights. Observe the symbols on TCMS DDU.
		Check the 50 % Saloon Lights Observe the symbols on TCMS DDU.
		Check the Lights functionality by operating DLL Control SW & IDDL Control SW in Auto, OFF & ON modes and observe the symbols on

S.No.	Equipment	Maintenance Activity
		DDU.
		Close all the doors and observe the symbol TCMS DDU.
		Give AC on command and observe the symbol TCMS DDU.

OTHER MAINTENANCE SCHEDULE ACTIVITIES

In addition to following perform all activities of daily schedule also.

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity							
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3	
1. Line & Traction Converter (MEDHA)–MC1,2,3											
		1.	Check that the converter unit is bolted tightly to the vehicle.	✓	✓	✓	✓	✓	✓	✓	✓
		2.	Check the converter unit for any damage.	✓	✓	✓	✓	✓	✓	✓	✓
		3.	Check that the air inlet and outlet openings are UN- obstructed.	✓	✓	✓	✓	✓	✓	✓	✓
		4.	Check the healthiness of all the blowers, there should not be any abnormal sound.	✓	✓	✓	✓	✓	✓	✓	✓
		5.	Inspect all the manufacturing hardware of the doors for any slackness by seeing changes in torque marking. Add any missed hardware.	✓	✓	✓	✓	✓	✓	✓	✓
		6.	While doing maintenance if any abnormality/ damage found, it should be addressed.	✓	✓	✓	✓	✓	✓	✓	✓
		7.	Remove inlet and outlet doors and clean the inlet and outlet chambers.		✓	✓	✓	✓	✓	✓	✓
		8.	Clean information and warning labels on doors.		✓	✓	✓	✓	✓	✓	✓
		9.	Check the healthiness (colour) of silica gel, they should be blue, replace silica gel if found pink.		✓	✓	✓	✓	✓	✓	✓
		10.	Clean heat sink fins.		✓	✓	✓	✓	✓	✓	✓
		11.	Open and clean all converter unit doors. Remount properly with all bolts.			✓	✓	✓	✓	✓	✓
		12.	Check all door gaskets for total availability and in good condition. Replace/add any damaged/ missed gasket with new.			✓	✓	✓	✓	✓	✓
		13.	Inspect all the mounting hardware for the mechanical and electrical			✓	✓	✓	✓	✓	✓

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
			components for any slackness by seeing changes in torque markings.							
		14.	Check electrical connections and ground connections for corrosion. Ensure that connections are tight.			✓	✓	✓	✓	✓
		15.	Check components and cables for damage. If found rectify them.			✓	✓	✓	✓	✓
		16.	Inspect for evidence of excessive temperature and arcing (Voltage flash over's) and resolve it.			✓	✓	✓	✓	✓
		17.	Check that all the cable ties are tight and intact.			✓	✓	✓	✓	✓
		18.	Clean the ventilated sections with dry compressed air.					✓	✓	✓
		19.	Replace any jammed hardware by new hardware with anti-seize compound applied by using screw extractor.					✓	✓	✓
		20.	Remove all unventilated section doors and clean the equipment sections and components with vacuum cleaner, brush and lint free cloth.					✓	✓	✓
1.1	HS Module									
		21.	Remove all DCL bus-bar, all power and control cables and detach connectors gently.					✓	✓	✓
		22.	Remove the module by sliding on module sliding bracket.					✓	✓	✓
		23.	Clean the Heat sink fins with ISO-propyl alcohol by using lint free cloth and brush.					✓	✓	✓
		24.	Suck the air through fins by vacuum blower for removing the dirt from fins.					✓	✓	✓
1.2	Blower									
		25.	Remove all power, control connections& mounting screws.					✓	✓	✓
		26.	Remove the blower from duct.					✓	✓	✓
		27.	Clean the Blower with ISO-propyl alcohol by using lint free cloth and brush.					✓	✓	✓
		28.	Suck the air through fins by vacuum blower for removing the dirt from fins.					✓	✓	✓
		29.	Clean all dust and dirt deposits with vacuum cleaner and brush.					✓	✓	✓

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		30.	Check the healthiness of all the blowers, there should not be any abnormal sound.					✓	✓	✓
2. Auxiliary Converter Unit (MEDHA)–TC										
		1.	Check that the converter unit is bolted tightly to the vehicle.	✓	✓	✓	✓	✓	✓	✓
		2.	Check the converter unit for any damage.	✓	✓	✓	✓	✓	✓	✓
		3.	Check that inlet and outlet air openings are un-obstructed	✓	✓	✓	✓	✓	✓	✓
		4.	Air blowing for inlet air filter to be done.	✓	✓	✓	✓	✓	✓	✓
		5.	Change the filter if torn out or damage. After checking secure the filter properly.	✓	✓	✓	✓	✓	✓	✓
		6.	Check the healthiness of all the blowers, there should not be any abnormal sound.	✓	✓	✓	✓	✓	✓	✓
		7.	While doing maintenance if any abnormality/ damage found, it should be rectified.	✓	✓	✓	✓	✓	✓	✓
		8.	Remove inlet air filters and clean the filters with compressed air/vacuum cleaner by separating the fins and wire mesh filter.		✓	✓	✓	✓	✓	✓
		9.	Change the filter if torn out or damage. After checking secure the filter properly.		✓	✓	✓	✓	✓	✓
		10.	Check the inlet air velocity at multiple locations on the air inlet doors & ensure the air flow average values should be ≥ 4 m/s.		✓	✓	✓	✓	✓	✓
		11.	Check the exit air velocity at multiple locations on the air outlet doors & ensure the air flow average values should be ≥ 2.8 m/s.		✓	✓	✓	✓	✓	✓
		12.	Check healthiness (color) of Silica gel, they should be Blue, Replace silica gel if found Pink.		✓	✓	✓	✓	✓	✓
		13.	Check all door sealing gaskets for any cut mark and physical damage, If found replace with new one.		✓	✓	✓	✓	✓	✓
		14.	Clean all doors and information and warning labels.			✓	✓	✓	✓	✓
		15.	Inspect all the mounting hardware (mechanical and electrical components)			✓	✓	✓	✓	✓

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity							
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3	
			for any slackness by seeing changes in torque markings.								
		16.	Check electrical connections and ground connections for corrosion to resolve. Check that connections are tight.			✓	✓	✓	✓	✓	
		17.	Check components and cables for damage. If found address them.			✓	✓	✓	✓	✓	
		18.	Inspect for evidence of excessive temperature and arcing (Voltage flashovers) and resolve it.			✓	✓	✓	✓	✓	
		19.	Check that all the cable ties are tight and intact.			✓	✓	✓	✓	✓	
		20.	Open and clean all converter unit doors. Remount properly with all bolts.			✓	✓	✓	✓	✓	
		21.	Clean the inlet filter with pressurized water, till the filter is free from dirt, dust & other debris.			✓	✓	✓	✓	✓	
		22.	Apply pressurized air on to filter to remove entrapped water particles.			✓	✓	✓	✓	✓	
		23.	Clean the sticky dust accumulated on blower impeller blades with cloth.			✓	✓	✓	✓	✓	
		24.	Check the gland seals, grommets and other cable sealing accessory for any damages. Replace them for any damage found.			✓	✓	✓	✓	✓	
		25.	Check for dust traces present in electronics zone. If found, seal it properly by applying Silicon sealant.			✓	✓	✓	✓	✓	
		26.	Clean all magnetics surface (i.e outer surface, terminals and other accessible dust deposited surfaces) with compressed air and soft brush only.					✓	✓	✓	
		27.	Suck the dust with vacuum cleaner & blow the magnetics with blower.					✓	✓	✓	
2.1	LC & Inverter Modules										
		28.	Check electrical, earth connections and all components for any abnormality/ damage and rectify or replace on need basis.					✓	✓	✓	
		29.	Check mounting of the modules for proper fitment.					✓	✓	✓	
2.2	DC-DC Modules										

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		30.	Check electrical, earth connections and all components for any abnormality/ damage and rectify or replace on need basis.					✓	✓	✓
		31.	Check mounting of the module for proper fitment.					✓	✓	✓
2.3	Heat Sink									
		32.	No preventive maintenance is required.					✓	✓	✓
		33.	If there is any Heat Sink thermal performance degradation is identified through temperature derations or shutdowns in the converter even if the blower motor is running in the right direction, then remove the Heat Sink module and clean it as per the procedure given below.					✓	✓	✓
		34.	Remove the modules from the unit.					✓	✓	✓
		35.	Clean the Heat sink fins with ISO-propyl alcohol by using lint free cloth and brush. Suck the air through fins by vacuum blower for removing the dirt from fins.					✓	✓	✓
3.	Battery Charger (MEDHA)-DTC, NDTC									
		1.	Check the Battery Charger mounting bolts for the tightness, there should not be any slackness in all the mounting fasteners, Cotter pin should be intact.	✓	✓	✓	✓	✓	✓	✓
		2.	Check the Battery Charger unit for any damage.	✓	✓	✓	✓	✓	✓	✓
		3.	Ensure that the heat sink heat sink fins top and bottom areas are unobstructed to air flow through the fins.	✓	✓	✓	✓	✓	✓	✓
		4.	Inspect visually all the manufacturing hardware of the doors for any slackness by seeing changes in torque marking. Add any missed hardware.	✓	✓	✓	✓	✓	✓	✓
		5.	Check the healthiness (colour) of silica gel (inside the door), they should be blue, replace silica gel if found pink		✓	✓	✓	✓	✓	✓
		6.	Check door sealing gaskets for any cut mark and physical damage.		✓	✓	✓	✓	✓	✓
		7.	Clean information and warning labels on doors.			✓	✓	✓	✓	✓

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		8.	Inspect all the mounting hardware (mechanical and electrical components) for any slackness by seeing changes in torque markings			✓	✓	✓	✓	✓
		9.	Check electrical connections and ground connections for corrosion to resolve. Check connections tightness.			✓	✓	✓	✓	✓
		10.	Check the inductor whether potting is detached from enclosure at terminal face.			✓	✓	✓	✓	✓
		11.	Check cracks on potting surface of the inductor.			✓	✓	✓	✓	✓
		12.	Check components and cables for damage. If found, rectify them.			✓	✓	✓	✓	✓
		13.	Do visual inspections for evidence of excessive temperature and arcing (Voltage flash over's) and resolve it.			✓	✓	✓	✓	✓
		14.	Clean heat sink fins. On need basis if there is any heat sink thermal performance degradation is identified through temperature durations and shutdowns, then remove the modules and clean the heat sink fins).			✓	✓	✓	✓	✓
		15.	Clean all magnetics surface (i.e outer surface, terminals and other accessible dust deposited surfaces) with soft brush only.			✓	✓	✓	✓	✓
		16.	Check the gland seals, grommets and other rubber components for any damages. Replace them for any damage found.			✓	✓	✓	✓	✓
		17.	Check all the cable ties are tight and intact.			✓	✓	✓	✓	✓
		18.	Open and clean all BCS doors. Remount properly with all bolts.			✓	✓	✓	✓	✓
		19.	While doing maintenance if any abnormality/ damage found, it should rectified.			✓	✓	✓	✓	
4. Battery (AMARA RAJA)-DTC, NDTC										
		1.	Check battery boxes mounting bolts for the tightness, there should not be any slackness in all the mounting fasteners.	✓	✓	✓	✓	✓	✓	

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
			Cotter pin should be intact.							
		2.	Check visually battery boxes and suspension for any damage or irregularity.	✓	✓	✓	✓	✓	✓	✓
		3.	Check for by-passing of the failed cells. If the cells are found by-passed, replace these failed cells immediately with the healthy ones.	✓	✓	✓	✓			
		4.	Clean dust accumulation with dry cotton cloth and apply Vaseline on cell terminal after cleaning.	✓	✓	✓	✓			
		5.	Check cell cover / container for any crack, leakage or burst, if noted, replace the cell with a healthy cell immediately.	✓	✓	✓	✓			
		6.	In case of battery terminal/ cable over heating sign, check for loose connection at the cell terminal post / cable end. If required, replace the cable immediately.	✓	✓	✓	✓			
		7.	Check, protective lid on safety valve if missing, provide new one immediately.	✓	✓	✓	✓			
		8.	Charge the cell, preferably for 6-8 hrs., after arrival of train by 111V for 48 cell of battery bank i.e. 2.3 Volt per cell, as cells maybe partially discharged.	✓	✓	✓	✓			
		9.	Do not boost charge the cells for more than 12 hrs.	✓	✓	✓	✓			
		10.	Confirm the 10 ± 1 Nm, tightening torque of terminals bolt. Do not over tight.		✓	✓	✓			
		11.	Terminal post corrosion – if observed remove the cable and clean the terminal post and cable lug with brass brush or fine emery paper and apply petroleum jelly.			✓	✓			
		12.	Check the open circuit voltage.			✓	✓			
		13.	If the open circuit voltage of total battery bank (48 Cell), is above 98.5 Volt:			✓	✓			
		14.	The following steps shall be followed:- Discharge the battery bank with full coach load for 15 minutes (based on coach arrival battery state of charge).			✓	✓			
		15.	Note down the individual cell readings			✓	✓			

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		16.	after 15 minutes while the coach is still connected during the discharge. If all the cell voltages are 1.98 Volts and above then the cells are in healthy condition –Charge the cells with system voltage of 111V, i.e. 2.3V per cell and put back into service.			✓	✓			
		17.	If some of the cell voltages are less than 1.98 Volts then give boost charging with 2.30V per Cell for 12 hrs. By charging them separately with current limited to 20% of battery rated capacity.			✓	✓			
		18.	The weak cells, which are charged separately, must be checked through a discharge at C-10 rate for 30 minutes, the end of discharge voltage should be above 2.0 V. If such re-charged cell fails to qualify the above test, it should not be put back in the service.			✓	✓			
		19.	After performing the discharge test on the revived cells, the cells need to be charged at least for 4 hours, prior to fitment in the service.			✓	✓			
		20.	If the open circuit voltage of total battery bank (48 cell) is less than 98.5V.			✓	✓			
		21.	Charge the cells for 12 hrs. with 2.30 V per cell and follow the following steps:			✓	✓			
		22.	Discharge the battery bank with full coach load for 15 minutes (based on coach arrival battery State of charge).			✓	✓			
		23.	Note down the individual cell readings after 15 minutes while the coach is still connected during the discharge.			✓	✓			
		24.	If all the cell voltages are 1.98 Volts and above then the cells are in healthy condition – Charge the cells with system voltage of 111V, i.e. 2.3V per cell and put back into service			✓	✓			
		4.1	Major Schedule							
		25.	Remove all the cell terminal connections and stacking bolts.					✓	✓	✓
		26.	Remove the modules with batteries from					✓	✓	✓

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
			battery box.							
		27.	Clean all the cell terminal posts and inter cell connectors / cable lugs with a brass wire brush.					✓	✓	✓
		28.	Examine batteries for damaged areas, Vent plugs, cell cover for electrolyte leakage etc.					✓	✓	✓
		29.	Check connectors and terminals of cells for hot spots.					✓	✓	✓
		30.	Record lug date to determine the life of the battery.					✓	✓	✓
4.1.2	Charging									
		31.	Refit the inter cell connectors'/cables and tighten the bolts along with the flat and spring washers to specified torque. Replace old spring washers 100%.					✓	✓	✓
		32.	Discharge the battery banks @ 10% of capacity and by-pass each cell whenever it reaches end cell voltage of 1.75V.					✓	✓	✓
		33.	Charge the cells at 5% constant current for 24 hours (5% of 300Ah i.e.15 Amps).					✓	✓	✓
		34.	Again give rest to the cells for 6-8 hours.					✓	✓	✓
		35.	Discharge the cells at C10 capacity i.e. 30Amps and gradually by passing each cell whenever any cell reaches to 1.75 V. Duration of discharge shall be recorded. If the discharge duration of the cells is found to be more than 8.5 hrs. these cells can be put back in service after charging.					✓	✓	✓
		36.	If the cells do not give more than 8.5 hrs. of discharge duration before reaching end cell voltage of 1.75 V, repeat this charging and discharging cycle once more. Cells should not be discharged below 1.75 Volts.					✓	✓	✓
		37.	Even then, if the cells do not give more than 8.5 hrs. then the cells shall not be put in service.					✓	✓	✓
4.1.3	Battery Boxes									

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		38.	Clean and repair battery boxes and repaint with anti-corrosive epoxy based paint.					✓	✓	✓
		39.	Clean and repaint the modules / cell trays. These may be numbered with the help of stencilling to identify the modules consisting of a battery set for a coach (Say Module No/ Set No.E.g.08/01 means 8 th module of Set. No.1). The other details like cell number, date of manufacture as indicated on the cell lid and date of fitment shall also be recorded to monitor age-wise performance of the cells.					✓	✓	✓
4.1.4	Loading on to the Coach									
		40.	After recharge, remove all the inter module connectors/ cables etc., to avoid shorting of the cell/modules during loading on to the battery box/ cradle with care to avoid the physical damages.					✓	✓	✓
		41.	Apply petroleum jelly over the module connectors, wherever necessary.					✓	✓	✓
		42.	Put back the batteries into the battery box/ cradle as per the connection diagram and fix the stacking bolts between the battery boxes to cradle.					✓	✓	✓
5.	Brake Chopper Resistor (MEDHA)- MC1,2,3									
		1.	Check the Brake Chopper resistor for damages and welded joints. If any damages/ cracks found, take corrective action.	✓	✓	✓	✓	✓	✓	✓
		2.	Check the insulators .If any cracks are observed, then replace the same.	✓	✓	✓	✓	✓	✓	✓
		3.	Make sure that the VCB is opened and manual DC link discharge switch is operated in the basic unit.	✓	✓	✓	✓	✓	✓	✓
		4.	The resistor cannot be energized it is necessary to wait for 30 minutes after power cut off to allow the resistor active parts and the frame to cool.	✓	✓	✓	✓	✓	✓	✓
		5.	Blow compressed air on active parts of	✓	✓	✓	✓	✓	✓	✓

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
			the resistor and their own insulation washers.							
		6.	Remove the covers (mesh) and do air blowing. Clean internal insulators using a duster and brush for removing greasy or sticky contamination.	✓	✓	✓	✓	✓	✓	✓
		7.	Check for any foreign bodies trapped on covers and elements. Remove if any.	✓	✓	✓	✓	✓	✓	✓
		8.	Do visual inspection for evidence of excessive temperature and arcing (voltage flash over).	✓	✓	✓	✓	✓	✓	✓
		9.	Measure the cold resistance value, corresponds to 20°C ambient temperature shall be in between 3.42 to 3.85Ω.	✓	✓	✓	✓	✓	✓	✓
		10.	Check tightness of all bolts and electrical connections as per torque values mentioned in OEM's Manual.			✓	✓	✓	✓	✓
6. DC Link Earthing Switch (MEDHA)-MC1,2,3										
		1.	Check that the unit is bolted tightly to the vehicle.	✓	✓	✓	✓	✓	✓	✓
		2.	Check the unit visually for any damage.	✓	✓	✓	✓	✓	✓	✓
		3.	Clean information and warning labels on doors.	✓	✓	✓	✓	✓	✓	✓
		4.	Inspect visually all the manufacturing hardware of the doors for any slackness by seeing changes in torque marking. Add any missed hardware.	✓	✓	✓	✓	✓	✓	✓
		5.	Check electrical connections and ground connections for corrosion to resolve. Check connections tightness.	✓	✓	✓	✓	✓	✓	✓
		6.	Check components and cables for damage. If found, rectify them.	✓	✓	✓	✓	✓	✓	✓
		7.	Do visual inspections for evidence of excessive temperature and arcing (Voltage flash over's) and resolve it.	✓	✓	✓	✓	✓	✓	✓
		8.	Check all the cable ties are tight and intact.	✓	✓	✓	✓	✓	✓	✓
		9.	Check the healthiness (color) of silica gel (inside the door), they should be blue, replace silica gel if found pink.	✓	✓	✓	✓	✓	✓	✓
		10.	While doing maintenance if any	✓	✓	✓	✓	✓	✓	✓

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
			abnormality / damage found, it should be rectified.							
		11.	Check door mountings for total presence/ availability and in good condition.	✓	✓	✓	✓	✓	✓	✓
		12.	Clean dust and dirt deposits with vacuum cleaner.		✓	✓	✓	✓	✓	✓
		13.	Check tightness of electrical connection as per torque values mentioned in OEM's Manual.			✓	✓	✓	✓	✓
7. Pantograph (SCHUNK)-TC										
		1.	Clean insulators with soft, clean & dry cloth.	✓	✓	✓	✓	✓	✓	✓
		2.	Check insulators for cracks and flash marks.	✓	✓	✓	✓	✓	✓	✓
		3.	Check tightness of fasteners.	✓	✓	✓	✓	✓	✓	✓
		4.	Inspect carbon strips for damages on surface and wear. Replace carbon strips if thickness is < 5-6 mm.	✓	✓	✓	✓	✓	✓	✓
		5.	Check contact force according technical data. As per practical experience the contact force should be between 75N & 80N i.e. 75N (+5-0N)	✓	✓	✓	✓	✓	✓	✓
		6.	Check raising and lowering time of pantograph. Raising time: 6 to 10 Sec. Lowering time: 6 to 10 Sec.	✓	✓	✓	✓	✓	✓	✓
		7.	Check for lateral play of panto-pan minimum 2degree.	✓	✓	✓	✓			
		8.	Inspect parallel guide bar for free movement of the pan head.	✓	✓	✓	✓	✓	✓	✓
		9.	Inspect Teflon insulating hose for any damage. Exchange if necessary.	✓	✓	✓	✓	✓	✓	✓
		10.	Inspect air hose for any damages on surface. Exchange if necessary.	✓	✓	✓	✓	✓	✓	✓
		11.	Check functioning of ADD & ORD device		✓	✓	✓	✓	✓	✓
		12.	Inspect cam & cable with thread fittings of raising mechanism for any damages.		✓	✓	✓	✓	✓	✓
		13.	Clean & apply Moly Graf CC2 Grease on cable and cam groove.		✓	✓	✓	✓	✓	✓
		14.	Exchange cable, if more than ten single wires or one single braid	✓	✓	✓	✓	✓	✓	✓

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity							
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3	
			broken/damaged.								
		15.	Inspect shunt strains for damages/ cutting. Change shunts in case more than 5% of wire strains are broken.		✓	✓	✓	✓	✓	✓	✓
		16.	Whenever shunts are required to replace, clean contact area and apply copper content contact grease MolygrafTC-55		✓	✓	✓	✓	✓	✓	✓
		17.	Inspect the pneumatic connectors for tightness and any air leakages.			✓	✓	✓	✓	✓	✓
		18.	Check function of Pressure Regulator as described in OEM’s manual.			✓	✓	✓	✓	✓	✓
		19.	Check function of Safety Valves as described in OEM’s manual.			✓	✓	✓	✓	✓	✓
		20.	Inspect pan head leaf springs and support spring of base frame for any bend, coating peel-off. Exchange, if necessary.			✓	✓	✓	✓	✓	✓
		21.	Remove diaphragm of ADD Valve and clean. After refitting, carry out functional inspection of ADD valve.			✓	✓	✓	✓	✓	✓
		22.	Inspect hydraulic dampers for any leakage of fluid.			✓	✓	✓	✓	✓	✓
		23.	Functional inspection of hydraulic dampers.			✓	✓	✓	✓	✓	✓
		24.	Fix damper at one end and hang 2 kg weight at other end and damper should open to max. extension in 1 min. ± 10sec. Exchange, if necessary for any damage.			✓	✓	✓	✓	✓	✓
		25.	Inspect of Air bellows drive for any leakages/ damages/ rubbing marks. Exchange, if necessary for any damage.			✓	✓	✓	✓	✓	✓
		26.	Functional check of Air Filter.			✓	✓	✓	✓	✓	✓
		27.	Replace the Element, O-Rings when one of followings occurs. • Pressure drop reaches0.1Mpa. • Element operates for 1.5years.			✓	✓	✓	✓	✓	✓
		28.	Check for friction of ball bearings of base frame, upper frame and coupling rod. Replace ball bearings, if necessary.			✓	✓	✓	✓	✓	✓

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		29.	Ensure Pressure Switch setting (P-max and P-min)				✓	✓	✓	✓
7.1	General Information									
		30.	Each pantograph has been calibrated by the manufacturer.				✓	✓	✓	✓
		31.	Adjustment works are to be carried out in the following order:				✓	✓	✓	✓
		32.	Adjust coupling rod and resting position.				✓	✓	✓	✓
		33.	Adjust the air bellow drive.				✓	✓	✓	✓
		34.	Adjust pneumatic control.				✓	✓	✓	✓
		35.	Adjust curve of contact pressure.				✓	✓	✓	✓
		36.	Adjust parallelism of carbon mounted panto-pans.				✓	✓	✓	✓
		37.	Adjust mobility of pantograph head.				✓	✓	✓	✓
8.	Vacuum Circuit Breaker (AAL)-TC									
		1.	Clean insulators with soft, clean & dry cloth.	✓	✓	✓	✓	✓	✓	✓
		2.	Check insulators for cracks and flash marks.	✓	✓	✓	✓	✓	✓	✓
		3.	Check for damage to connection of the earthing isolator.		✓	✓	✓	✓	✓	✓
		4.	Cleaning & greasing earthing isolate if necessary.		✓	✓	✓	✓	✓	✓
		5.	Drain the pressure regulator. (To be done before each winter period strictly.)		✓	✓	✓	✓	✓	✓
		6.	Drain the air tank. (To be done before each winter period strictly.)		✓	✓	✓	✓	✓	✓
		7.	Check contact spring.		✓	✓	✓	✓	✓	✓
		8.	Check the tightening torque 70Nm of H.V. connection.			✓	✓	✓	✓	✓
		9.	Check the torque of VCB fixing screws, tightening torque 70 Nm.			✓	✓	✓	✓	✓
		10.	Check the earthing connection, tightening torque 70 Nm.			✓	✓	✓	✓	✓
		11.	Check for any air leakage in VCB.			✓	✓	✓	✓	✓
		12.	Check the sealing of connectors, flexible pipe, regulator, air tank etc.			✓	✓	✓	✓	✓
		13.	Check for any damages, cut & tightness of the connectors, connections, pins etc. Including pressure switch, EP valve solenoid coil and connector.			✓	✓	✓	✓	✓

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		14.	Check the tightness of pneumatic connection of pressure switch.			✓	✓	✓	✓	✓
		15.	Weigh the air dryer. If increase in weight is more than 0.8 kg from new weight, regenerate molecular sieves by heating and replace, if required.			✓	✓	✓		
		16.	Check and set valve of the pressure regulator.				✓	✓	✓	✓
		17.	Change the filter cartridge of pressure regulator with O-Ring.				✓	✓	✓	✓
		18.	Check screw of auxiliary switch for breakage or other damage.				✓	✓		
		19.	Check the moving contacts of auxiliary switch for its continuity.				✓	✓		
		20.	Check the cables and lugs of auxiliary switch for broken cables, lugs looseness				✓	✓		
		21.	Check securing of auxiliary switches and support plate (Tightening torque- 10Nm)				✓	✓		
		22.	Check the working order of each auxiliary contact.				✓	✓		
		23.	Check proper fixing/ sticking of shock absorber plate.				✓	✓		
		24.	Check for any air leakage from piston assembly.				✓	✓	✓	✓
		25.	Change the kit of O-ring of side cover (First time after 3 years then every year).				✓	✓	✓	✓
		26.	Check the healthiness of EP valve coil resistance1510 Ω ± 8 % at 35°C.				✓	✓	✓	✓
		27.	Check the setting of pressure switch.				✓	✓	✓	✓
		28.	Lubricate contact spring.				✓	✓	✓	✓
		29.	Lubricate driving plate assembly as per OEM guidelines.				✓	✓	✓	✓
		30.	Lubricate shafting head bearing guides, vertical springs, flexible braids, piston seal, piston rod& EP valve.				✓	✓	✓	✓
		31.	RC network – Measure individual resistance and capacitance value 4.7Ω ± 10 % and 25 μF ± 10 %. Replace abnormal components.				✓	✓	✓	✓
		32.	Check Torque Tightening: Rear flange- 19.3Nm Shafting head – 67Nm				✓ ✓	✓ ✓	✓ ✓	✓ ✓

S.No.	Equipment / Sub- Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
			Vertical insulator -67Nm Bolts of cover for holding cylinder -39.4 Nm.				✓ ✓	✓ ✓	✓ ✓	✓ ✓
		33.	Air tank mounting nuts – 15Nm.				✓	✓	✓	✓
		34.	Check for damage to connection of the earthing isolator.					✓	✓	✓
8.2	Vacuum Switch Tube									
		1.	Check the healthiness of VST (Di-electric test 40 kV for 10sec.)					✓	✓	✓
		2.	Check closing & opening speed (First after 3 years on new breaker & then every year).					✓	✓	✓
		3.	Inspections of main contacts wear in vacuum switch tube. (First after 3 years on new breaker & then every year)					✓	✓	✓
8.3	Additional Items for SS-2, SS-3									
		4.	Check compression springs.						✓	✓
		5.	Change the auxiliary switch						✓	✓
		6.	Change the shock absorber plate.						✓	✓
		7.	Replace pressure switch with union bend.						✓	✓
		8.	Replace molecular sieves of air dryer.						✓	✓
		9.	Check torque tightening of Nuts of base plate-15Nm						✓	✓
		10	Change pressure regulator.							✓
		11	Replace piston seal of piston assembly.							✓
9.	Earthing Switch for VCB (PATRA & CHANDRA)-TC									
		1.	Check for smooth operation and intactness.	✓	✓	✓	✓	✓	✓	✓
		2.	Clean earthing switch Isolator blade& fixed contacts and apply grease lightly.		✓	✓	✓	✓	✓	✓
		3.	Ensure tightness of all connections.			✓	✓	✓	✓	✓
		4.	Seal/ rubber gasket to be replaced with new one whenever entire switch is removed from the roof.						✓	✓
		5.	Replace Scrapper (Seals)for Main Shaft with new one and clean the inside of the cover and apply grease.							✓
		6.	Replace contact spring with new one.							✓
		7.	Replace key-A (Blue) and Key-B (Yellow) with new keys.							✓

S.No.	Equipment / Sub- Assy.	#	Activities	Maintenance Periodicity							
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3	
10. AC Surge Arrester (Siemens)-TC											
		1.	Clean the dust and dirt from the Insulator surface with cotton cloth.	✓	✓	✓	✓	✓	✓	✓	✓
		2.	Inspect the insulator thoroughly, in case there is tearing of the silicone housing (black), the arrester must be replaced immediately.	✓	✓	✓	✓	✓	✓	✓	✓
		3.	Check the TELLTALE gap, if installed.		✓	✓	✓	✓	✓	✓	✓
		4.	Make sure that the line and ground terminals remain tight.		✓	✓	✓	✓	✓	✓	✓
		5.	Check the earth cable for any damage and ensure it is connected properly.		✓	✓	✓	✓	✓	✓	✓
		6.	Check the M16 bolt for high tension line connection for looseness. If found loose, apply the torque value of 105Nm.					✓	✓	✓	
11. Main Transformer (JST)-TC											
		1.	Check color change of the desiccant (silica gel) through air dryer window. If color has switched from orange to green or if oil is present in the air dryer, replace the desiccant.	✓	✓	✓					
11.1	Cooling System										
		2.	Clean the cooler surface by soft brush and remove deposits with industrial vacuum cleaner.		✓	✓	✓	✓	✓	✓	✓
		3.	Clean the cooler surface by soft brush and remove deposits with industrial vacuum cleaner.			✓	✓	✓	✓	✓	✓
		4.	Apply a small quantity of soft detergent on the clogged surface and make it act for 30-45 minutes.			✓	✓	✓	✓	✓	✓
		5.	Wash aluminum radiator (by a pressure equipment, pressure must not exceed 50bar.			✓	✓	✓	✓	✓	✓
		6.	Dry the cooler by passing pressurized air (it must not exceed 6bar).Refer OEM manual for details.			✓	✓	✓	✓	✓	✓
11.2	Transformer – General check										
		7.	Check for any apparent damage, oil leakage or rust on the transformer and all the equipment.			✓	✓	✓	✓	✓	✓

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		8.	Check the transformer’s oil level. Get the temperature of oil from Thermometer. Compare oil level with oil temperature.			✓	✓	✓	✓	✓
		9.	If the temperature differs by more than 10 °C, look for leaks visually at transformer appearance (weld accessories, connections).			✓	✓	✓	✓	✓
		10.	Check if all screws are well tightened.			✓	✓	✓	✓	✓
11.3	Tommy Gun									
		11.	Check the level of oil in the oil sight glass placed on the container. Note: This procedure has to be done every time an alarm has been triggered.			✓	✓	✓	✓	✓
		12.	If there is oil, drain the container by unscrewing the drain plug. Mount back the drain plug by 75 Nm torque once the container is empty.			✓	✓	✓	✓	✓
11.4	PT100 Sensors									
		13.	Check the resistance of PT100 sensor while it’s mounted.				✓	✓	✓	✓
		14.	With a laser thermometer, check the temperature of the tank just close to the PT100.				✓	✓	✓	✓
		15.	Take a matching table between resistance value and temperature. Compare this temperature with temperature measured on tank. If there is a difference more than 5 degrees Celsius, please refer OEM’s manual.				✓	✓	✓	✓
11.5	Air Dryers - Dehydrating Agent									
		16.	Remove air dryers from conservator and LV bushing.				✓	✓	✓	✓
		17.	Empty silica gel from the air dryer body.				✓	✓	✓	✓
		18.	Clean inside the air dryers body by blowing compressed air.				✓	✓	✓	✓
		19.	Slowly put a charge of Silica gel with new or regenerated through top opening.				✓	✓	✓	✓
		20.	Screw back air dryer for conservator with 60 N.m. torque.				✓	✓	✓	✓
		21.	Install back air dryer LV bushing on the pipe and screw it with a 40Nm torque.				✓	✓	✓	✓
11.6	Damper									

S.No.	Equipment / Sub- Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		22.	Inspect visually the rubber of the damper and check that there is no cracks, no missing material, no shock and no marking etc.				✓	✓	✓	✓
		23.	Inspect visually the damper and check that there is no shock, no missing bolt.				✓	✓	✓	✓
11.7	Oil Sampling									
		24.	Collect oil sample of transformer oil as per procedure and send to the lab for testing as per OEM’s manual and RDSO guidelines. Breakdown voltage>40kV Water content < 30 ppm Acidity < 0.3 mgKOH/ gm. Oil				✓	✓	✓	✓
		25.	Filtration to be done if required.				✓	✓	✓	✓
11.8	Pressure Relief Device									
		26.	Clean thoroughly the outside of the pressure relief device.				✓	✓	✓	✓
		27.	Ensure the healthiness of pressure relief valve				✓	✓	✓	✓
11.9	Cooling System Vibration Checking									
		28.	Check level of vibration of cooling system motors while powered.					✓	✓	✓
		29.	Analyze the vibration of oil pump while it’s powered.					✓	✓	✓
11.10	Oil Level Indicator									
		30.	Check for any sign of leakage or crack. If oil leakage is detected, replace the oil level indicator.					✓	✓	✓
		31.	Check tightening of oil level indicator-10N.m					✓	✓	✓
		32.	Clean the surface of the oil level indicator.					✓	✓	✓
11.11	Windings									
		33.	Check IR of primary and secondary windings.					✓	✓	✓
11.12	Oil pump – Bearings replacement									
		34.	Close both ends valves of oil pump pipe lines and drain oil of the pipe.							✓
		35.	Remove the oil pump and replace the ball bearings of the pump as per pump							✓

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
			manufacturer guidelines.							
		36.	Install back the oil pump and other accessories.							✓
		37.	Refill transformer with recycled oil, run the pump during 5 minutes and purge it.							✓
11.13	Main Bushing									
		38.	Clean the main bushing thoroughly.		✓	✓	✓	✓	✓	✓
		39.	Check for any damage or defect.		✓	✓	✓	✓	✓	✓
		40.	Check tightness of all connections including earthing and roof bushing connections.		✓	✓	✓	✓	✓	✓
12.	Traction Motor (TSA) – MC 1, 2, 3									
		1.	Clean air inlet filters with vacuum cleaner from outside without dismounting of air filters from traction motors. If required clean filters after dismantling. Replace the air filters in case of damage.	✓	✓	✓	✓	✓	✓	✓
		2.	Check mounting bolts for their looseness.	✓	✓	✓	✓	✓	✓	✓
		3.	Check visually for external damage of traction motor, power supply cable & traction motor suspension.	✓	✓	✓	✓	✓	✓	✓
		4.	Clean the traction motor & its accessories thoroughly.		✓	✓	✓	✓	✓	✓
		5.	Repair or damage or change mounting parts, if necessary.		✓	✓	✓	✓	✓	✓
		6.	If necessary, replace the corrosion protection on the damaged spots.		✓	✓	✓	✓	✓	✓
		7.	Inspect of mechanical connection elements.		✓	✓	✓	✓	✓	✓
		8.	Check attachment points of traction motor to bogie for cracks on the motor nose and lower mounting points.		✓	✓	✓	✓	✓	✓
		9.	Check for signs of overheating, presence of bad odor.		✓	✓	✓	✓	✓	✓
		10.	Check external bolts/screws for tightness.		✓	✓	✓	✓	✓	✓
		11.	Check for bolt tightness for the traction motor power supply cable connections. Required torque -35Nm.		✓		✓	✓	✓	✓

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		12.	Check earthing cable connection, speed sensor cable & temperature sensor cable with connector for any external/mechanical damage like stone hitting etc.		✓	✓	✓	✓	✓	✓
		13.	Check the tightness of connector connection of speed sensor and temperature sensor.		✓	✓	✓	✓	✓	✓
		14.	Check for bolt tightness for traction motor mounting on bogie. Refer drawing no. Train/MC/AC-0-0-003 for tightening torque values.		✓	✓	✓	✓	✓	✓
		15.	Dissemble the air filters and clean with dry cloth, brush or vacuum cleaner for removing dirt.		✓	✓	✓	✓	✓	✓
		16.	Clean the air filter thoroughly on both sides with dry compressed air or water with cleaning agent.		✓	✓	✓	✓	✓	✓
		17.	Dry the filters before re-assembling.		✓	✓	✓	✓	✓	✓
		18.	If the air filters are heavy polluted and cannot be cleaned, replace with a new.		✓	✓	✓	✓	✓	✓
		19.	Fit the air filters and brackets to the stator housing and tighten with a torque 30Nm.		✓	✓	✓	✓	✓	✓
		20.	Visual Inspect the guard grids for any damages. Remove any debris.		✓	✓	✓	✓	✓	✓
		21.	Clean the guard grids with a brush and a vacuum cleaner externally without dismounting.		✓	✓	✓	✓	✓	✓
		22.	If cleaning from outside is not proper, then dissemble the guard grids & clean them thoroughly on both sides with dry compressed air or vacuum cleaner and brush.		✓	✓	✓	✓	✓	✓
		23.	If the grids are heavy polluted for cleaning or damaged, replace with a new.		✓	✓	✓	✓	✓	✓
		24.	Fit the guard grids to the stator housing and tighten with a torque 10Nm if dissembled.		✓	✓	✓	✓	✓	✓
25.	Check that all outlet portions of bearing box and end bracket are not clogged				✓	✓	✓	✓		

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
			with foreign material.							
		26.	Remove accumulated dust in rotor vent holes by using dust blowing equipment and compressed air.				✓	✓	✓	✓
		27.	Check bearings for signs of grease leakage.				✓	✓	✓	✓
		28.	Re-grease the cylindrical roller bearing in the end shield NDE with 9 g and the deep groove ball bearing in the end shield DE with 21 g roller bearing grease SHELL GADUS S3 V220C 2 as per OEM guidelines.				✓	✓	✓	✓
		29.	Replace the Motor bearings , Whole motor reconditioning/ Periodic overhauling (POH)** as per OEM’s “Operating Manual” (every 30,00,000 km)							✓
13. TM Cable Junction Box-MC 1, 2, 3										
		1.	Check that the TM cables junction box bolted tightly to the vehicle.	✓	✓	✓	✓	✓	✓	✓
		2.	Check the junction box for any damage.	✓	✓	✓	✓	✓	✓	✓
		3.	Inspect all the manufacturing hardware of the doors for any slackness by seeing changes in torque marking.	✓	✓	✓	✓	✓	✓	✓
		4.	Check electrical connections and ground connections for corrosion to resolve. Ensure the connections are tight.	✓	✓	✓	✓	✓	✓	✓
		5.	Check components and cables for damage. If found address them.	✓	✓	✓	✓	✓	✓	✓
		6.	Inspect visually for evidence of excessive temperature and arcing (voltage flash overs) and resolve it.	✓	✓	✓	✓	✓	✓	✓
		7.	Clean information and warning labels on doors.	✓	✓	✓	✓	✓	✓	✓
		8.	Open and clean junction box doors. Remount properly with all bolts.		✓	✓	✓	✓	✓	✓
		9.	Check that the door sealing gaskets are free from cut marks and physical damages.		✓	✓	✓	✓	✓	✓
		10.	Inspect all the mounting hardware (mechanical and electrical components) for any slackness by seeing changes in		✓	✓	✓	✓	✓	✓

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
			torque markings.							
14. Jumper Couplers (Power Couplers)-MC, TC										
		1.	Clean & check the power coupler junction box, HARTING connector plate, and cable holding plate for damages and welded joints. If any damages/ cracks are found, rectify them.	✓	✓	✓	✓	✓	✓	✓
		2.	Check the insulators. If any cracks are observed, they are to be replaced.	✓	✓	✓	✓	✓	✓	✓
		3.	Check for corrosion in the electrical contacts.	✓	✓	✓	✓	✓	✓	✓
		4.	Check the tightening torque of all bolts, cable glands, HARTING connectors and electrical connections as per OEM's instructions.	✓	✓	✓	✓	✓	✓	✓
		5.	Tighten cable glands with proper tool.	✓	✓	✓	✓	✓	✓	✓
		6.	Inspect the unit visually for any cracks.		✓	✓	✓	✓	✓	✓
		7.	Inspect hardware and unit mounting frame for cracks.		✓	✓	✓	✓	✓	✓
15. Power Coupler Junction Box-MC, TC										
		1.	Check that the Power Coupler JB & Plates are bolted tightly to the vehicle.	✓	✓	✓	✓	✓	✓	✓
		2.	Check the Power Coupler JB & Plates for any damage.	✓	✓	✓	✓	✓	✓	✓
		3.	Open and clean all Power Coupler JB doors. Remount properly with all bolts.		✓	✓	✓	✓	✓	✓
		4.	Clean information and warning labels on doors.		✓	✓	✓	✓	✓	✓
		5.	Inspect all the manufacturing hardware of the doors for any slackness by seeing changes in torque marking.		✓	✓	✓	✓	✓	✓
		6.	Check door sealing gaskets for any cut mark and physical damage.		✓	✓	✓	✓	✓	✓
		7.	Inspect all the mounting hardware (mechanical and electrical components) for any slackness by seeing changes in torque markings.		✓	✓	✓	✓	✓	✓
		8.	Check electrical connections and ground connections for corrosion to resolve. Ensure that connections are tight.		✓	✓	✓	✓	✓	✓
		9.	Check components and cables for damage. If found address them.		✓	✓	✓	✓	✓	✓

S.No.	Equipment / Sub- Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		10.	Inspect for evidence of excessive temperature and arcing (Voltage flash overs) and resolve it.		✓	✓	✓	✓	✓	✓
16. Inter Vehicular (IV) Coupler-All Coaches										
		1.	Inspect and clean MU receptacles and jumper cables. Jumper cables should not be allowed to hang with one end free.	✓	✓	✓	✓	✓	✓	✓
		2.	Visual inspection of the cable in rest position, should not be deformed or crossed.			✓	✓	✓	✓	✓
		3.	Visual inspection: <ul style="list-style-type: none">• Mechanical damage• Tightness of the fixing bolts (controlling the safety marks)			✓	✓	✓	✓	✓
		4.	Visual inspection of the cable jacket / sheath and grommets: <ul style="list-style-type: none">• Cracks and scratches.• Damage caused by a hitting rocks.• Damage on the cable jacket.• Grommets shouldn't be pulled from the cable glands.• Safety marks of cable glands.			✓	✓	✓	✓	✓
		5.	The cables located in the inner and outer positions have to be controlled with more intensity, since they have is a higher risk to be damaged and to be hit by a rock.				✓	✓	✓	✓
		6.	Intensive visual inspection for mechanical damage.				✓	✓	✓	✓
		7.	Visual check that all screws are tight. (controlling the safety marks)				✓	✓	✓	✓
		8.	Check for tightness of the fixing screws.(controlling the safety marks)				✓	✓	✓	✓
		9.	Tightness testing by opening the plugs and check for corrosion in the electrical contacts.				✓	✓	✓	✓
		10.	Clean & check the IV coupler for damages and welded joints. If any damages/ cracks are found, rectify them.				✓	✓	✓	✓

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		11.	Check that all the coupler sockets and jumpers are bolted and fitted correctly to the vehicle.					✓	✓	✓
		12.	Inspect hardware and unit mounting frame for cracks.					✓	✓	✓
		13.	Visually inspect all the mounting hardware for corrosion.					✓	✓	✓
		14.	Inspect the unit visually for any cracks.					✓	✓	✓
		15.	Do visual inspection for evidence of excessive temperature and arcing (voltage flash overs) and resolve it.					✓	✓	✓
17. Isolation Transformer (MEDHA)-All Coaches										
		1.	Ensure that the isolation transformer is bolted tightly to the vehicle.	✓	✓	✓	✓	✓	✓	✓
		2.	Check the Isolation Transformer visually for damages.	✓	✓	✓	✓	✓	✓	✓
		3.	Check that heat sink guard is not clogged (any foreign material should be removed by hand).	✓	✓	✓	✓	✓	✓	✓
		4.	Check electrical connections and ground connections for corrosion to resolve.	✓	✓	✓	✓	✓	✓	✓
		5.	Check components and cables for any damage. If found address them.	✓	✓	✓	✓	✓	✓	✓
		6.	Do visual inspection for evidence of excessive temperature and arcing (voltage flash over's) and resolve it.	✓	✓	✓	✓	✓	✓	✓
		7.	Blow compressed air over the Transformer (especially on heat sink guard) to remove the dust on mesh).		✓	✓	✓	✓	✓	✓
		8.	Check the visual aspect and the tightening torque of 75 N-m on transformer mounting frame at 4 locations.		✓	✓	✓	✓	✓	✓
18. Master Controller (SCHALTBAU)-DTC										
		1.	Check that master controller handle is not loose and there is no excessive play.	✓	✓	✓	✓	✓	✓	✓
		2.	Visually check master controller handle and mode selector handle for signs of damage such as cracking, excessive wearing etc.			✓	✓	✓	✓	✓
		3.	Confirm that the master controller and			✓	✓	✓	✓	✓

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
			mode selector handle can be operated smoothly and without excessive force.							
		4.	Check the interlocking between MSH and MCH.			✓	✓	✓	✓	✓
		5.	Check multiple pin connectors for damage or loosening.			✓	✓	✓	✓	✓
		6.	Check all screws and nuts for loosening.			✓	✓	✓	✓	✓
		7.	Clean all parts with dry compressed air				✓	✓	✓	✓
		8.	Visually check all electrical/ mechanical connections and springs with regard to visible damages.				✓	✓	✓	✓
		9.	Check notch roll, if necessary replace. Grease by using high performance grease.				✓	✓	✓	✓
		10.	Check snap-action switches of the complete Master Controller				✓	✓	✓	✓
		11.	Lubricate bearings with the special lubricating oil as per OEM guidelines.				✓	✓	✓	✓
		12.	Grease toothed wheels and notch disks with high- performance lubricating grease as per OEM guidelines.				✓	✓	✓	✓
19. Driver Console (MEDHA)-DTC										
		1.	Clean driver console externally with soft brush and lint free cloth soaked with tap water.	✓	✓	✓	✓	✓	✓	✓
		2.	Check DDU for any active fault.	✓	✓	✓	✓	✓	✓	✓
		3.	Check general appearance& function of all switches & push button with their indications on Driver Desk and their stenciling.	✓	✓	✓	✓	✓	✓	✓
		4.	Check console light, cab light, fire extinguisher, function of horn etc.	✓	✓	✓	✓	✓	✓	✓
		5.	Check function of all pressure gauges.	✓	✓	✓	✓	✓	✓	✓
		6.	Check the condition of DDU, MMI (HMI) & CCTV screen for any damage.	✓	✓	✓	✓	✓	✓	✓
		7.	Ensure the intactness of USB port, Ether Net Connector & power supply connector.	✓	✓	✓	✓	✓	✓	✓
		8.	Check the healthiness of touch function and its response time.	✓	✓	✓	✓	✓	✓	✓

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		9.	Ensure the healthy and working status of all equipment at train level (entire rake).	✓	✓	✓	✓	✓	✓	✓
		10.	Ensure the healthy and working status of all equipment at unit level.	✓	✓	✓	✓	✓	✓	✓
		11.	Check for any active failure on events screen.	✓	✓	✓	✓	✓	✓	✓
		12.	Ensure healthy status of equipment/functions on train level and unit level of various screens of Main System.	✓	✓	✓	✓	✓	✓	✓
		13.	Check the healthiness of all Door Proving Loop on DDU.	✓	✓	✓	✓	✓	✓	✓
		14.	Check the healthiness of all EBL on DDU.	✓	✓	✓	✓	✓	✓	✓
		15.	Check working of Flasher light in both normal and standby mode.	✓	✓	✓	✓	✓	✓	✓
		16.	Focus setting of Main head light.	✓	✓	✓	✓	✓	✓	✓
		17.	Check working of Dim/Full function of Main head light.	✓	✓	✓	✓	✓	✓	✓
		18.	Working of Marker light Red and white.	✓	✓	✓	✓	✓	✓	✓
		19.	Check working of Frequency Generator Unit.	✓	✓	✓	✓	✓	✓	✓
		20.	Cab Light (Driver/ Asst Driver side) – Inspection	✓	✓	✓	✓	✓	✓	✓
		21.	Spot Light (Driver/ Asst Driver side) – Inspection	✓	✓	✓	✓	✓	✓	✓
		22.	Check Compartment/saloon light by operating.	✓	✓	✓	✓	✓	✓	✓
		23.	Check function of Signal Bell.	✓	✓	✓	✓	✓	✓	✓
		24.	Clean the entire internal housing and the equipment with the vacuum cleaner.		✓	✓	✓	✓	✓	✓
		25.	Visually inspect the entire box, enclosure walls, covers, and welds for any damage or cracks.		✓	✓	✓	✓	✓	✓
		26.	Visually inspect all internal and external cable connections of the Driver console for damage.		✓	✓	✓	✓	✓	✓
		27.	Ensure that all glands and connectors are in good condition.		✓	✓	✓	✓	✓	✓

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		28.	Ensure that all terminal blocks, HARTING connectors are in good condition.		✓	✓	✓	✓	✓	✓
		29.	Visually inspect the screws securing the Driver console to the supporting beams. Ensure that all screws are present and tightened.		✓	✓	✓	✓	✓	✓
		30.	Check the condition of hinges/brackets for the hinged assembly, if any defect found, rectify the same.		✓	✓	✓	✓	✓	✓
		31.	Check The Network screen for communication healthiness of all the nodes.		✓	✓	✓	✓	✓	✓
		32.	Check The Communication screen for communication healthiness of TCMS various interfaces.		✓	✓	✓	✓	✓	✓
		33.	Check the version number screen for various modules s/w details.		✓	✓	✓	✓	✓	✓
		34.	Ensure healthy status of all Auxiliary Convertor on DDU.		✓	✓	✓	✓	✓	✓
		35.	Ensure healthy status of Cab occupation on DDU in Regular & High Priority mode.		✓	✓	✓	✓	✓	✓
		36.	Check the Door screen for status of each door.		✓	✓	✓	✓	✓	✓
		37.	Check the RMPU screen for status of each RMPU.		✓	✓	✓	✓	✓	✓
		38.	Calibrate all pressure gauges.					✓	✓	✓
19.1	General									
		39.	Replace all cable ties (straps), removed during the maintenance work by new ones of the same type and size.	✓	✓	✓	✓	✓	✓	✓
20. CRW, GCRW, ECC, and EWP – All coaches										
20.1	MCBs, Contactor, TBs& relays									
		1.	Open the doors of the unit by unlocking with a square key.	✓	✓	✓	✓	✓	✓	✓
		2.	Check MCBs, contactors for any loose mounting and also visually inspect for any abnormality.	✓	✓	✓	✓	✓	✓	✓
		3.	Visually inspect for any abnormality.	✓	✓	✓	✓	✓	✓	✓
		4.	Check the connection intactness for main and auxiliary contact.	✓	✓	✓	✓	✓	✓	✓

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		5.	Check for any loose contact block or burn mark at cable connections.	✓	✓	✓	✓	✓	✓	✓
		6.	Check the operation of all MCBs.	✓	✓	✓	✓	✓	✓	✓
		7.	If there is any faulty component, they are to be replaced by taking proper precautions	✓	✓	✓	✓	✓	✓	✓
		8.	Ensure all the doors of the unit are tightly closed and locked during cleaning/ water wash of coach.	✓	✓	✓	✓	✓	✓	✓
		9.	Check intactness of all Ethernet & IP connectors.	✓	✓	✓	✓	✓	✓	✓
		10.	Check & ensure intactness of earthing shunts at all earthing points.	✓	✓	✓	✓	✓	✓	✓
		11.	Clean the entire internal housing and the equipment with the vacuum cleaner.		✓	✓	✓	✓	✓	✓
		12.	Visually inspect the entire box, enclosure walls, covers, and welds for any damage or cracks.		✓	✓	✓	✓	✓	✓
		13.	Visually inspect all internal and external cable connections for damage.		✓	✓	✓	✓	✓	✓
		14.	Check all glands and connectors are in good condition.		✓	✓	✓	✓	✓	✓
		15.	Clean & check all other electronics equipment & their accessories/ connectors for their healthiness.		✓	✓	✓	✓	✓	✓
		16.	Inspect the bolts, used for mounting the unit to bottom and top mounting frames. Ensure that all bolts are available and tightened.		✓	✓	✓	✓	✓	✓
		17.	Check door gasket is in good condition without holes and cracks. If the gasket is damaged, replace it with a new gasket.		✓	✓	✓	✓	✓	✓
		18.	Check the condition of hinges.		✓	✓	✓	✓	✓	✓
		19.	Clean & check availability of labels on all cabinets and their equipment.		✓	✓	✓	✓	✓	✓
		20.	Close the doors of the unit after compressing the gasket properly.		✓	✓	✓	✓	✓	✓
		21.	Lock the doors with the square key.		✓	✓	✓	✓	✓	✓
21.	Passenger information System (PIS)-All coaches									
		1.	Ensure all PIS sub systems health status in driver display unit.	✓	✓	✓	✓	✓	✓	✓

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		2.	Do the display test from MMI unit. Verify the LED displays (In coach display, Head code displays, Side Destination board display) functionality.	✓	✓	✓	✓	✓	✓	✓
		3.	Enable PA communication by pressing PA button in the MMI keypad and verify the audio.	✓	✓	✓	✓	✓	✓	✓
		4.	Do the audio test listen jingle sound from each speaker.	✓	✓	✓	✓	✓	✓	✓
		5.	Enable IC communication by pressing IC button in the MMI keypad and verify the audio.	✓	✓	✓	✓	✓	✓	✓
		6.	Check function of PECU system from minimum two coaches.	✓	✓	✓	✓	✓	✓	✓
		7.	Clean the speaker units and check for any damages.	✓	✓	✓	✓	✓	✓	✓
		8.	Clean & check the ambient noise measurement modules for any damages.	✓	✓	✓	✓	✓	✓	✓
21.1	Head Code Unit- DTC only									
		9.	Clean the dust particle settled on the screen glass with a cloth from outside.	✓	✓	✓	✓	✓	✓	✓
		10.	Check the status of LED's in the HCD at the outside of the cab.	✓	✓	✓	✓	✓	✓	✓
		11.	Check the damage of HCD. If found any damage such as Cracking, distortion, deformation replace the HCD.	✓	✓	✓	✓	✓	✓	✓
		12.	Clean the dust particle if settled on the screen with a cloth.			✓	✓	✓	✓	✓
		13.	Check the power Connections, Ensure they are tightly connected.			✓	✓	✓	✓	✓
		14.	Check the fasteners for tightness. If loosened, tighten the fasteners to the torque of 4.4Nm.			✓	✓	✓	✓	✓
21.2	In Coach Display Unit – All Coaches									
		15.	Check the status of LED's in the ICD.	✓	✓	✓	✓	✓	✓	✓
		16.	Open the ICD mounting panel.			✓	✓	✓	✓	✓
		17.	Check the power Connections, Ensure they are tightly connected.			✓	✓	✓	✓	✓
		18.	Clean the dust particle settled on the screen with a cloth.			✓	✓	✓	✓	✓

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		19.	Check the damage of ICD. If found any damage such as Cracking, distortion, deformation replace the HCD.			✓	✓	✓	✓	✓
		20.	Check the fasteners for tightness. If loosened, tighten the fasteners to the torque of 4.4Nm.			✓	✓	✓	✓	✓
		21.	Close the ICD panel after inspection of ICD.			✓	✓	✓	✓	✓
21.3	Side Destination Board Unit – All Coaches									
		22.	Check the status of LED’s in the SDB at the outside of the Cab.	✓	✓	✓	✓	✓	✓	✓
		23.	Check and clean the glass covering of SDB. Replace, if found broken.	✓	✓	✓	✓	✓	✓	✓
		24.	Open the Luggage rack cover for SDB on upper Side panel of the cab			✓	✓	✓	✓	✓
		25.	Check the power Connections, Ensure they are tightly connected			✓	✓	✓	✓	✓
		26.	Clean the dust particle settled on the Screen with a cloth			✓	✓	✓	✓	✓
		27.	Check the damage of SDB, If found any damage such as Cracking, distortion, deformation replace the SDB.			✓	✓	✓	✓	✓
		28.	Check the fasteners for tightness. If loosened, tighten the fasteners to the torque of 4.4Nm.			✓	✓	✓	✓	✓
		29.	Close the side cover for SDB on upper Side panel of the cab.			✓	✓	✓	✓	
21.4	Man Machine Interface-DTC only									
		30.	Visually inspect the damage of Keypad and LCD of MMI	✓	✓	✓	✓	✓	✓	✓
		31.	Remove MMI from installed location.			✓	✓	✓	✓	✓
		32.	Visually inspect the damage on the connector and cable.			✓	✓	✓	✓	✓
		33.	Remove the foreign substance and dirt.			✓	✓	✓	✓	✓
		34.	Install MMI.			✓	✓	✓	✓	✓
		35.	Check the fasteners for tightness. If loosened, tighten the fasteners to the torque of 4.4Nm.			✓	✓	✓	✓	✓
		36.	Clean the relevant components, after careful inspection.			✓	✓	✓	✓	✓
		37.	If found any damage such as Cracking, distortion, deformation replace the			✓	✓	✓	✓	

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
			MMI.							
21.7	Passenger Emergency Communication Unit – All Coaches									
		38.	Clean & inspect the LED, micro phone switch and name plate of PECU.	✓	✓	✓	✓	✓	✓	✓
		39.	Check the power connections for tightness.		✓	✓	✓	✓	✓	✓
		40.	Check PECU for any distortion, deformation etc., replace if required.		✓	✓	✓	✓	✓	✓
		41.	Check the fitment and tighten the fasteners to the torque of 2.5Nm.		✓	✓	✓	✓	✓	✓
22.	CCTV System – All Coaches									
		1.	Blow off the loose dirt and dust from the camera with compressed air carefully.	✓	✓	✓	✓	✓	✓	✓
		2.	Clean camera dome cover (glass) with microfiber cloth with gentle pressure.	✓	✓	✓	✓	✓	✓	✓
		3.	Check the connections and fitment for any abnormality.		✓	✓	✓	✓	✓	✓
23.	Saloon, Reading & Gangway Lights-All Coaches									
		1.	Clean all saloon, reading& gangway lights.	✓	✓	✓	✓	✓	✓	✓
		2.	Check saloon, reading& gangway lights and their diffusers for any crack or mechanical damage.	✓	✓	✓	✓	✓	✓	✓
		3.	Check mounting hardware position and intactness.	✓	✓	✓	✓	✓	✓	✓
		4.	Check the working of all lights and replace the defective part.	✓	✓	✓	✓	✓	✓	✓
24.	Head Lights (LED)-DTC									
		1.	Clean head light thoroughly with soft cloth and powder.	✓	✓	✓	✓	✓	✓	✓
		2.	Ensure proper working of head light.	✓	✓	✓	✓	✓	✓	✓
25.	LED Marker Lights (Altos)-DTC									
		1.	Clean and check marker light glass for any damages.	✓	✓	✓	✓	✓	✓	✓
		2.	Check the proper functioning of marker lights.	✓	✓	✓	✓	✓	✓	✓
		3.	Check the electrical connections and fitment for healthiness.		✓	✓	✓	✓	✓	✓
26.	LED Flasher Lights (Altos)-DTC									
26.1	Control Box									

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		1.	Clean and check the flasher light control box, toggle switches, fuses etc.	✓	✓	✓	✓	✓	✓	✓
		2.	Check the availability of spare fuses.	✓	✓	✓	✓	✓	✓	✓
		3.	Check the mounting fitment and electrical connection for intactness.		✓	✓	✓	✓	✓	✓
26.2	Flasher Light									
		4.	Check the flasher light and its protection net and hood for any damages.	✓	✓	✓	✓	✓	✓	✓
		5.	Ensure the tightness of mounting hardware.	✓	✓	✓	✓	✓	✓	✓
		6.	Check the function of LED flasher light in both normal and standby mode.	✓	✓	✓	✓	✓	✓	✓
		7.	Remove the protection net and clean the glass with soft cloth and soft cleaner.		✓	✓	✓	✓	✓	✓
27.	LP & ALP Seats (FISA) – DTC									
		1.	Check the condition of LP seat, ALP seat and their proper functioning.	✓	✓	✓	✓	✓	✓	✓
		2.	Remove dust with industrial vacuum cleaner from LP and ALP seat. Remove Stains if any.	✓	✓	✓	✓	✓	✓	✓
		3.	Check both pilot seats for all adjustments and perfect working of suspension mechanism.		✓	✓	✓	✓	✓	✓
		4.	Clean the both pilot seats and lubricate the mechanism with MOLYCOTE DX high pressure grease.			✓	✓	✓	✓	✓
28.	Wiper (Hepworth Rail)-DTC									
		1.	Check wiper blades for damage, torn and replace if worn or perished.	✓	✓	✓				
		2.	Remove oil, transports or similar deposits from the windscreen with methylated spirits (denatured alcohol).	✓	✓	✓	✓	✓	✓	✓
		3.	Ensure wash tank is filled with washer fluid to prevent wipers being used on a dry screen.	✓	✓	✓	✓	✓	✓	✓
		4.	Perform function test of wiper washer system. Do not carry out function test on a dry screen.	✓	✓	✓	✓	✓	✓	✓
		5.	Inspect tubing for damage or loose connection on nozzle. Check operation of spray nozzle on windscreen	✓	✓	✓	✓	✓	✓	✓

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		6.	Check fixing nut tightness of wiper arm to wiper spindle with torque wrench as per OEMs .			✓	✓	✓	✓	✓
		7.	Check complete system for wear, Replace/ overhaul parts if necessary.			✓	✓	✓	✓	✓
		8.	Check all torque settings for complete wiper system as per OEM.			✓	✓	✓	✓	✓
		9.	Carryout visual check for wear in rod end as per OEM.			✓	✓	✓	✓	✓
		10.	Ensure all electrical connections in good condition.				✓	✓	✓	✓
		11.	Replace the wiper blades with new one.				✓	✓	✓	✓
29. Roof Mounted AC Package Unit (SIDWAL) – All Coaches										
		1.	Check the log sheet maintained in each AC coach and attained the defects recorded by escorting staff during run.	✓	✓	✓	✓	✓	✓	✓
		2.	Clean all dust by vacuum cleaner or by compressed air from the switch board cabinet and tighten the cable terminals, if found loose.	✓	✓	✓	✓	✓	✓	✓
		3.	Replace/ reconnect defective/ bypassed components.	✓	✓	✓	✓	✓	✓	✓
		4.	Verify that filters are not worn/ damaged.	✓	✓	✓	✓			
		5.	Remove fresh and return air filters by opening the access doors of the unit. Clean these filters with compressed air after taking out the filters and place them gently in their places or replace with pre-cleaned/ new filter/ filter media and close the doors properly. <i>Note: After this activity, the service doors shall be latched properly in case of return air and fresh air filter. Similarly, the fresh air grill shall be positioned and locked properly.</i>	✓	✓	✓	✓			
		6.	Inspect microprocessor’s input/ output connections for loose wires.	✓	✓	✓	✓	✓	✓	✓
		7.	Verify that the microprocessor controller is firmly mounted.	✓	✓	✓	✓	✓	✓	✓
		8.	Operate rotary switches (AIR CO/ PRESSURE) on switch panel.	✓	✓	✓	✓	✓	✓	✓

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		9.	If insufficient cooling is noticed, check the system for a possible refrigerant leak (soap solution, electronic leak detector). If a leak is found, it must be attended before the system is re-charged. If the refrigerant charge is removed, replace the filter drier.	✓	✓	✓	✓	✓	✓	✓
		10.	Verify toggle latches of mixed air compartment covers are in good condition.	✓	✓	✓	✓	✓	✓	✓
		11.	Check the condenser fan impellers for visible damages/ cracks.		✓	✓	✓	✓	✓	✓
		12.	Clean the condenser coil after opening the cover of condenser area. To clean the condenser coils, flush out dust and dirt with clean soft water.		✓	✓	✓	✓	✓	✓
		13.	Run the plant with microprocessor controller and check for any abnormality (sound, vibration, smell)		✓	✓	✓	✓	✓	✓
		14.	Check the heater overheat protection as follows: <ul style="list-style-type: none"> • Switch off 100 VDC supply to control unit • Install jumper wire to energize heater output of control unit with +110 DC. • Trip MCBs of blowers, compressors, condenser fans • Switch on 110 V supply to control unit • Verify LED at OHP input of control unit lights up • On Display Unit, select temperature & humidity screen • Monitor rising supply air temperature • Verify OHP input LED goes off at 50 °C... 80 °C. • Switch off 110 V DC supply and remove jumper wire. <i>*Note: Check once a year before the start of the winter season.</i>				* ✓	✓	✓	✓

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
			<i>Warning: This test bypasses the control unit and its protective devices (except ESTI fuse). Never leave the unit unattended during this test.</i>							
		15.	Check the continuity of the ESTI switch, by disconnecting power supply and verify that three-phase resistances across the heater MCB output are the same. <i>*Note: Check once a year before the start of the winter season.</i>				* ✓	✓		
		16.	Run the plant for half an hour and then check the three phase operating current with the help of clamp tester (tongue tester).				✓	✓	✓	✓
			The normal operating currents are: <ul style="list-style-type: none">Package unit in cooling mode – 23 -28 AmpsCompressor currents - 8 – 12 Amps.Condenser fan motor - 1.5 – 2.1 Amps.Blower motor - 1.5-2.5 AmpsPackage unit in heating mode – 13-15 Amps.				✓	✓	✓	✓
		17.	Check and tighten mountings of blower, compressor and blower motors and ensure that they are in good condition.				✓	✓	✓	✓
		18.	Verify that screws of supply fan compartment cover is tightened				✓	✓	✓	✓
		19.	Verify braided earth wires are installed to connect the RMPU to the coach body				✓	✓		
		20.	Check the condition of canvas ducts ('bellows') provided at return & supply interfaces. Replace the same, if torn.				✓			
		21.	Visually inspect anti-vibration mounts (between RMPU frame and coach roof) for damages.				✓	✓		
		22.	Replace fresh and return air filters.					✓	✓	✓
		23.	Replace canvas ducts ('bellows') provided at return & supply interfaces.					✓	✓	✓

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		24.	Disconnect microcontroller and measure the insulation resistance of all the motors & compressors with 1 kV insulation resistance tester ('MEGGER'). Attend the motors, if insulation resistance of a motor falls below 2 MΩ.					✓	✓	✓
		25.	Check electric cables for any visible damages (cuts, chafing, makeshift joints). Replace as required					✓	✓	✓
		26.	Inspect RMPU housing enclosure for damages and cracks					✓	✓	✓
		27.	Take ESTI apart and check condition.						✓	✓
		28.	Replace braided earth wires connected RMPU to the coach body.						✓	✓
		29.	Replace anti-vibration mounts (between RMPU frame and coach roof).						✓	✓
29.1	Pipe work									
		30.	Check all threaded joints of pipe work for leaks (by soap solution, electronic leak detector) of- • LP, HP, PC switches • Service access valves				✓	✓	✓	✓
		31.	Verify all refrigerant pipe work is properly supported and held in place.					✓	✓	✓
		32.	Check pipe work any sign of chafing. A gap must remain between neighboring pipe work items and between pipe work and sheet metal parts.					✓	✓	✓
		33.	Check the feeler capillary of the heater overheats protector for damages.					✓	✓	✓
29.2	Refrigerant Compressors									
		34.	Check holding clamps for looseness.				✓	✓	✓	✓
		35.	Check compressor mounting screws for looseness.				✓	✓	✓	✓
		36.	Check accumulator mounting screws for looseness.				✓	✓	✓	✓
		37.	Verify condenser covers are fastened and do not touch the top of the compressors.				✓	✓	✓	✓
		38.	Verify compressor cables are terminated with lugs and terminal box is closed.				✓	✓	✓	✓
29.3	Condenser and Supply Fans									

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		39.	Verify all fasteners are properly tightened.				✓	✓	✓	✓
		40.	Verify terminal boxes are closed and in good condition.				✓	✓	✓	✓
		41.	Verify that all motors have two earth leads.				✓	✓		
		42.	Verify that impellers are <ul style="list-style-type: none">not damageddo not touch any other part				✓	✓	✓	✓
		43.	Verify cables & conduits are in good condition and securely fastened.				✓	✓	✓	✓
		44.	Ensure that impellers are properly tightened.				✓	✓	✓	✓
		45.	Electrical terminal box is properly tightened & cables are terminated with lugs.				✓	✓	✓	✓
		46.	Replace all earth leads of all motors.						✓	✓
		47.	Overhauling of Blower and condenser fan motors include the following: <ul style="list-style-type: none">The incoming motors shall be checked for abnormal noise and vibration.Check the condition of bearing and replace with specified make.The IR value of motor stator shall be measured between motor terminal and frame before and after overhauling. The value of IR shall not be less than 2 MΩ, when measured with 1000 volt MEGGER.Winding resistance of motors shall be measured between RY, YB & BR phases. The winding resistance shall be ±10% of resistance declared by OEM in cold condition.Check closely terminal block and connecting lead for any physical damage or any flash mark over it. Replace the same, if not satisfactory.							✓
29.4	Pressure Switches and Transducer, OHP									
		48.	Verify wires attached to the pressure switches are in good condition.				✓	✓	✓	✓

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		49.	Verify OHP cover is in good condition.				✓	✓	✓	✓
		50.	Remove dust from OHP sensor bulb. <i>*Note: Check once a year before the start of the winter season.</i>				* ✓	✓	✓	✓
29.5	Heaters									
		51.	Check heating elements for looseness.				✓	✓	✓	✓
		52.	Check heater terminals for looseness and signs of deterioration.				✓	✓	✓	✓
29.6	RAT / FAT/ SAT Sensors									
		53.	Check for looseness.				✓	✓	✓	✓
		54.	Verify wires are properly clamped.				✓	✓	✓	✓
		55.	Remove dust from temperature probes.				✓	✓	✓	✓
29.7	Thermal Expansion Valves									
		56.	Ensure that the bulb is attached to the suction line and thermally insulated.				✓	✓	✓	✓
		57.	Check TX valve, capillary, bulb and equalizing line for visible damages.				✓	✓	✓	✓
29.8	Cooling Coil (Evaporator)									
		58.	Check fins for visible damages. Apply fin comb to straighten bent fins.					✓	✓	✓
		59.	Verify that no air bypasses the filter and coil.					✓	✓	✓
		60.	➤ Clean coil. • Use spray bottle to apply a cleaning fluid approved for use on aluminum-finned heat exchangers. • Let fluid soak in before washing the coils with clean soft water. Verify that wash water leaves through the condensate drain holes.					✓	✓	✓
		61.	Verify coil is properly fastened to the frame					✓	✓	✓
29.9	Filter Driers & Sight Glass									
		62.	Verify that the drier is installed with the refrigerant low in the direction of the arrow on the filter label.				✓	✓	✓	✓
		63.	• Never try to clean / reuse a filter drier.							

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		64.	<ul style="list-style-type: none">To minimize the moisture ingress in the system, install filter drier & compressor before the system is leak tested, evacuated and charged							
29.10	Service Covers									
		65.	Verify sealing profiles of mixed air & blower compartment covers are in good condition.				✓	✓	✓	✓
29.11	Condensate Trays									
		66.	Verify that <ul style="list-style-type: none">Condensate trays are clean.Condensate drains freely.No condensate leaks into the mixed or supply fan sections.				✓	✓	✓	✓
29.12	Condenser compartments									
		67.	Check fins for visible damages. Apply fin comb to straighten bent fins.				✓	✓	✓	✓
		68.	Verify coil is properly fastened to the frame.					✓	✓	✓
29.13	Microprocessor Controller									
		69.	Check control logic of microprocessor controller on simulating kit.					✓	✓	✓
30.	Driver's Cab Air Conditioning Unit (SUBROS)-DTC									
30.1	Cabin side inspection									
		1.	Check the MCB operation (three pole).	✓	✓	✓	✓	✓	✓	✓
		2.	Operate AC and check cooling effect (feeling wise).	✓	✓	✓	✓	✓	✓	✓
		3.	Check AC Cut-off/Cut-in operation.	✓	✓	✓	✓	✓	✓	✓
		4.	Check display in control box.	✓	✓	✓	✓	✓	✓	✓
		5.	Check blower operation in all speeds.	✓	✓	✓	✓	✓	✓	✓
		6.	Clean and check rotary switch panel switches and indications for healthiness.	✓	✓	✓	✓	✓	✓	✓
		7.	Remove (unfasten) the return air grill and clean the filter using water or air below and re-assemble.		✓	✓	✓			
		8.	Check the MCB and electrical connections for tightness and proper fitment.			✓	✓	✓	✓	✓
		9.	Check main supply connector tightness.			✓	✓	✓	✓	✓

S.No.	Equipment / Sub- Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		10.	Check & ensure proper Locking of Amphenol connector to avoid loose contact.			✓	✓	✓	✓	✓
		11.	Clean fresh air filter and replace if required.				✓			
		12.	Replace the fresh air filer with new one.					✓	✓	✓
		13.	Replace the return air filer with new one.					✓	✓	✓
30.2	Roof side Inspection									
		14.	Clean wall perforations of RMPU (condenser intake air side) using water spray/wire brush/ compressed air.	✓	✓	✓	✓	✓	✓	✓
		15.	Check for condensate water drain blockage and clean.		✓	✓	✓	✓	✓	✓
		16.	Check all pipe joints for any oil traces.				✓	✓	✓	✓
		17.	Check and clean Evaporator core for clogging.				✓	✓	✓	✓
		18.	Check Compressor mounting bolts and tighten them.				✓	✓	✓	✓
		19.	Check Condenser fan bracket mounting bolts and tighten them.				✓	✓	✓	✓
		20.	Clean Condenser fins using water spray/compressed air.				✓	✓	✓	✓
		21.	Clean and check for condensate water drain blockage.					✓	✓	✓
		22.	Clean and check blower for proper fitment.					✓	✓	✓
		23.	Check and clean heater element with compressed air.					✓	✓	✓
31. Earth Return JB and Return CT JB (STE) - TC										
		1.	Check that the CT Box is bolted tight to the vehicle.	✓	✓	✓	✓	✓	✓	✓
		2.	Check the CT Box for any damage.	✓	✓	✓	✓	✓	✓	✓
		3.	Clean information and warning labels on doors.	✓	✓	✓	✓	✓	✓	✓
		4.	Visual inspection of all manufacturing hardware for the doors for any slackness by seeing changes in the torque markings.	✓	✓	✓	✓	✓	✓	✓
		5.	Check electrical connections and ground connections for corrosion to resolve. Ensure that connections are tight.	✓	✓	✓	✓	✓	✓	✓

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		6.	Check components and cables for damage. If found address them.	✓	✓	✓	✓	✓	✓	✓
		7.	Do visual inspection for evidence of excessive temperature and arcing (Voltage flash overs) and resolve it.	✓	✓	✓	✓	✓	✓	✓
		8.	Clean thoroughly the external surface of the current transformer and its accessories.		✓	✓	✓	✓	✓	✓
		9.	Check the external aspect of the current transformer for any damage.		✓	✓	✓	✓	✓	✓
		10.	Check the tightness of the screws or the tie rods of the fixing structure			✓	✓	✓	✓	✓
		11.	Check tightness of the screw of the fixing screws of the two parts.			✓	✓	✓	✓	✓
		12.	Check the tightness of terminals and connections.			✓	✓	✓	✓	✓
		13.	Open and clean all CT box doors. Remount properly with all bolts.			✓	✓	✓	✓	✓
		14.	Check that the door sealing gaskets are free from cut marks and physical damages.			✓	✓	✓	✓	✓
		15.	Visual inspection of all the mounting and electrical connection hardware for the mechanical and electrical for any slackness by seeing changes in torque markings.			✓	✓	✓	✓	✓
32. Primary CT - TC										
		1.	Check covers for any damage.	✓	✓	✓	✓	✓	✓	✓
		2.	Clean the external surface of CT.	✓	✓	✓	✓	✓	✓	✓
		3.	Check the external aspects of CT for any damage.	✓	✓	✓	✓	✓	✓	✓
		4.	Check the fitting of CT.	✓	✓	✓	✓	✓	✓	✓
		5.	Check for terminal tightness.	✓	✓	✓	✓	✓	✓	✓
		6.	Check for tightness of glands.	✓	✓	✓	✓	✓	✓	✓
		7.	Check the electrical connection on CT.	✓	✓	✓	✓	✓	✓	✓
		8.	Check cracks to mounting brackets.	✓	✓	✓	✓	✓	✓	✓
		9.	Check the Earthing Cables.	✓	✓	✓	✓	✓	✓	✓
33. Potential Transformer (STE)-TC										
		1.	Check visually the external surface for any mechanical damage.	✓	✓	✓	✓	✓	✓	✓
		2.	Check the surface of the PT for eventual damages (flaws in the silicon, peeling off	✓	✓	✓	✓	✓	✓	✓

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
			the silicon) on composite insulator. Replace without delay if deep flaws in the silicon to the glass fibre reinforced tube or damages of the tube (de-lamination) observed.							
		3.	Check the earth cable for damage and loose connection. If found any damage, replace it with new.	✓	✓	✓	✓	✓	✓	✓
		4.	Clean insulator surface with cotton cloth soaked in neutral detergent solution with water and wipe clean with wet cloth and thereafter with dry cloth.	✓	✓	✓	✓	✓	✓	✓
		5.	Check the high tension connection by hand for looseness. If found loose, tighten the bolt.	✓	✓	✓	✓	✓	✓	✓
		6.	Visually check for any insulation damage on HV Cable.	✓	✓	✓	✓	✓	✓	✓
		7.	Check the low tension connections/ secondary terminals which can be accessed from inside of the TC by hand for looseness. If found loose, tighten the bolts.			✓	✓	✓	✓	✓
		8.	Check the insulation resistance between HV/LV terminals to the Ground using 1000 Volt Insulation Resistance Tester. Confirm that the measured value is minimum 10 MΩ.			✓	✓	✓	✓	✓
		9.	Check the tightness of mounting bolts, If required; tighten to a torque of 50 Nm. <i>Caution:</i> The transformer has to be earthed by the screw connection of the PT to the TC roof. Ensure correct potential bonding.			✓	✓	✓	✓	✓
		34. ERCU-Ground Contact (FROST) - All Coach								
		1	Check ground contact for any damage after flow through a short circuit current. In case of damages found, replace the ground contact parts.	✓	✓	✓	✓	✓	✓	✓
		2.	Visually inspect insulating ring for any cracks. If found, parts have to be replaced.	✓	✓	✓	✓	✓	✓	✓

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		3.	Carry out a visual inspection of the ground contact. Basically damaged parts of the carbon brush have to be replaced with new ones.			✓	✓	✓	✓	✓
		4.	Remove the cover and the sealing from the brush holder, spring support and the carbon brushes out of the shafts of the brush holder.			✓	✓	✓	✓	✓
		5.	Clean the spring support with a lint-free cloth.			✓	✓	✓	✓	✓
		6.	Measure the height of the carbon brushes with a slide gauge.			✓	✓	✓	✓	✓
		7.	Replace the carbon brush if the remaining height to the wearing mark is equal or smaller than 3mm.			✓	✓	✓	✓	✓
		8.	In case of damages of the carbon brush, it has also to be replaced.			✓	✓	✓	✓	✓
		9.	Replace the wear parts with new ones as per procedure mentioned in OEM’s manual.					✓	✓	✓
		10.	Replace insulation ring with new one as per procedure mentioned in OEM’s manual.						✓	✓
35. Mini Pantry Items-All Coaches										
		1.	Check all the items and complete unit visually for any damage or any wire cut.	✓	✓	✓	✓	✓	✓	✓
		2.	Clean all the pantry equipment thoroughly as per OEM’s instructions.	✓	✓	✓	✓	✓	✓	✓
		3.	Check the working of indication lamps.	✓	✓	✓	✓	✓	✓	✓
		4.	Check earthing of each equipment.	✓	✓	✓	✓	✓	✓	✓
		5.	Replenish the item if found deficient.	✓	✓	✓	✓	✓	✓	✓
		6.	Check and test working of all mini-pantry equipment.	✓	✓	✓	✓	✓	✓	✓
		7.	Check the insulation resistance of live terminals to body.				✓	✓	✓	✓
35.1 Hot Case										
		8.	Inspect door gasket for any damage, proper fitment.		✓	✓	✓	✓	✓	✓
		9.	Inspect door window gasket of Hot case for any damage, proper fitment.		✓	✓	✓	✓	✓	✓
		10.	Clean out cooling fan intake and exhaust vents of Hot Case.		✓	✓	✓	✓	✓	✓

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		11.	Inspect cavity door vent slides for proper operation		✓	✓	✓	✓	✓	✓
		12.	Open control area and inspect/tighten all wiring.				✓	✓	✓	✓
		13.	Inspect all electrical components.				✓	✓	✓	✓
		14.	Test elements for electrical short to ground. Replace/repair as needed.				✓	✓	✓	✓
		15.	Visually inspect the cavity for structural integrity.				✓	✓	✓	✓
		16.	Inspect door gasket. Replace if needed.				✓	✓	✓	✓
		17.	Visually inspect any door handles and hinges. Replace/repair as needed.				✓	✓	✓	✓
		18.	Remove any loose handle and hinge screws. Loctite and then properly secure the screws.				✓	✓	✓	✓
		19.	Inspect and test control and control functions.				✓	✓	✓	✓
		20.	Inspect temperature or thermostat control knobs. Replace if needed.				✓	✓	✓	✓
		21.	Inspect power cord. Tighten cord connection inside the appliance control area.				✓	✓	✓	✓
		22.	Test/Replace independent indicator lights (where applicable).				✓	✓	✓	✓
		23.	Inspect Heating element.				✓	✓	✓	✓
		24.	Confirm proper current draw of heating elements.				✓	✓	✓	✓
35.2	Refrigerating Unit									
		25.	Inspect door gasket for any damage and proper fitment.		✓	✓	✓	✓	✓	✓
		26.	Inspect Electrical Component& Wiring.		✓	✓	✓	✓	✓	✓
		27.	Clean drainage Pipe.		✓	✓	✓	✓	✓	✓
		28.	Open control area and inspect/tighten all wiring.				✓	✓	✓	✓
		29.	Inspect all electrical components.				✓	✓	✓	✓
		30.	Test elements for electrical short to ground. Replace/repair as needed.				✓	✓	✓	✓
		31.	Visually inspect the cavity for structural integrity.				✓	✓	✓	✓
		32.	Inspect door gasket. Replace if needed.				✓	✓	✓	✓
		33.	Visually inspect any door handles and hinges. Replace/repair as needed.				✓	✓	✓	✓

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		34.	Remove any loose handle and hinge screws. Loctite and then properly secure the screws.				✓	✓	✓	✓
		35.	Inspect temperature or thermostat control knobs. Replace if needed.				✓	✓	✓	✓
		36.	Inspect power cord. Tighten cord connection inside the appliance control area.				✓	✓	✓	✓
		37.	Test/Replace independent indicator lights (where applicable).				✓	✓	✓	✓
35.3	Water Boiler									
		38.	Clean the water tank and tap as per OEM guidelines.		✓	✓	✓	✓	✓	✓
		39.	Inspect and test control and control functions.		✓	✓	✓	✓	✓	✓
		40.	Confirm proper current draw of heating elements.		✓	✓	✓	✓	✓	✓
		41.	Inspect Wiring connection, tight if any loose connection.		✓	✓	✓	✓	✓	✓
		42.	Open control area and inspect/tighten all wiring.				✓	✓	✓	✓
		43.	Inspect all electrical components, replace / repair if required.				✓	✓	✓	✓
		44.	Inspect Wiring connection, tight if any loose connection.							
		45.	Inspect Heating element.				✓	✓	✓	✓
		46.	Inspect and test control and control functions.				✓	✓	✓	✓
		47.	Confirm proper current draw of heating elements.				✓	✓	✓	✓
36. Power supply socket junction box for external 415 V AC- All Coaches										
		1.	Check that the Power Supply Socket Junction Box is bolted tightly to the vehicle.	✓	✓	✓	✓		✓	✓
		2.	Check the Power Supply Socket Junction Box for any damage.	✓	✓	✓	✓	✓	✓	✓
		3.	Open and clean all Power Supply Socket Junction Box doors. Remount properly with all doors.		✓	✓	✓	✓	✓	✓
		4.	Clean information and warning labels on doors.		✓	✓	✓	✓	✓	✓

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		5.	Visual inspection of all the manufacturing hardware of the doors for any slackness by seeing changes in torque marking.		✓	✓	✓	✓	✓	✓
		6.	Ensure that the door sealing gaskets are free from cut marks and physical damages.		✓	✓	✓	✓	✓	✓
		7.	Visual inspection of all the mounting hardware for the mechanical and electrical components for any slackness by seeing changes in torque markings.		✓	✓	✓	✓	✓	✓
		8.	Check electrical connections and ground connections for corrosion to resolve. Ensure the connections are tight.		✓	✓	✓	✓	✓	✓
		9.	Check components and cables for damage. If found address them.		✓	✓	✓	✓	✓	✓
		10.	Do visual inspection for evidence of excessive temperature and arcing (Voltage flash overs) and resolve it.		✓	✓	✓	✓	✓	✓
37. Speedometer-DTC										
		1.	Visually inspect for any abnormality.	✓	✓	✓	✓	✓	✓	✓
		2.	Check the intactness of all connector.	✓	✓	✓	✓	✓	✓	✓
		3.	Check for any loose contact block or burn mark at cable connections.	✓	✓	✓	✓	✓	✓	✓
		4.	Ensure that the indicating light for speedometer is in operation.	✓	✓	✓	✓	✓	✓	✓
		5.	Clean & check the function of speedometer.	✓	✓	✓	✓	✓	✓	✓
		6.	Ensure the closing of all plate and door lock	✓	✓	✓	✓	✓	✓	✓
		7.	Check mechanical speedometer flexible drive and lubricate if necessary.			✓	✓	✓	✓	✓
		8.	Overhaul speedometer, gear unit and flexible drive.				✓	✓	✓	✓
		9.	Calibration and testing of speedometer/speed recorder and techogenerator to be done.				✓	✓	✓	✓
38. Frequency Generator Unit-DTC										
		1.	Check the FGU for signs of damage.		✓	✓	✓	✓	✓	✓
		2.	Check the mounting of FGU.		✓	✓	✓	✓	✓	✓
		3.	Check the multiple pin connectors for proper tightness.		✓	✓	✓	✓	✓	✓
		4.	Check earthing of FGU.		✓	✓	✓	✓	✓	✓

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		5.	Check all screws and nuts for loosening.		✓	✓	✓	✓	✓	✓
		6.	Calibration and testing of frequency generator to be done.					✓	✓	✓
39. HT cable-TC										
		1.	Clean the housings to prevent excessive build-up of pollution deposits that can eventually lead to increased risk of electrical flash-over. Water with mild detergent can be used warm (up to 45°C) may be used cleaning. Recommended Citrus based cleaning products, TE EPPA-004 cable cleaning tissue, 3M NOVEC Contact Cleaner & IPA (for removal of localized sticky residues).		✓	✓	✓	✓	✓	✓
		2.	Soft, lint free, cleaning cloth should be used and any residual cleaning deposits washed off the EVA using clean water. Abrasive cloths or cleaning materials must not be used. The EVA must not be coated in grease or paint for any reason.		✓	✓	✓	✓	✓	✓
		3.	Visual inspection to check that the earth lead connection is intact.		✓	✓	✓	✓	✓	✓
		4.	Connector boot should be replaced if found to have tears or cuts to the rubber.		✓	✓	✓	✓	✓	✓
		5.	Replace EPDM rubber T-connector boots if exposed to oil contamination from a leaking transformer bushing.		✓	✓	✓	✓	✓	✓
40. Water supply system – All Coaches										
		1.	Check functioning of water pumping arrangement in test mode/pump controller.	✓	✓	✓	✓	✓	✓	✓
		2.	Visual check the mounting arrangement for proper fitment.	✓	✓	✓	✓	✓	✓	✓
		3.	Check the mono-block pump set for any damage.	✓	✓	✓	✓	✓	✓	✓
		4.	Replace old Mono-block pump with new one.						✓	✓
41. Lavatory equipment – All Coaches										
		1.	Check and ensure working of lavatory exhaust fans and saving razor socket.	✓	✓	✓	✓	✓	✓	✓

S.No.	Equipment / Sub-Assy.	#	Activities	Maintenance Periodicity						
				Trip	Monthly	Quarterly	9 Monthly	SS1	SS2	SS3
		2.	Ensure cleaning and availability of sealing of covers/grills.		✓	✓	✓	✓	✓	✓
		3.	Cleaning the impellers of the exhaust items					✓	✓	✓
		4.	Replace old saving razor socket.						✓	✓
General Applicable to all										
		1.	Check condition of attachment points of all under-slung equipment with car body.	✓	✓	✓	✓	✓	✓	✓
		2.	Check for tightness of all mounting hardware, terminal hardware of each equipment.		✓	✓	✓	✓	✓	✓
		3.	IR values of power and control cables shall be checked.					✓	✓	✓

ANNEXURE - A

(For details refer: BONATRANS - Maintenance Manual for Wheels, Motors and Trailer Axles. Ver-1)

SUMMARY OF MAINTENANCE ACTIVITIES FOR WHEELS AND AXLES

Part	To be checked	Inspection method	Maintenance level					Reference
			2D	2W	3M	1Y	20	
Wheel set	Condition of surface and its protection	visual	✓	✓	✓	✓	✓	6.1.1.1
	Condition of wheel tread and rim face surfaces	visual		✓	✓	✓	✓	6.1.1.2
	Electrical resistance ($\leq 0.01 \Omega$)	measurement					✓	
	Back-to-back dimension "a ₁₁ ", "a ₁₂ ", "a ₁₃ " @ 120°, a ₁ = (a ₁₁ +a ₁₂ +a ₁₃) / 3 (A _R)	measurement					✓	6.1.3.1
	Diameter difference between wheels on the same axle d1 - d2	measurement	After re-profiling		✓	✓	✓	6.1.3.2
	Dimensions of wheelset's wheel treads (wheel treads) "e", "h", "qR", "L"	measurement			✓	✓	✓	6.1.3.3
	Front-to-front dimension a ₂ = (e ₁ +a ₁ + e ₂), (S _R)	calculation					✓	6.1.3.4
	Axial and radial run-out of both wheelset's wheels	measurement					✓	6.1.3.5
	Defectoscopy test of axle for presence of cracks	measurement				✓	✓	6.1.6.1
	Defectoscopy test of wheel rims for presence of cracks	measurement					✓	6.1.6.2

ANNEXURE - B**AIR PRESSURE BUILT -UP TEST**

S. N.	Activity	BU1/DT C	BU2/ NDTC	BU3/ NDTC	BU4/ DTC	Pressure Built up Time (minutes)	Remarks
A	Cut off all compressor from DDU	Cut Out	Cut Out	Cut Out	Cut Out		
1	Drain MR in whole train-set to zero bar						
2	Cut in BU1 Compressor and all other Compressor shall remain cut out	Cut In	Remains Cut Out	Remains Cut Out	Remains Cut Out		
3	Note Down Pressure Build up time from 0 bar to 10 bar MR in whole train-set						
B	Cut off all compressor from DDU	Cut Out	Cut Out	Cut Out	Cut Out		
1	Drain MR in whole train-set to zero bar						
2	Cut in BU2 Compressor and all other Compressor shall remain cut out	Remains Cut Out	Cut In	Remains Cut Out	Remains Cut Out		
3	Note Down Pressure Build up time from 0 bar to 10 bar MR in whole train-set						
C	Cut off all compressor from DDU	Cut Out	Cut Out	Cut Out	Cut Out		
1	Drain MR in whole train-set to zero bar						
2	Cut in BU3 Compressor and all other Compressor shall remain cut out	Remains Cut Out	Remains Cut Out	Cut In	Remains Cut Out		
3	Note Down Pressure Build up time from 0 bar to 10 bar MR in whole train-set						
D	Cut off all compressor from DDU	Cut Out	Cut Out	Cut Out	Cut Out		
1	Drain MR in whole train-set to zero bar						
2	Cut in BU4 Compressor and all other Compressor shall remain cut out	Remains Cut Out	Remains Cut Out	Remains Cut Out	Cut In		
3	Note Down Pressure Build up time from 0 bar to 10 bar MR in whole train-set						

Note: If pressure build up time is more, then leakage areas to be found out for their rectification. After completing test cut-in all compressors.

ANNEXURE - C**MR PRESSURE DROP TEST**

Train-set: _____

S.No	Pressure Reading		Time		Total Drop per Hour	Remark
	Initial (Bar)	Final (Bar)	Initial	Final		

Note:

1. Charge MR Pressure to 10 Bar and BP pressure to 5Bar.
2. Cut Out all compressors from DDU.
3. Leave the train in this condition for one hour. Don't do any other activity on train.
4. Note down initial pressure and final pressure reading within one hour.

BP Pressure Drop Test

Train-set: _____

S.No	Pressure Reading		Time		Total Drop per Hour	Remark
	Initial (Bar)	Final (Bar)	Initial	Final		

Note:

1. Charge MR Pressure to 10 Bar and BP pressure to 5Bar.
2. Put the Auto Brake Handle in BP Charging Position
3. Cut Out all compressors from DDU.
4. Leave the train in this condition for one hour. Don't do any other activity on train.
5. Note down initial pressure and final pressure reading within one hour.

ANNEXURE - D**BC PRESSURE TEST**

Brake Type			FSB	Holding Brake	EB	EB by ABH	EB by Push Button
Handle Position			MCH at FSB	MCH at Coast	MCH at EB	Auto Brake Handle at EB	Press Emergency Brake Switch on Control Desk
BU1	DTC	B1					
		B2					
	MC1	B1					
		B2					
	TC	B1					
		B2					
	MC2	B1					
		B2					
	NDTC	B1					
		B2					
	MC1	B1					
		B2					
BU2	TC	B1					
		B2					
	MC2	B1					
		B2					
	NDTC	B1					
		B2					
	MC1	B1					
		B2					
	TC	B1					
		B2					
	MC2	B1					
		B2					
BU3	MC3	B1					
		B2					
	TC	B1					
		B2					
	MC1	B1					
		B2					
	DTC	B1					
		B2					
	NDTC	B1					
		B2					
	MC2	B1					
		B2					
BU4	MC3	B1					
		B2					
	TC	B1					
		B2					
	MC1	B1					
		B2					
	DTC	B1					
		B2					
	NDTC	B1					
		B2					
	MC2	B1					
		B2					

ANNEXURE - E

For details refer: TSA Traction Gearbox(1-52-372A) - Operating Manual (TSA017120)

SUMMARY OF MAINTENANCE ACTIVITIES FOR TRACTION GEAR BOX MAINTENANCE (TSA)

Intervals		Actions	Chapter
1-52-372A	1-65-372B		
After the first 5,000 km or after 1 month (after first start up or general overhaul*)		First oil change to remove particles and residue from the assembly and start-up phase **)	5.5.5
Every 25,000 km or monthly *)		Visual inspection for general condition **)	5.5.1
		Check of all screw and plug connections **)	5.5.2
		Oil level check **) Abrasive wear dust in the oil (magnetic oil drain plug or magnetic stick) **)	5.5.3
Every 6 months		Inspection of magnet (magnetic stick) or oil drain plug) for wear **)	5.5.3
Every 300,000 km or once a year *)	Every 200,000 km or once a year *)	Oil change **)	5.5.5
Every 3,000,000 km	Every 2,000,000 km	General overhaul ***) including - bearing replacement, - visual inspection of tothing, - replacement of all O-rings	5.6 and 5.7
Every 1,200,000 km or after 4 years *)	Every 800,000 km or after 4 years *)	Changing elastomer of reaction rod ***)	5.6.7, 5.7.10 and 5.7.12
Every 1,600,000 km or after 8 years *)		Grease change in the coupling ***)	see Operating Manual Gear Coupling KWN31426
		Change oil level indicator (with sealing)	5.6.7

* Whatever comes first.

** Maintenance work on the installed traction drive.

*** Maintenance work on the de-installed traction drive.

ANNEXURE - F

For details refer: IRCAMTECH - BOOKLET ON TRACTION MOTOR & GEAR BOX OF TRAIN SET

SUMMARY OF MAINTENANCE ACTIVITIES FOR TRACTION GEAR BOX MAINTENANCE (IRCAMTECH)

S. No	Maintenance Task	After the first 5,000km	Every 25,000 km or 45 Days*	Every 300,000 km or once a year*	Every 1,200,000 km or after 4 years*	Every 1,600,000 km or after 6 years*	Every 3,000,000 km or after 10years*
1.	First oil change to remove debris**	✓					
2.	Check for damages oil glass window**		✓				
3.	Ensure intactness of Motor & gear box mounting bolts with Bogie**		✓				
4.	Gear box oil level check & top-up**		✓				
5.	Gear box oil change**			✓			
6.	Gear box alignment verification / adjustment**			✓			
7.	Changing elastomer of reaction rod ***				✓		
8.	Grease change in the coupling ***					✓	
9.	Inspection of Gear & Pinion for damage***						✓
10.	General overhaul *** including Replace Pinion bearings, Main gear bearings, suspension bearing from reaction rod, All O-rings (Periodic overhauling (POH))						✓

* Whatever comes first.

** Maintenance work on the installed traction drive.

*** Maintenance work on the de-installed traction drive.

ANNEXURE-G**FUNCTIONAL TEST UNDER TRIP SCHEDULE****Task 1: Function Test I (with only DC power)****Work Preparation**

1. Turn on the Switch for DC power.
2. Examine that all the switches are in normal position in the cab.

S.No.	System/ Equipment	Functional Test	Remark
1.	Pantograph	Check the lifting and lowering times of the pantograph <ul style="list-style-type: none"> • Lifting time-should be within 6 to 10 Sec • Lowering time-should be within 6 to 10 Sec. 	

Task 2: Function Test II (with AC & DC power)**Work Preparation**

1. Safety Inspection and energizing the overhead supply line.
2. Make sure that all switches are in normal position.
3. Raise the Panto and Close the VCB.

S.No.	System/ Equipment	Functional Test	Remark
2.	Brake System	<ul style="list-style-type: none"> • Inspect MR pressure (8 to 10 bar) by the MR gauge and the TCMS in DT-cars. • Apply and release the service brake several times by MCH and check the brake cylinder pressure (BC pressure) is increased and decreased according to the position of MCH by the MR gauge and TCMS. • Check the application and release of service brake. • Check that brake equipment is working without any abnormal noise. • Check that pressure gauge in the cab working properly. • TCMS brake system on board test during train testing. • Difference between TCMS and pressure gauge reading to be checked and recorded in any difference found there. 	
3.	Emergency Brake Test	<ul style="list-style-type: none"> • Inspect MR pressure (8 to 10 bar) by the MR gauge and the TCMS in DT-cars. • Apply and release the emergency brake several time by MCH, Drivers brake valve and Emergency Brake Push Buttons. Verify EB from BC gauge as well as TCMS. 	
4.	Parking Brake	<ul style="list-style-type: none"> • Release Holding brake from DDU. Apply parking brake by "Parking Brake ON" push 	

S.No.	System/ Equipment	Functional Test	Remark
		button and check parking brake ON by "Parking Brake ON" lamp and moving each brake caliper unit. <ul style="list-style-type: none"> • Check the parking brake application through TCMS and visually (static condition) during testing. • Release Parking brake by Parking brake release push button. Verify the status of parking brake in DDU. • Enable Holding from DDU. 	
5.	Driver Display Unit	<ul style="list-style-type: none"> • Ensure the intactness of USB port, Ether Net Connector & power supply connector. • Check the healthiness of touch function and its response time. • Train Overview: Ensure the healthy and working status of all equipment. • Unit Level: Ensure the healthy and working status of all Equipment. • Events Screen: Check for any active failure on events screen. • Ensure healthy status of equipment /functions on train level and unit level of various screens of Main System. • Check the healthiness of all Door Proving Loop on DDU. • Check the healthiness of all EBL on DDU. • Check The Network screen for communication healthiness of all the nodes. • Check The Communication screen for communication healthiness of TCMS various interfaces. • Check the version number screen for various modules s/w details. • Ensure healthy status of all Auxiliary Convertor on DDU. • Ensure healthy status of Cab occupation on DDU in Regular & High Priority mode. • Check the Door screen for status of each door. • Check the RMPU screen for status of each RMPU. 	
6.	Cab light	<ul style="list-style-type: none"> • Check Cab driver/guard light by operating respective Switch 	
7.	Cab Spot light	<ul style="list-style-type: none"> • Check Cab driver/guard Spot light by operating respective Switch 	
8.	Cab Emergency Light	<ul style="list-style-type: none"> • Check Cab Emergency light by operating Cab Emergency Light Switch 	

S.No.	System/ Equipment	Functional Test	Remark
9.	Cab Fans	<ul style="list-style-type: none"> Check Cab Fans by operating Cab Fan Switch 	
10.	Head light Marker light Flasher light	<ul style="list-style-type: none"> Check head light by operating Head Light Switch. Check marker lights by operating marker light switch. Check Flasher lights by operating Flasher Light Switch. 	
11.	Horn	Check the operation in all the 3 Functionalities. <ul style="list-style-type: none"> Electro Pneumatic Horn Driver Foot Operated Horn Guard Horn 	
12.	CCTV	<ul style="list-style-type: none"> Check and ensure all cameras live views are showing in CCTV display unit. 	
13.	Cab AC	<ul style="list-style-type: none"> Turn on the Cab AC system and check the cooling states. Correct working of 'Fan speed selector switch' in all positions. 	
14.	Wiper	<ul style="list-style-type: none"> Check the wiper function in low/ high & wash mode from wiper switch 	
15.	Saloon Light	<ul style="list-style-type: none"> Check all saloon lights (50%, 100%) Emergency lights, Gangway lights are glowing by giving command from driving cab. 	
16.	Lights	<ul style="list-style-type: none"> Check the Lights functionality by operating DLL Control Switch & IDLL Control Switch in Auto, OFF & ON modes and observe the symbols on DDU. 	
17.	RMPU	<ul style="list-style-type: none"> Turn on the RMPU system and check the cooling states. Check the RMPU unit from inside & outside of the train. Examine that refrigerant is full with green color. If the sight glass is not full and bubbles appear, the refrigeration system may have a less refrigerant. Check for proper function of inverter by running the RMPU in emergency mode through TCMS and air duct in the saloon. Check for proper function RMPU through TCMS. 	
18.	Passenger Saloon Door	<ul style="list-style-type: none"> Open/close the Passenger Saloon doors in standby mode by pressing two push buttons from both Cabs. Check the results while opening and closing door, check that doors open and close without obstruction on TCMS Display. After opening of door, check all outside and inside lamp should glow. 	

S.No.	System/ Equipment	Functional Test	Remark
		<ul style="list-style-type: none"> After closing of door check the DPL Left, DPL Right in both cab and LDSLR, LDSRR of all coach status on TCMS. It should be energizes. After closing all doors, check ADCR status on TCMS, it should be in energize. 	
19.	PA & PIS	<p>Ensure all the units working condition by Switching ON Power supply:</p> <ul style="list-style-type: none"> MMI should boot up and display the default screen as "Cab Not Active" up-to Cab Occupied Key enable. ICDs, HCDs & SDBDs should display default message "Indian Railways". Coach Control should "announce Jingle" through Speakers at Power ON. Indication LED of all the PECU units should blink continuously. After Completion of all above units power ON to be verified all units health status for Selecting the "PIS Health" from TCMS DDU screen. <p>Ensure all the units working condition by Train Route Selection:</p> <ul style="list-style-type: none"> Select the Train Route from MMI unit. Check End to End when route is selected, MMI unit on other side shall become Slave. Check the HCD display for displaying the Destination of the selected route in both DTC's HCD Displays Check the SDBD display for displaying the Source & Destination with Via station name of the selected route in All coaches SDBD Displays. Check the selected train route is displayed properly in ICDs of each coach. Check the selected train route is announced properly in Coach Control through speakers of each coach. 	
20.	Main Air Compressor	Ensure that the Compressor and Air dryer are working during the pressure is building.	
21.	Leakage Test	<p>Ensure that MR pressure is 7 bar</p> <ol style="list-style-type: none"> Check that pressure in MR (through gauge in Motor car) does not fall below 0.1bar in 5min value. Check the pressure on TCMS. If the pressure are different, it should be recorded. 	
22.	Log book	<ul style="list-style-type: none"> Check the Crew remarks. 	
23.	Data download	<ul style="list-style-type: none"> Download Data Through MAE675U Application Software. 	

S.No.	System/ Equipment	Functional Test	Remark
24.	Reading Note Down	<ul style="list-style-type: none">• Note Down the Energy Consumption.• Note Down the Regeneration Energy.• Note Down the Kilometer Reading.	

FUNCTIONAL TEST UNDER MONTHLY SCHEDULE**Task 1: Function Test I (with only DC power)****Work Preparation**

1. Turn ON the Switch for DC power.
2. Examine that all the switches are in normal position in the cab.

S.No.	System/ Equipment	Functional Test	Remark
1.	DC/LT Test	<ul style="list-style-type: none"> • Check the TCMS DDU for any abnormality indications. • Check the TCMS Network Screen for any abnormalities. • Check the High Voltage Screen for any abnormalities. • Check the ACU Screen for any abnormalities or any Earth Faults. • Cab Occupation in Key ON Mode-Cab Selector Switch in Normal Mode. • Cab Occupation in RDM Mode-Cab Selector Switch in Normal Mode. • Cab Occupation in Key ON Mode-Cab Selector Switch in High Priority Mode. • Cab Occupation in RDM Mode-Cab Selector Switch in High Priority Mode. • Check the Signal Bell Functionality from both driver and guard panels. • Check the Emergency Bell Functionality by pressing SB2 button from both driver and guard panel. • Check Emergency bell by pressing emergency stop button in passenger saloon area and observe the indication on TCMS DDU and also on SB2 Switch. • Check the Train BN Battery voltage. 	
2.	Auxiliary Air Compressor	<ul style="list-style-type: none"> • Check the Auxiliary Air Compressor is working without any abnormal sound. • Check the Auxiliary Air Compressor is working based on the pressure switch(5.3Kg-6.3Kg). 	
3.	Pantograph	<ul style="list-style-type: none"> • Check the lifting and lowering times of the pantograph <ul style="list-style-type: none"> - Lifting time-should be within 6 to 10 Sec - Lowering time-should be within 6 to 10 Sec 	

Task 2: Function Test II (with AC &DC power)**Work Preparation**

1. Safety Inspection and Energizing the overhead supply line.
2. Make sure that all switches are in normal position.
3. Raise the Panto and Switch On the VCB.

S.No.	System/ Equipment	Functional Test	Remark
	Cab light	<ul style="list-style-type: none"> Check Cab driver/guard light by operating respective Switch. 	
	Cab Spot light	<ul style="list-style-type: none"> Check Cab driver/guard Spot light by operating respective Switch. 	
	Cab Emergency Light	<ul style="list-style-type: none"> Check Cab Emergency light by operating Cab Emergency Light Switch. 	
	Cab Fans	<ul style="list-style-type: none"> Check Cab Fans by operating Cab Fan Switch. 	
	Head light	<ul style="list-style-type: none"> Check head light by operating Head Light Switch. 	
	Marker light	<ul style="list-style-type: none"> Check marker lights by operating marker light switch. 	
	Flasher light	<ul style="list-style-type: none"> Check Flasher lights by operating Flasher Light Switch. 	
	Horn	<ul style="list-style-type: none"> Check the operation in all the 3 Functionalities. <ul style="list-style-type: none"> Electro Pneumatic Horn Driver Foot Operated Horn Guard Horn 	
	CCTV	<ul style="list-style-type: none"> Check and ensure all cameras live views are showing in CCTV display unit. 	
	Cab AC	<ul style="list-style-type: none"> Turn on the Cab AC system and check the cooling states. Correct working of 'Fan speed selector switch' in all positions. 	
	Wiper	<ul style="list-style-type: none"> Check the wiper function in low / high & wash mode from wiper switch 	
	Saloon Light	<ul style="list-style-type: none"> Check all saloon lights (50%, 100%) Emergency lights, Gangway lights are glowing by giving command from driving cab. Check the lights by operating DLL/IDLL control Switch in Auto, ON and OFF modes. 	
	RMPU	<ul style="list-style-type: none"> Turn on the RMPU system and check the cooling states. Check the RMPU unit from inside & outside of the train. Examine that refrigerant is full with green color. If the sight glass is not full and bubbles appear, the refrigeration 	

S.No.	System/ Equipment	Functional Test	Remark
		<p>system may have a less refrigerant.</p> <ul style="list-style-type: none"> Check for proper function of inverter by running the RMPU in emergency mode through TCMS and air duct in the saloon. Check for proper function RMPU through TCMS. 	
	Passenger Saloon Door	<ul style="list-style-type: none"> Open/close the Passenger Saloon doors in standby mode by pressing two push buttons from both Cabs. Check the results while opening and closing door, Check that doors open and close without obstruction on TCMS Display. After opening of door check all outside and inside lamp should glow. After closing of door check the DPL Left, DPL Right in both cab and LDSLR, LDSRR of all coach status on TCMS. It should be energizes. After closing all the doors and check the status of ADCR relay, it should energize. 	
	PA & PIS	<p>Ensure all the units working condition by Switching ON Power supply:</p> <ul style="list-style-type: none"> MMI should boot up and display the default screen as “Cab Not Active” up-to Cab Occupied Key enable. ICDs, HCDs & SDBDs should display default message “Indian Railways”. Coach Control should “announce Jingle” through Speakers at Power ON. Indication LED of all the PECU units should blink continuously. After Completion of all above units power ON to be verified all units health status for Selecting the “PIS Health” from TCMS DDU screen. <p>Ensure all the units working condition by Train Route Selection:</p> <ul style="list-style-type: none"> Select the Train Route from MMI unit. Check End to End when route is selected, MMI unit on other side shall become Slave Check the HCD display for displaying the Destination of the selected route in both DTC's HCD Displays Check the SDBD display for displaying the Source & Destination with Via station name of the selected route in All 	

S.No.	System/ Equipment	Functional Test	Remark
		coaches SDBD Displays	
		<ul style="list-style-type: none"> Check the selected train route is displayed properly in ICDs of each coach Check the selected train route is announced properly in Coach Control through speakers of each coach <p>Ensure HCD units working condition by Manual Route Selection(In case of Emergency condition)</p> <ul style="list-style-type: none"> Select the train route in TCMS DDU Check the HCD display for displaying the Destination of the selected route <p>Display Test: The purpose of this test is to ensure all the display units status.</p> <ul style="list-style-type: none"> Select the “Display Test” from 'Diagnostics' option in MMI then all the ICD, SDBD and HCD displays should displays the Test Pattern screen <p>Speaker Test: The purpose of this test is to ensure all the display units status.</p> <ul style="list-style-type: none"> Select the “Loud Speaker Test” from 'Diagnostics' option in MMI then all Coach Control units should “announce Jingle” through Speakers in all coaches <p>Inter-Com(IC) Test:</p> <ul style="list-style-type: none"> Press 'IC' Button on the MMI – Non Active Cab. MMI should display the “Inter Communication Enabled” message on both sides of MMI display. IC Indication LEDs shall be blink on both MMI's & Jingle Sound shall be played from both Cab Loudspeakers Press IC button on the MMI Keypad of Active cab then both MMI IC Indication LEDs should be ON continuously. Speak through Microphone then voice should be heard from other cab speaker and Vise-Versa. After that again Press 'IC' Button on the MMI – Non Active Cab MMI should display the “IC” Disabled” message on both sides of MMI display. IC indication LED should OFF at both sides of MMI. <p>Repeat the above case from other side MMI.</p> <p>Passenger Announcement (PA) Test:</p>	

S.No.	System/ Equipment	Functional Test	Remark
		<ul style="list-style-type: none"> Press 'PA' Button on the MMI – Non Active Cab 	
		<ul style="list-style-type: none"> MMI should display the “PA Enabled” message on both sides of MMI display. PA indication LED should ON at both sides of MMI. Speak through Microphone and Listen the voice from all the speakers in coach area. After that again Press 'PA' Button on the MMI –Non Active Cab MMI should display the “PA Disabled” message on both sides of MMI display and PA indication LED should OFF mode. PA indication LED should OFF mode at both sides of MMI. Speak through Microphone then observe, No voice shall be heard from any of the speaker. <p>Repeat the above case from other side MMI.</p> <p>Passenger Emergency Communication Unit (PECU) Test:</p> <ul style="list-style-type: none"> Power On Health check PECU indication LED should blink in Red color continuously. Then Press the PECU Push Button of any of the PECU from any of the coach.(Example: PECU1 from CC1) PECU indication LED should stop blinking and glow in Red color constantly. MMI should get and display the PECU information. PAS buzzer in driver cab should be ON continuously until PAS acknowledgement button is pressed. Select “CC1” to enable the PECU communication establishment. MMI should display the PECU request menu to Accept/Reject. Press “Accept” button to enable the PECU. MMI should display the PECU communication establishment screen. PECU Indication LED should glow constantly in Green color and Push button LED should continuously ON. Speak through Cab Microphone Voice 	

S.No.	System/ Equipment	Functional Test	Remark
		<p>should be heard from PECU speaker.</p> <ul style="list-style-type: none"> • Speak through PECU microphone Voice should be heard from Cab loud speaker. • Press “Call End” button on MMI then changed to normal operation mode automatically and PECU call should be disconnected, in PECU indication LED shall start blinking and Push button LED should be in OFF mode. <p><i>Note: During One PECU call other call will be maintained in queue</i></p>	
		Same procedure can be applicable for other PECU units testing.	
	Main Air Compressor	<ul style="list-style-type: none"> • Ensure that the Compressor and Air dryer are working during the pressure is building. 	
	Brake System	<ul style="list-style-type: none"> • Inspect MR pressure (8 to 10 bar) by the MR gauge and the TCMS in DT-cars. • Apply and release the service brake several times by MCH and check the brake cylinder pressure (BC pressure) is increased and decreased according to the position of MCH by the MR gauge and TCMS. • Check the application and release of service brake. • Check that brake equipment is working without any abnormal noise. • Check that pressure gauge in the cab working properly. • TCMS brake system on board test during train testing. • Difference between TCMS and pressure gauge reading to be checked and recorded in any difference found there. 	
	Parking Brake	<ul style="list-style-type: none"> • Release Holding brake from DDU. Apply parking brake by “Parking Brake ON” push button and check parking brake ON by • “Parking Brake ON” lamp and moving each brake caliper unit. • Check the parking brake application through TCMS and visually (static condition) during testing. • Release Parking brake by Parking brake release push button. Verify the status of parking brake in DDU. 	

S.No.	System/ Equipment	Functional Test	Remark
		<ul style="list-style-type: none"> • Enable Holding from DDU 	
	Emergency Brake Test	<ul style="list-style-type: none"> • Inspect MR pressure (8 to 10 bar) by the MR gauge and the TCMS in DT-cars. • Apply and release the emergency brake several time by MCH, Drivers brake valve and Emergency Brake Push Buttons. Verify EB from BC gauge as well as TCMS. 	
	Leakage Test	<p>Ensure that MR pressure is 10bar</p> <ol style="list-style-type: none"> 1. Check that pressure in MR(through gauge in M car) does not fall below 0.1bar in 5minvalue. 2. Check the pressure on TCMS. If the pressure are different, it should be recorded 	
	Log book	<ul style="list-style-type: none"> • Check the Crew remarks 	
	Data download	<ul style="list-style-type: none"> • Download Data ThroughMAE675U Application Software 	
	Reading Note Down	<ul style="list-style-type: none"> • Note Down the Energy Consumption • Note Down the Regeneration Energy • Note Down the Kilometer Reading 	

ANNEXURE-I**FUNCTIONAL TEST UNDER QUARTERLY SCHEDULE****Task 1 : Function Test I (with only DC power)****Work Preparation**

1. Turn on the Switch for DC power
2. Examine that all the switches are in normal position in the cab.

S.No.	System/ Equipment	Functional Test	Remark
1.	DC/LT Test	<ul style="list-style-type: none"> • Check the TCMS DDU for any abnormality indications. • Check the TCMS Network Screen for any abnormalities • Check the High Voltage Screen for any abnormalities • Check the ACU Screen for any abnormalities or any Earth Faults • Cab Occupation in Key ON Mode-Cab Selector Switch in Normal Mode. • Cab Occupation in RDM Mode-Cab Selector Switch in Normal Mode. • Cab Occupation in Key ON Mode-Cab Selector Switch in High Priority Mode. • Cab Occupation in RDM Mode-Cab Selector Switch in High Priority Mode. • Check the Signal Bell Functionality from both driver and guard panels. • Check the Emergency Bell Functionality by pressing SB2 button from both driver and guard panel. • Check Emergency bell by pressing Emergency stop button in passenger saloon area and observe the indication on TCMS DDU and also on SB2 Switch. • Check the Train BN Battery voltage 	
2.	Auxiliary Air Compressor	<ul style="list-style-type: none"> • Check the Auxiliary Air Compressor is working without any abnormal sound • Check the Auxiliary Air Compressor is working based on the pressure switch(5.3Kg-6.3Kg) 	
3.	Pantograph	<ul style="list-style-type: none"> • Check the lifting and lowering times of the pantograph <ul style="list-style-type: none"> - Lifting time-should be within 6 to 10 Sec - Lowering time-should be within 6 to 10 Sec 	

Task 2 : Function Test II (with AC &DC power)**Work Preparation**

1. Safety Inspection and Energizing the overhead supply line
2. Make sure that all switches are in normal position
3. Raise the Panto and Switch On the VCB

S.No.	System/ Equipment	Functional Test	Remark
1.	Cab light	• Check Cab driver/guard light by operating respective Switch	
2.	Cab Spot light	• Check Cab driver/guard Spot light by operating respective Switch	
3.	Cab Emergency Light	• Check Cab Emergency light by operating Cab Emergency Light Switch	
4.	Cab Fans	• Check Cab Fans by operating Cab Fan Switch	
5.	Head light	• Check head light by operating Head Light Switch.	
6.	Marker light	• Check marker lights by operating marker light switch.	
7.	Flasher light	• Check Flasher lights by operating Flasher Light Switch.	
8.	Horn	• Check the operation in all the 3 Functionalities. - Electro Pneumatic Horn - Driver Foot Operated Horn - Guard Horn	
9.	CCTV	• Check and ensure all cameras live views are showing in CCTV display unit.	
10.	Cab AC	• Turn on the Cab AC system and check the cooling states. • Correct working of 'Fan speed selector switch' in all positions.	
11.	Wiper	• Check the wiper function in low / high & wash mode from wiper switch	
12.	Saloon Light	• Check all saloon lights (50%, 100%) Emergency lights, Gangway lights are glowing by giving command from driving cab. • Check the lights by operating DLL/IDLL control Switch in Auto, ON and OFF modes	
13.	RMPU	• Turn on the RMPU system and check the cooling states. • Check the RMPU unit from inside & outside of the train • Examine that refrigerant is full with green color. If the sight glass is not full and bubbles appear, the refrigeration system may have a less refrigerant.	

S.No.	System/ Equipment	Functional Test	Remark
		<ul style="list-style-type: none"> Check for proper function of inverter by running the RMPU in emergency mode through TCMS and air duct in the saloon. Check for proper function RMPU through TCMS. 	
14.	Passenger Saloon Door	<ul style="list-style-type: none"> Open/close the Passenger Saloon doors in standby mode by pressing two push buttons from both Cabs. Check the results while opening and closing door, Check that doors open and close without obstruction on TCMS Display. After opening of door check all outside and inside lamp should glow. After closing of door check the DPL Left, DPL Right in both cab and LDSLR, LDSRR of all coaches' status on TCMS. It should be energizes. 	
15.	PA & PIS	<p>Ensure all the units working condition by Switching ON Power supply:</p> <ul style="list-style-type: none"> MMI should boot up and display the default screen as "Cab Not Active" up-to Cab Occupied Key enable. ICDs, HCDs & SDBDs should display default message "Indian Railways" Coach Control should "announce Jingle" through Speakers at Power ON Indication LED of all the PECU units should blink continuously. After Completion of all above units power ON to be verified all units health status for Selecting the "PIS Health" from TCMS DDU screen. <p>Ensure all the units working condition by Train Route Selection:</p> <ul style="list-style-type: none"> Select the Train Route from MMI unit Check End to End when route is selected, MMI unit on other side shall become Slave Check the HCD display for displaying the Destination of the selected route in both DTC's HCD Displays Check the SDBD display for displaying the Source & Destination with Via station name of the selected route in All coaches SDBD Displays Check the selected train route is 	

S.No.	System/ Equipment	Functional Test	Remark
		<p>displayed properly in ICDs of each coach</p> <ul style="list-style-type: none"> Check the selected train route is announced properly in Coach control through speakers of each coach <p>Ensure HCD units working condition by Manual Route Selection(In case of Emergency condition)</p> <ul style="list-style-type: none"> Select the train route in TCMS DDU Check the HCD display for displaying the Destination of the selected route <p>Display Test: The purpose of this test is to ensure all the display units status.</p> <ul style="list-style-type: none"> Select the “Display Test” from 'Diagnostics' option in MMI then all the ICD, SDBD and HCD displays should displays the Test Pattern screen <p>Speaker Test: The purpose of this test is to ensure all the display units status.</p> <ul style="list-style-type: none"> Select the “Loud Speaker Test” from 'Diagnostics' option in MMI then all Coach Control units should “announce Jingle” through Speakers in all coaches <p>Inter-Com (IC) Test:</p> <ul style="list-style-type: none"> Press 'IC' Button on the MMI – Non Active Cab. MMI should display the “Inter Communication Enabled” message on both sides of MMI display. IC Indication LEDs shall be blink on both MMI's & Jingle Sound shall be played from both Cab Loudspeakers Press IC button on the MMI Keypad of Active cab then both MMI IC Indication LEDs should be ON continuously. Speak through Microphone then voice should be heard from other cab speaker and vise-versa. After that again Press 'IC' Button on the MMI – Non Active Cab MMI should display the “IC” Disabled” message on both sides of MMI display. IC indication LED should OFF at both sides of MMI. <p>Repeat the above case from other side MMI.</p> <p>Passenger Announcement (PA) Test:</p> <ul style="list-style-type: none"> Press 'PA' Button on the MMI – Non 	

S.No.	System/ Equipment	Functional Test	Remark
		<p>Active Cab</p> <ul style="list-style-type: none"> MMI should display the “PA Enabled” message on both sides of MMI display. PA indication LED should ON at both sides of MMI. Speak through Microphone and Listen the voice from all the speakers in coach area. After that again Press 'PA' Button on the MMI –Non Active Cab MMI should display the “PA Disabled” message on both sides of MMI display and PA indication LED should OFF mode. PA indication LED should OFF mode at both sides of MMI. Speak through Microphone then observe No voice shall be heard from any of the speaker. <p>Repeat the above case from other side MMI.</p> <p>Passenger Emergency Communication Unit (PECU) Test:</p> <ul style="list-style-type: none"> Power on Health check PECU indication LED should blink in Red color continuously. Then Press the PECU Push Button of any of the PECU from any of the coach.(Example: PECU1 from CC1) PECU indication LED should stop blinking and glow in Red color constantly. MMI should get and display the PECU information. PAS buzzer in driver cab should be ON continuously until PAS acknowledgement button is pressed. Select “CC1” to enable the PECU communication establishment. MMI should display the PECU request menu to Accept/Reject. Press “Accept” button to enable the PECU. MMI should display the PECU communication establishment screen. PECU Indication LED should glow constantly in Green color and Push button LED should continuously ON. 	

S.No.	System/ Equipment	Functional Test	Remark
		<ul style="list-style-type: none"> • Speak through Cab Microphone Voice should be heard from PECU speaker. • Speak through PECU microphone Voice should be heard from Cab loud speaker. • Press “Call End” button on MMI then changed to normal operation mode automatically and PECU call should be disconnected, in PECU indication LED shall start blinking and Push button LED should be in OFF mode. <p>Note: During One PECU call other call will be maintained in queue.</p>	
		Same procedure can be applicable for other PECU units testing.	
16.	Main Air Compressor	<ul style="list-style-type: none"> • Ensure that the Compressor and Air drier are working during the pressure is building. 	
17.	Brake System	<ul style="list-style-type: none"> • Inspect MR pressure (8 to 10 bar) by the MR gauge and the TCMS in DT-cars. • Apply and release the service brake several times by MCH and check the brake cylinder pressure (BC pressure) is increased and decreased according to the position of MCH by the MR gauge and TCMS. • Check the application and release of service brake. • Check that brake equipment is working without any abnormal noise. • Check that pressure gauge in the cab working properly. • TCMS brake system on board test during train testing. • Difference between TCMS and pressure gauge reading to be checked and recorded in any difference found there. 	
18.	Parking Brake	<ul style="list-style-type: none"> • Release Holding brake from DDU. Apply parking brake by “Parking Brake ON” push button and check parking brake ON by • “Parking Brake ON” lamp and moving each brake caliper unit. • Check the parking brake application through TCMS and visually (static condition) during testing. • Release Parking brake by Parking brake 	

S.No.	System/ Equipment	Functional Test	Remark
		release push button. Verify the status of parking brake in DDU. <ul style="list-style-type: none"> • Enable Holding from DDU 	
19.	Emergency Brake Test	<ul style="list-style-type: none"> • Inspect MR pressure (8 to 10 bar) by the MR gauge and the TCMS in DT-cars. • Apply and release the emergency brake several time by MCH, Drivers brake valve and Emergency Brake Push Buttons. Verify EB from BC gauge as well as TCMS. 	
20.	Leakage Test	<ul style="list-style-type: none"> • Ensure that MR pressure is 10 bar 1. Check that pressure in MR(through gauge in M car) does not fall below 0.1bar in 5minvalue. 2. Check the pressure on TCMS. If the pressure are different, it should be recorded 	
21.	Log book	<ul style="list-style-type: none"> • Check the Crew remarks 	
22.	Data download	<ul style="list-style-type: none"> • Download Data Through MAE675U Application Software 	
23.	Reading Note Down	<ul style="list-style-type: none"> • Note Down the Energy Consumption • Note Down the Regeneration Energy • Note Down the Kilometer Reading. 	

ANNEXURE-J**FUNCTIONAL TEST UNDER NINE MONTHLY SCHEDULE****Task 1 : Function Test I (with only DC power)****Work Preparation**

1. Turn on the Switch for DC power.
2. Examine that all the switches are in normal position in the cab.

S.No.	System/ Equipment	Functional Test	Remark
1.	DC/LT Test	<ul style="list-style-type: none"> • Ensure the intactness of USB port, Ether Net Connector & power supply connector. • Check the healthiness of touch function and its response time. • Train Overview: Ensure the healthy and working status of all equipment. • Unit Level: Ensure the healthy and working status of all Equipment. • Events Screen: Check for any active failure on events screen. • Ensure healthy status of equipment /functions on train level and unit level of various screens of Main System. • Check the healthiness of all Door Proving Loop on DDU. • Check the healthiness of all EBL on DDU. • Check The Network screen for communication healthiness of all the nodes. • Check The Communication screen for communication healthiness of TCMS various interfaces. • Check the version number screen for various modules s/w details • Ensure healthy status of all Auxiliary Convertor on DDU. • Ensure healthy status of Cab occupation on DDU in Regular & High Priority mode. • Check the Door screen for status of each door. • Check the RMPU screen for status of each RMPU. 	
2.	Auxiliary Air Compressor	<ul style="list-style-type: none"> • Check the Auxiliary Air Compressor is working without any abnormal sound • Check the Auxiliary Air Compressor is working based on the pressure 	

		<ul style="list-style-type: none"> • switch(5.3Kg-6.3Kg) 	
3.	Pantograph	<ul style="list-style-type: none"> • Check the lifting and lowering times of the pantograph <ul style="list-style-type: none"> - Lifting time should be within 6 to 10 Sec - Lowering time should be within 6 to 10 Sec • Check pantograph raise/ lower smoothly. 	

Task 2: Function Test II (with AC & DC power)**Work Preparation**

1. Safety Inspection and Energizing the overhead supply line
2. Make sure that all S/W are in normal position
3. Raise the Panto and Switch On the VCB

S.No.	System/ Equipment	Functional Test	Remark
1.	Cab light	<ul style="list-style-type: none"> Check Cab driver/guard light by operating respective Switch 	
2.	Cab Spot light	<ul style="list-style-type: none"> Check Cab driver/guard Spot light by operating respective Switch 	
3.	Cab Emergency Light	<ul style="list-style-type: none"> Check Cab Emergency light by operating Cab Emergency Light Switch 	
4.	Cab Fans	<ul style="list-style-type: none"> Check Cab Fans by operating Cab Fan Switch 	
5.	Head light	<ul style="list-style-type: none"> Check head light by operating Head Light Switch. Check Aux head lights by operating Head Light Switch. 	
6.	Marker light	<ul style="list-style-type: none"> Check tail/ marker lights by operating tail/ marker light switch. 	
7.	Flasher light	<ul style="list-style-type: none"> Check Flasher lights by operating Flasher Light Switch. 	
8.	Horn	<ul style="list-style-type: none"> Check the operation in all the 3 Functionalities. <ul style="list-style-type: none"> Electro Pneumatic Horn Driver Foot Operated Horn Guard Horn 	
9.	CCTV	Check and ensure all cameras live views are showing in CCTV display unit.	
10.	Cab AC	<ul style="list-style-type: none"> Turn on the Cab HVAC system and check the cooling states. Correct working of 'Selector switch' in all positions. Check the operation of CAB HVAC in 'Back Up' Mode. 	
11.	Wiper	<ul style="list-style-type: none"> Check the wiper function in low / high & wash mode from wiper switch 	
12.	Saloon Light	<ul style="list-style-type: none"> Check all saloon lights (50%, 100%) Emergency lights, Gangway lights are glowing by giving command from driving cab. Check the lights by operating DLL/IDLL control Switch in Auto, ON and OFF modes 	
13.	Saloon RMPU	<ul style="list-style-type: none"> Turn on the RMPU system and check the functioning. Check the RMPU unit from inside 	

		&outside of the train <ul style="list-style-type: none"> Examine that refrigerant is full with green color. If the sight glass is not full and bubbles appear, the refrigeration system may have a less refrigerant. Check for proper function of inverter through TCMS by 'ON BOARD' test. 	
14.	Saloon RMPU functional check	<ul style="list-style-type: none"> Check for proper function of inverter by running the RMPU in emergency mode through TCMS and feel air by hand in duct in the saloon. Function check using Laptop or other device(DDU). Check for proper function through TCMS by on board test during testing. 	
15.	Passenger Saloon Door	<ul style="list-style-type: none"> Open/close the Passenger Saloon doors in standby mode by pressing two push buttons from both Cabs. Check the results while opening and closing door, Check that doors open and close without obstruction on TCMS Display. After opening of door check all outside and inside lamp should glow. After closing of door check the DPL Left, DPL Right in both cab and LDSLR, LDSRR of all coaches status on TCMS. It should be energizes. After closing all the doors and check the status of ADCR relay, it should energize. 	
16.	PA & PIS	Ensure all the units working condition by Switching ON Power supply: <ul style="list-style-type: none"> MMI should boot up and display the default screen as "Cab Not Active" up-to Cab Occupied Key enable. ICDs, HCDs & SDBDs should display default message "Indian Railways" CC should "announce Jingle" through Speakers at Power ON Indication LED of all the PECU units should blink continuously. After Completion of all above units power ON to be verified all units health status for Selecting the "PIS Health" from TCMS DDU screen. Ensure all the units working condition by Train Route Selection: <ul style="list-style-type: none"> Select the Train Route from MMI unit 	

			<ul style="list-style-type: none"> • Check End to End when route is selected, MMI unit on other side shall become Slave • Check the HCD display for displaying the Destination of the selected route in both DTC's HCD Displays • Check the SDBD display for displaying the Source & Destination with Via station name of the selected route in All coaches SDBD Displays • Check the selected train route is displayed properly in ICDs of each coach • Check the selected train route is announced properly in CC through speakers of each coach <p>Ensure HCD units working condition by Manual Route Selection (In case of Emergency condition)</p> <ul style="list-style-type: none"> • Select the train route in TCMS DDU • Check the HCD display for displaying the Destination of the selected route <p>Display Test: The purpose of this test is to ensure all the display units status.</p> <ul style="list-style-type: none"> • Select the "Display Test" from 'Diagnostics' option in MMI then all the ICD, SDBD and HCD displays should displays the Test Pattern screen <p>Speaker Test: The purpose of this test is to ensure all the display units status.</p> <ul style="list-style-type: none"> • Select the "Loud Speaker Test" from 'Diagnostics' option in MMI then all CC units should "announce Jingle" through Speakers in all coaches <p>Inter-Com (IC) Test:</p> <ul style="list-style-type: none"> • Press 'IC' Button on the MMI – Non Active Cab. • MMI should display the "Inter Communication Enabled" message on both sides of MMI display. • IC Indication LEDs shall be blink on both MMI's & Jingle Sound shall be played from both Cab Loudspeakers • Press IC button on the MMI Keypad of Active cab then both MMI IC Indication LEDs should be ON continuously. • Speak through Microphone then voice should be heard from other cab speaker and vise-versa. 	
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			<ul style="list-style-type: none"> • After that again Press 'IC' Button on the MMI – Non Active Cab • MMI should display the “IC” Disabled” message on both sides of MMI display. • IC indication LED should OFF at both sides of MMI. <p>Repeat the above case from other side MMI.</p> <p>Passenger Announcement (PA) Test:</p> <ul style="list-style-type: none"> • Press 'PA' Button on the MMI – Non Active Cab • MMI should display the “PA Enabled” message on both sides of MMI display. • PA indication LED should ON at both sides of MMI. • Speak through Microphone and Listen the voice from all the speakers in coach area. • After that again Press 'PA' Button on the MMI –Non Active Cab • MMI should display the “PA Disabled” message on both sides of MMI display and PA indication LED should OFF mode. • PA indication LED should OFF mode at both sides of MMI. • Speak through Microphone then observe No voice shall be heard from any of the speaker. <p>Repeat the above case from other side MMI.</p> <p>Passenger Emergency Communication Unit (PECU) Test:</p> <ul style="list-style-type: none"> • Power on Health check PECU indication LED should blink in Red color continuously. • Then Press the PECU Push Button of any of the PECU from any of the coach.(Example: PECU1 from CC1) • PECU indication LED should stop blinking and glow in Red color constantly. • MMI should get and display the PECU information. • PAS buzzer in driver cab should be ON continuously until PAS acknowledgement button is pressed. 	
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		<ul style="list-style-type: none"> • Select “CC1” to enable the PECU communication establishment. MMI should display the PECU request menu to Accept/Reject. • Press “Accept” button to enable the PECU. • MMI should display the PECU communication establishment screen. • PECU Indication LED should glow constantly in Green color and Push button LED should continuously ON. • Speak through Cab Microphone Voice should be heard from PECU speaker. • Speak through PECU microphone Voice should be heard from Cab loud speaker. • Press “Call End” button on MMI then changed to normal operation mode automatically and PECU call should be disconnected, in PECU indication LED shall start blinking and Push button LED should be in OFF mode. <p><i>Note: During One PECU call other call will be maintained in queue.</i></p>	
		Same procedure can be applicable for other PECU units testing.	
17.	Main Air Compressor	<ul style="list-style-type: none"> • Check the all compressor for abnormal sound in working condition during testing 	
18.	Brake System	<ul style="list-style-type: none"> • Inspect MR pressure (8 to 10 bar) by the MR gauge and the TCMS in DT-cars. • Apply and release the service brake several times by MCH and check the brake cylinder pressure (BC pressure) is increased and decreased according to the position of MCH by the MR gauge and TCMS. • Check the application and release of service brake. • Check that brake equipment is working without any abnormal noise. • Check that pressure gauge in the cab working properly. • TCMS brake system on board test during train testing. • Difference between TCMS and pressure gauge reading to be checked and recorded in any difference found there. 	

19.	Emergency Brake Test	<ul style="list-style-type: none"> Inspect MR pressure (8 to 10 bar) by the MR gauge and the TCMS in DT-cars. 	
		<ul style="list-style-type: none"> Apply and release the emergency brake several time by MCH, Drivers brake valve and Emergency Brake Push Buttons. Verify EB from BC gauge as well as TCMS. 	
19.	Parking Brake	<ul style="list-style-type: none"> Release Holding brake from DDU. Apply parking brake by "Parking Brake ON" push button and check parking brake ON by "Parking Brake ON" lamp and moving each brake caliper unit. Check the parking brake application through TCMS and visually (static condition) during testing. Release Parking brake by Parking brake release push button. Verify the status of parking brake in DDU. Enable Holding from DDU 	
20.	Leakage Test	<ul style="list-style-type: none"> Do not perform any task after isolating overhead line which will cause air consumption for 5 minutes. Check that MR gauge reading should not decrease below 0.2bar (from setting pressure value.) in 5 minutes. duration 	
21.	Log book	<ul style="list-style-type: none"> Check the Crew remarks 	
22.	Data download	<ul style="list-style-type: none"> Download Data Through MAE675U Application Software 	
23.	Reading Note Down	<ul style="list-style-type: none"> Note Down the Energy Consumption Note Down the Regeneration Energy Note Down the Kilometer Reading 	

4. TOOLS AND ACCESSORIES

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1.00



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Amendment and Revisions

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4.1. WHEELS AND AXLES

S.No	Instrument	Purpose	Specification
1	NEXTSENSE CALIPRI CW40 measuring instrument with add-on measurement modules.	Measurement of basic operating characteristics of wheelsets	As per BONATRANS manual for wheels and axles – Document no – 22 – 388 Date :2018-11-23
2	NEXTSENSE CW40 measuring system with a D-1050 diameter measuring gauge	Measurement of wheel diameter	same
3	NEXT SENSE CW40 measuring system	Measurement of wheel tread	same
4	Measuring system NEXT sense CW40 with a gauge	Measurement of back-to-back dimension	same
5	Measuring system NEXTSENSE CW40 with a trigger wedge K1 and a stand	Measuring axial and radial run-out	same
6	Special shape gauge	Measurement of Wheel tread shape gauge	same
7	Wheel Diameter Checking Gauge	Measurement of Wheel diameter	same
8	Wheel Distance gauge	Measurement of Back to back dimension	same
9	Axial and radial run-out device	Measuring alignment of press-fitted wheels	same

4.2. BEARING

S.No	Instrument	Purpose	Specification
1	Portable jacks consisting of an assembly sleeve, withdrawal plate, puller rods, and a pulling ring adapter	Bearing installation and removal	As per : TIMKEN Maintenance Manual MAINTENANCE MANUAL (A-73980) Section A1 Date : 07/09/2018
2	Micrometer	Measure the bearing seat	Not Specific

		diameters of axles	
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4.3. DRIVE GEAR UNIT

S.No	Instrument	Purpose	Specification
1	Ejector screws		M8, M12, various lengths
2	Collecting receptacle/collecting cup		volume > 8 l, low height
3	Axial fastening	For demounting coupling	
4	Wooden blocks	For supporting the wheelset shaft and the gear box	
5	Torque wrench		6 to 592 Nm
6	Spring balance		500 N
7	Threaded rod		M8, L= length of hydraulic cylinder + 70 mm; including M8 hex nuts
8	Lifting devices with a sufficient bearing capacity and fine control		for loads of 70 to 1650 kg
9	Hydraulic cylinder		
10	Hydraulic press-off device		Glycerine 2000 bar Max – G1/4" Connection
11	Hollow hydraulic cylinder single-action (spring return)		
12	Induction heater with demagnetization and temperature probe		
13	Freezer		for temperatures of -30 up to -70 °C
14	Long hole bars		L = 170 189 mm with hexagonal bolts
15	Long hole bars		L = 240 mm with hexagonal bolts, thickness of the long hole bar
16	Dial gauge		Gage: 1/100 mm or better
17	Dial gauge with lever gage		Gage: 1/100 mm

			or better
18	Stand with magnetic base	For the dial gauges	
19	3D lifting ring		M12
20	Vacuum cleaner		
21	Flashlight		
22	Assembly device main gear		AAV002150R0001 (Figure 62) of TSA manual - TSA017120 / 0 / EN
23	Adapter for measuring bearing clearance		same
24	Adapter for measuring flank clearance		same
25	Height control device		same
26	Press out device for spherical bearing		same
27	Pressing device for spherical bearing		same

4.4. AIR SPRING

S.No	Instrument	Purpose	Specification
1	Torque key		0 Nm up to 120 Nm
2	Hexagon socket screw key		Not specific
3	Hammer		1000 g
4	Assembling aid		Hard wood
5	Press		As per GMT manual - WH_17305201_Air Spring System _en_01
6	Mounting level		same

4.5. CBC

S.No	Instrument	Purpose	Specification
1	Contour maintenance gauge (Profile gauge)		As per FAIVELEY maintenance manual for CBC document - FT0050978-100- E57MUM
2	Aligning wing limit gauge		same
3	Vertical height aligning wing pocket and guard arm gauge (Go-Gauge)		same
4	Vertical height condemning		same

	limit aligning wing pocket and guard arm gauge (No-Go-Gauge)		
5	Contour condemning limit gauge		same
6	Knuckle nose wear and stretch limit gauge		same
7	Central pin – puller		same
8	Balanced Draft Gear scragging fixture		same
9	Supporting device assy. fixture		same
10	Coupler head assembly fixture		same
11	Spherolastic bearing assembly fixture		same

4.6. SEMI PERMANENT COUPLER

S.No	Instrument	Purpose	Specification
1	Suitable Lifting Device		Not Specific
2	Standard Toolkit		same
3	Clamp, (169895)		As per DELLNER maintenance manual document - 130174_0_en

4.7. SLIDING DOOR

S.No	Instrument	Purpose	Specification
1	No Special tools required		As per PRAG manual document-Maintenance-ISD-001 (Rev0.0)

4.8. PLUG DOOR

S.No	Instrument	Purpose	Specification
1	No Special tools required		As per IFE maintenance manual document - DDSTE11071E09 (Rev.00)

4.9. GANGWAY

S.No	Instrument	Purpose	Specification
1	Overhead crane with a capacity of at least 600 kg		As per HUBNER technical description document – 049395349 (Rev-)

2	Fork lift		same
3	Ropes	For mounting purposes	same
4	Standard-Work shop equipment and tools		same
5	Hollow square spanner (9 mm)		same

4.10. VACUUM BIOTOILET

S.No	Instrument	Purpose	Specification
1	10531 Service terminal HT-793-English HT793E or 69833 Service terminal PC version		As per EVAC maintenance description document – 01 – 2018-08
2	23474 Tool for pan head screw		same
3	79017 Cleaning tool for EVAC flush nozzles		same

4.11. SEATS

S.No	Instrument	Purpose	Specification
1	Allen wrench 4 mm		As per FAIRSA maintenance description document – 771 Rev.00
2	Allen wrench 5 mm		same
3	Allen wrench 6 mm		same
4	Allen wrench 2.5 mm		same
5	Screwdriver Phillips PH2		same
6	Screwdriver head 81150 M4		same
7	Screwdriver head 81150 M6		same
8	Screwdriver head Torx		same
9	Fixed wrench 8 mm		same
10	Fixed wrench 10 mm		same
11	Fixed wrench 13 mm		same
12	Tubular wrench 13 mm		same
13	Fixed wrench 17 mm		same
14	Thread sealant		same

4.12. ELECTRO PNEUMATIC BRAKES AND AIR SUPPLY

S.No	Instrument	Purpose	Specification
1	Special hook (B64617). For check valve with damping. See figure 1 for details		As per KBIL overhaul instruction document – U-OF11-21 Rev-05-

			03.06.2009 en
2	Same tool as above for Impulse valve WIMHV5-NT		Document – U-GD80-24 Rev-00-13.11.2009
3	Same tool as above for Double Check Valve DRV7-T		Document – U-GF20-27 Rev-02-14.10.2010
4	Same tool as above for Pressure reducing Valve DMV15/T		Document – U-GE50-25 Rev-02-01.06.2009
5	Same tool as above for Piston valve WKV1-T		Document – U-GD70-23 Rev-03-14.01.2015
6	Same tool as above for Mean Pressure valve MDV1		Document – U-KF20-22 Rev-04-10.07.2012
7	Same tool as above for Magnet valve WMV1-ZEST		Document – U-GG21-41 Rev-03-17.05.2011
8	Same tool as above for Driver Brake Valve FB11, FB11-1		Document – U-FB22-21 Rev-02-11.2006
9	Same tool as above for Magnet Valve WMV- 20/2Z		Document – U-OG21-41 Rev-02-29.09.2009
10	Same tool as above for Overflow valve without reflux DR07-T		Document – U-TD20-28 Rev-01-21.07.2014
11	Assembly drift (dependent on the nominal bore) for Ballcock with an exhaust and switch module(SK-T-DN..E-SM, SK-T-DN..E-SM-K)		Document – U-GJ20-23 Rev-02-27.07.2016
12	Test gauge (dependent on the nominal bore) for Ballcock with an exhaust and switch module(SK-T-DN..E-SM, SK-T-DN..E-SM-K)		same
13	Press for Ballcock with an exhaust and switch module(SK-T-DN..E-SM, SK-T-DN..E-SM-K)		same
14	Assembly drift (dependent on the nominal bore) for Ballcock with an exhaust (SK-T-DN..E, SK-T-DN..E-K)		Document – U-GJ10-22 Rev-01-22.08.2016
15	Test gauge (dependent on the nominal bore) for Ballcock with an exhaust		same

	(SK-T-DN..E, SK-T-DN..E-K)		
16	Press for Ballcock with an exhaust and switch module(SK-T-DN..E, SK-T-DN..E-K)		same
17	Special hook (B64617). And Diaphragm extractor (A54802) for Distributor valve STV200. See Figure -1 and 2 for details		Document – U-EC90-22 Rev-00-29.02.2012
18	Precision torque wrench, and a sleeve (As per figure - 3) for Levelling Valve SV1205	For assembling the piston rod assembly. The latter must be made by the customer	Document – U-TD10-25 Rev-00
19	Regular strap wrench for Motor Compressor set V10-T		Document – U-LG10-22 Rev-05-25.01.2016

4.13. BRAKE CHOPPER RESISTOR

S.No	Instrument	Purpose	Specification
1	Double end open Spanner	For tightening or holding bolt	24x27mm
2	Ring spanners	For tightening or holding bolt	24x27mm
3	Torque wrench	For Torque tightening bolt.	70 - 350 N-m
4	Fork lift	Shifting the Brake Chopper Resistor from installation premises to maintenance location by using Fork lift.	0.5 Ton
5	Hydraulic lifter	Lift and adjust the Brake Chopper Resistor in between mounting brackets by using Hydraulic lifter.	0.5 Ton

4.14. VACUUM CIRCUIT BREAKER

As per details available in OEM's manual

4.15. MAIN TRANSFORMER

S.No	Instrument	Purpose	Specification
1	Air gun		Not Specific
2	Brush		Not Specific
3	Elevating table		Not Specific
4	Hexagon key		6mm
5	High pressure washer		Not Specific
6	Hydrant wrench		Not Specific
7	Jerry can		Not Specific
8	Laser thermometer		Not Specific
9	Manual pump		Not Specific
10	Mohr clamp		Not Specific
11	Screwdriver		Not Specific
12	Spirit Level		Not Specific
13	Syringe		Not Specific
14	Tissue		Not Specific
15	Vacuum cleaner		Not Specific
16	Wrench		size : 10mm,13mm,17mm,19mm, 22mm, 24mm, 36mm, 41mm, 46mm, 8mm
17	mallet		Not Specific
18	pliers		Not Specific
19	tool LV bushing		Not Specific
20	Oil Filling/Draining tool kit (oil pump, vacuum pump, filter,flexible pipes)		As per JST Transformers maintenance manual Part no - 1066463G000

4.16. TRACTION MOTOR

S.No	Instrument	Purpose	Specification
1	Grease gun		As per TSA manual document no - TSA018528 / 0 / EN
2	Torque wrench		5 230 Nm
3	Depth gauge		As per TSA manual
4	Shaft extension		same
5	Extension tube		same
6	Lifting eye bolts		M12, M16, M20
7	Ejector Screws		M8, M10, M12, M16
8	Wooden beams	For supporting the rotor	As per TSA manual
9	Hydraulic puller	For labyrinth ring Drive End	same
10	Hydraulic pressure device		same
11	Hoisting devices		Motor: 997 kg \pm 5% Gearbox: 620 kg \pm 10%
12	Two arm puller		As per TSA manual

13	Hydraulic press		same
14	Induction bearing heater with demagnetization and temperature test probe		same
15	Balancing machine		same
16	Vacuum cleaner		same
17	Electric torch		same
18	Ohmmeter		As per OEM recommendation NORMA Insulation*Tester / UNILAP ISO 5 kV
19	Furnace		As per TSA manual
20	Freezer		same
21	Mandrels		M12, M16
22	Shaft extension NDE		As per TSA manual
23	Sleeve	For pulling rotor	same
24	Dial Gauge		same
25	Compressed Air		Dry and de-oiled

4.17. JUMPER COUPLER

S.No	Instrument	Purpose	Specification
1	Measuring tape	For measuring the Centre distances on Mounting base and Mounting base to Side wall	Not specific
2	Double end open Spanner	For tightening or holding bolt	18x19mm
3	Ring spanners	For tightening or holding bolt	18x19mm
4	Double end open Spanner	For tightening or holding bolt	12x13mm
5	Ring spanners	For tightening or holding bolt	12x13mm
6	Torque wrench	For tightening or holding bolt	Up to 70 Nm

4.18. DRIVER CABIN

S.No	Instrument	Purpose	Specification
1	Allen key	Harting connectors	M4
2	Allen key	TFT Display units	M5
3	Allen key	FGU, Flasher	M6

		light unit	
4	Allen key	wiper motor	M8
5	Allen key	D0 panels assembly	M10
6	Star screw driver	For switch panels	Not specific
7	Soft brush	Dust Cleaning	Not specific
8	Vacuum cleaner	Dust Cleaning	ESD protected type

4.19. ECC AND CRW UNIT

S.No	Instrument	Purpose	Specification
1	Measuring tape	For measuring the Centre distances on Mounting base and Mounting base to Side wall	Not specific
2	Double end open Spanner	For tightening or holding bolt	18x19mm
3	Ring spanners	For tightening or holding bolt	18x19mm
4	Double end open Spanner	For tightening or holding bolt	12x13mm
5	Ring spanners	For tightening or holding bolt	12x13mm
6	Torque wrench	For tightening or holding bolt	70 to 350 Nm
7	Soft brush	Dust Cleaning	Not specific
8	Vacuum cleaner	Dust Cleaning	Not specific
9	Wago Inserting tool	For wago assembly / disassembly	Not specific
10	Cable cutter	For cutting cabel ties	Not specific
11	star philips screw driver	For screwing / unscrewing electronic components	M3, M4, M5
12	Gland spanner	For tightening glands	PG 21, PG 36, PG 48

4.20. PASSENGER INFORMATION SYSTEM

S.No	Instrument	Purpose	Specification
1	Ratchet box and handle	For Covers	Not specific

4.21. SALOON AND GANGWAY LIGHT

S.No	Instrument	Purpose	Specification
1	Measuring tape	For measuring the Centre distances on Mounting base	Not specific

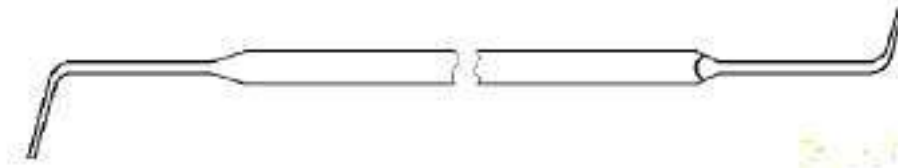
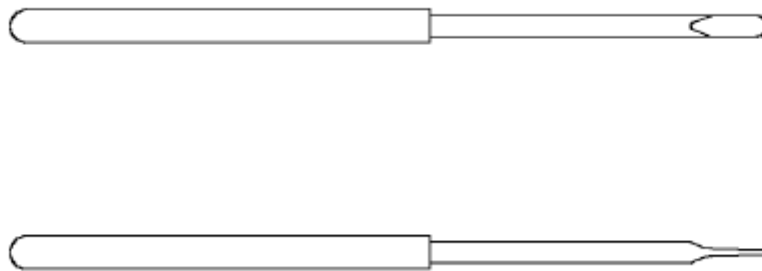
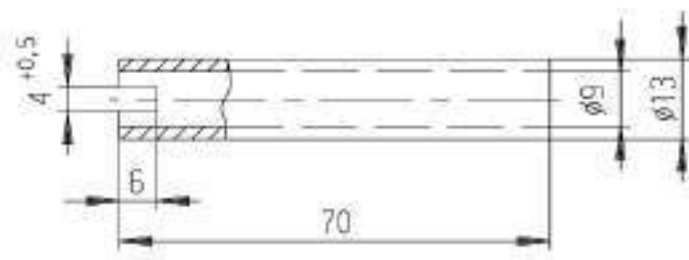
		and Mounting base to Side wall	
2	Ring spanners	For tightening or holding bolt	10x11mm
3	Ring spanners	For tightening or holding bolt	12x13mm
4	Torque wrench	For tightening or holding bolt	70 to 350 Nm
5	Hand grinding machine	For removing weld spatters, foreign particle etc. on mounting bracket	Not specific
6	Fork lift	For shifting the Nose Cone Equipment from stores to installation premises	3 Tons
7	Pallet	For coach inside movement of the panel	Not specific

4.22. GROUND CONTACT

S.No	Instrument	Purpose	Specification
1	Drive socket set		metric 10mm, 17mm + 19 mm
2	Plug-in with Allen		metric 5mm
3	Torque wrenches		½" drive, ratchet head
4	Manual hot air blower		min. 2000W

4.23. WIPER MOTOR

S.No	Instrument	Purpose	Specification
1	Arm Extractor Tool		As per HEPWORTH manual Part no - 60680600

Figure – 1 : Special hook**Figure – 2 : Diaphragm extractor****Figure – 3: Assembly Sleeve****Figure – 4: Arm Extractor tool.**

5. MAINTENANCE

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5.1 BOGIE

a. Trailer Bogie (SeeFigure 1)

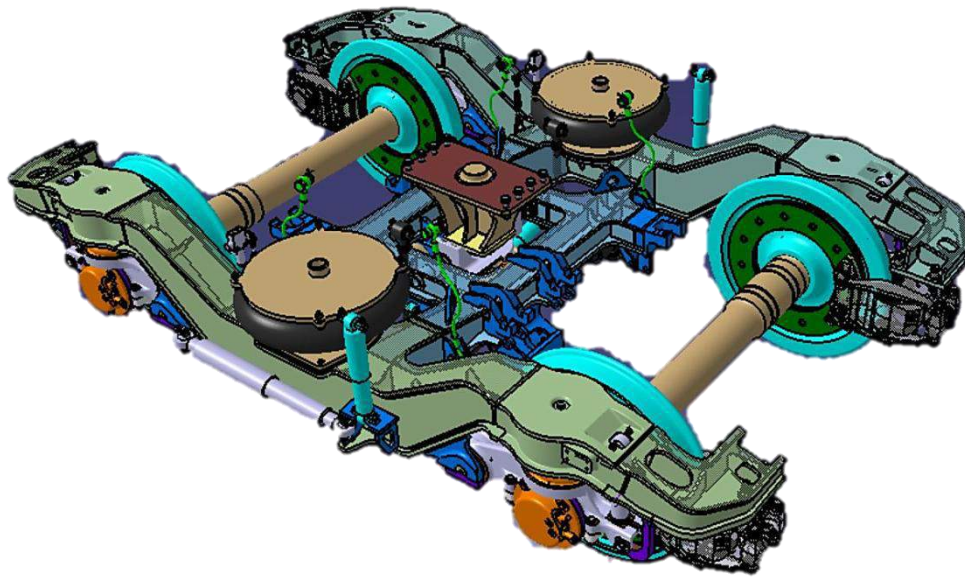


Figure 1

b. Motor Bogie(See Figure 2)

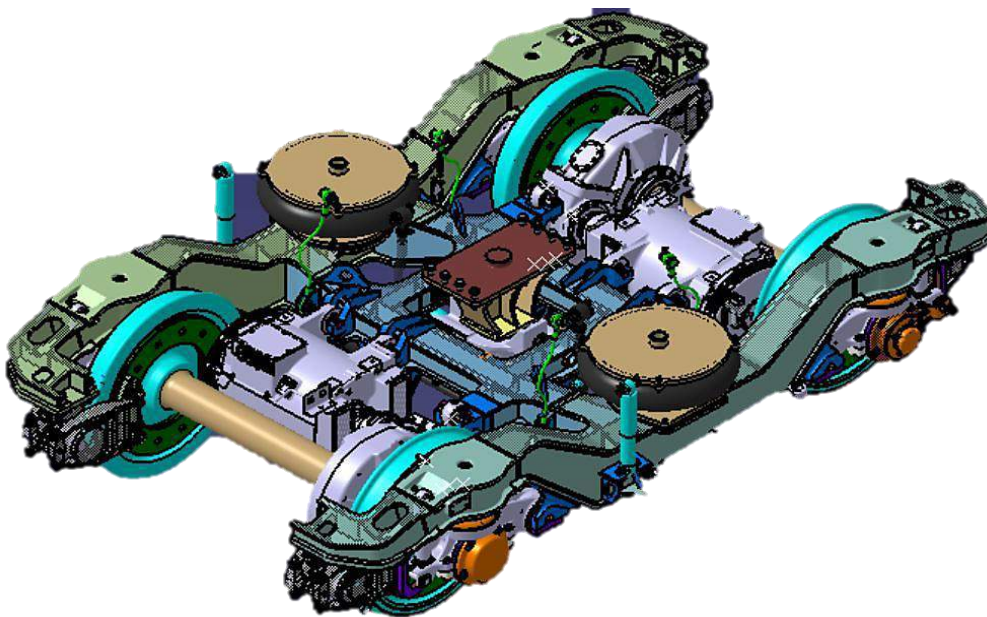


Figure 2

Features:

1. Bolster-less bogie design i.e. Carbody rests on air spring.
2. Fully Suspended Traction Motor so lesser un-sprung mass.
3. Wheel mounted Disc Brakes.
4. Secondary suspension with Air springs.

5.1.1 SAFETY INSTRUCTIONS

Basically, the regulations and safety precautions as set out in the previous chapter apply. Descriptions of the work following assumes they are being observed.

Warning!

When working on the bogies, the vehicle MUST be secured against rolling away. Any system components, on which it will be necessary to work, and any individual pressure pipes or hoses MUST, before work is started, be depressurised at both sides of the component.

The usual safety rules for electrical equipment must be observed:

- Switch off,
- Secure against re-energising,
- Check that no current is flowing.

When identical components are mounted more than once on a bogie, e.g. guides, dampers, springs etc., the appropriate instructions for removal or assembly always applies to each part.

Before assembling a bogie, all mechanical assembly surfaces must be cleaned!

5.1.2 DRAWING

Designation	Drawing number
Bogie General Arrgt. for Train18 DTC & NDTC	Train18/DTC/AC/0-0-002
Bogie General Arrgt. for Train18 Motor Coaches	Train18/DTC/AC/0-0-001

Table 1: Drawings for dismantling and assembly of bogies

5.1.3 TOOLS AND ACCESSORIES

Tools and accessories for dismantling and assembly

- Torque-wrench in the range 29 N-m to 800Nm
- 4-point lifting apparatus for complete vehicle (50t)
- Lifting apparatus for bogie (5t)
- Tool for disconnecting and reconnecting of cable-connectors

5.1.4 MAINTENANCE AND INSPECTION

Maintenance and inspection must be carried out in accordance with the intervals prescribed in the Maintenance Schedule of VANDE BHARAT EXPRESS (for further maintenance and inspection instructions, see manufacturer's documentation).

5.1.5 LIFTING THE VEHICLE

Warning!

Follow safety instructions relating to the lifting equipment!
Ensure that the marked lifting-points are used!

Information

For disconnecting the bogies, a maintenance pit is essential.

To

separate the bogies from the vehicle, disconnection of electrical connections, air-pipes and mechanical separation is first necessary.

All connections between body and the bogies must be split. The individual procedures will be described in the next section.

After disconnecting the bogies, the complete vehicle must be lifted by means of a four-point lifting apparatus at the jacking-points. The jacking-points are marked and are located behind or in front of the bogies.

The same basic procedure is also adopted when only one bogie is to be removed.

When lifting the vehicle, care must be taken to ensure no connections remain attached; if there are, they must be separated.

Assembly of the bogies takes place in the reverse order.

5.1.6 DISCONNECTING THE BOGIES

Disconnecting the bogies is accomplished in the following order:

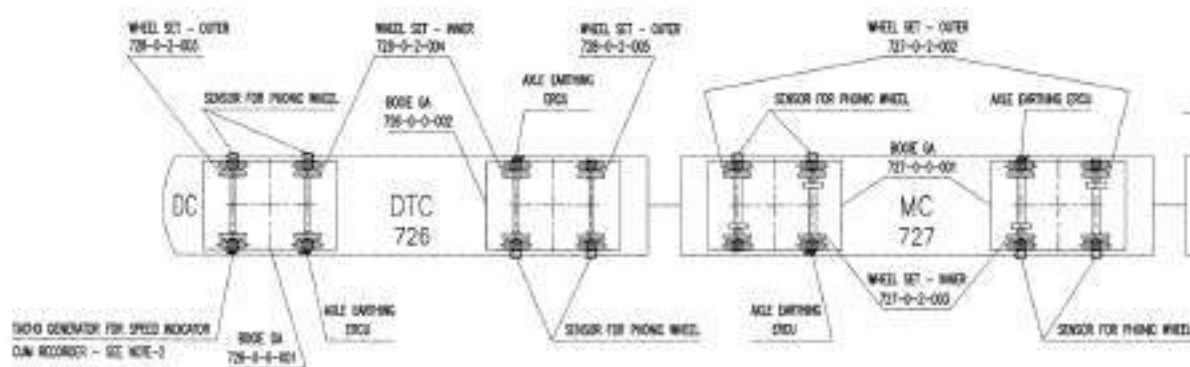
- Electrical disconnection
- Disconnecting air-pipes
- Mechanical disconnection

5.1.6.1 ELECTRICAL DISCONNECTION

Warning!

Cables hanging loose must be secured both against being damaged and becoming dirty

Removal of Cables: Disconnect all cables to traction (Figure 4) motors and axle end equipment i.e ERCU, speed sensor, phonic wheel sensor, earthing connection (body to bogie) etc. See Figure 3.



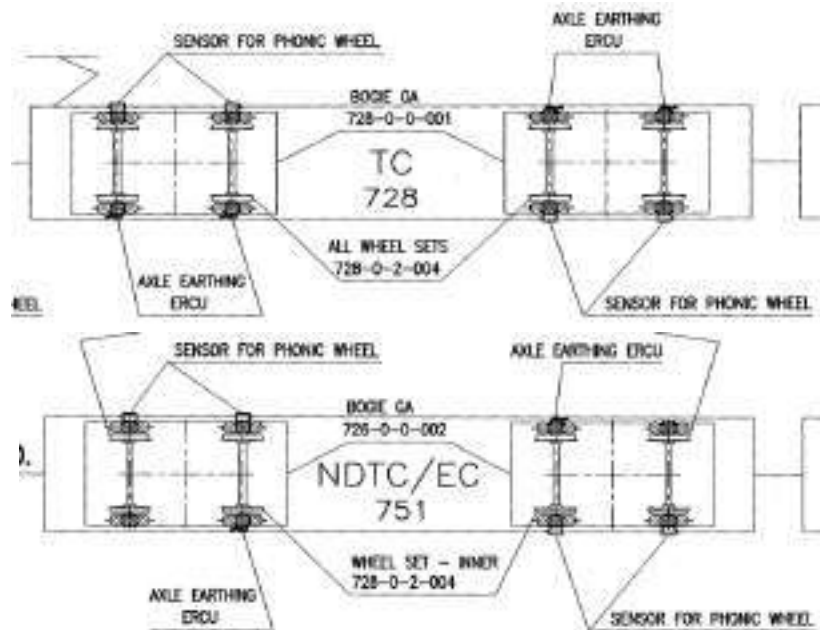


Figure 3: Axle End Equipments

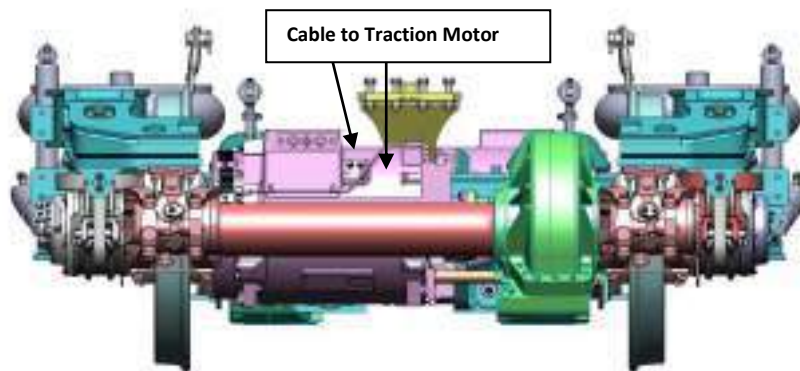


Figure 4

5.1.6.2 DISCONNECTING AIR-PIPE

Disconnect all pneumatic hose connections to brake caliper units & parking brake units.
(Figure 5) Pull manual release & ensure release of all PB units.

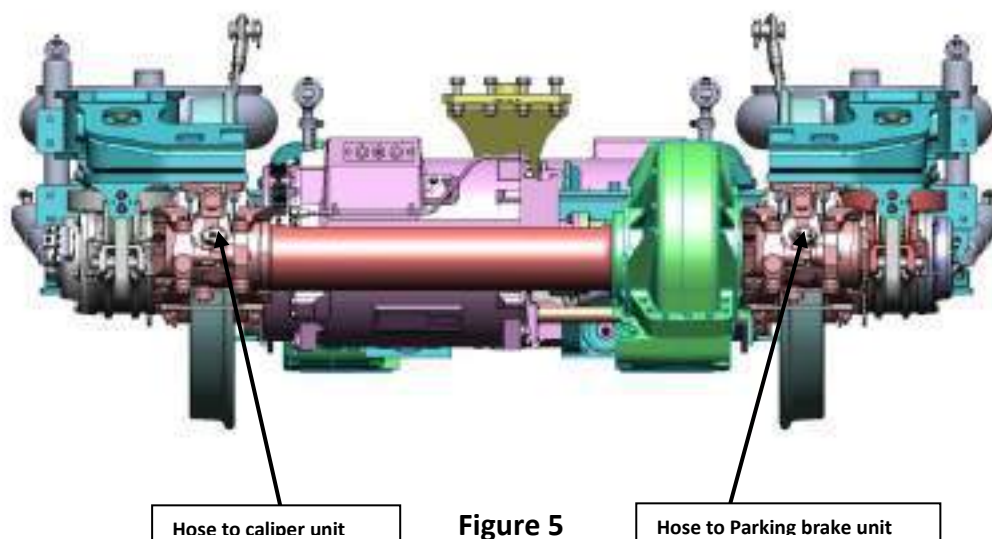
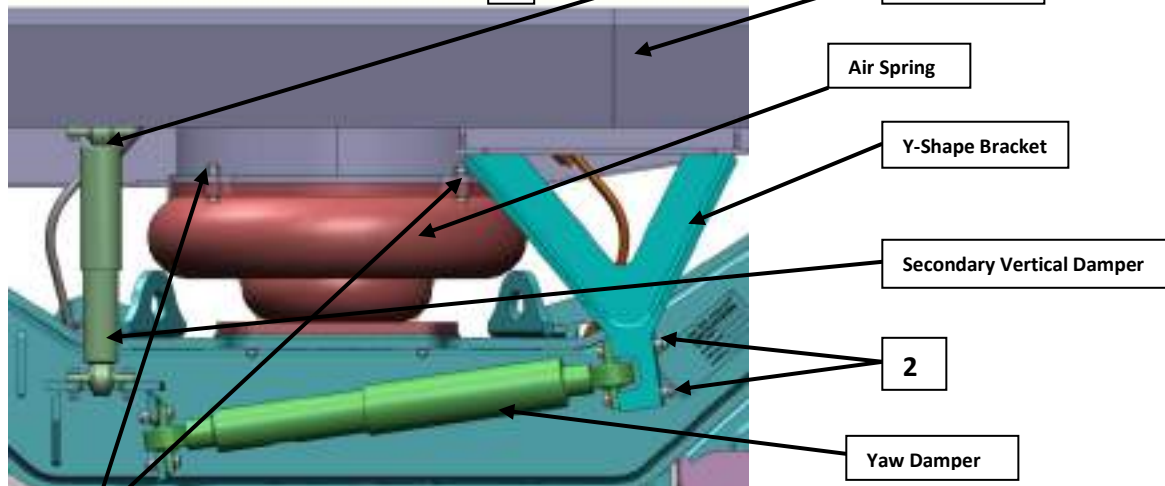
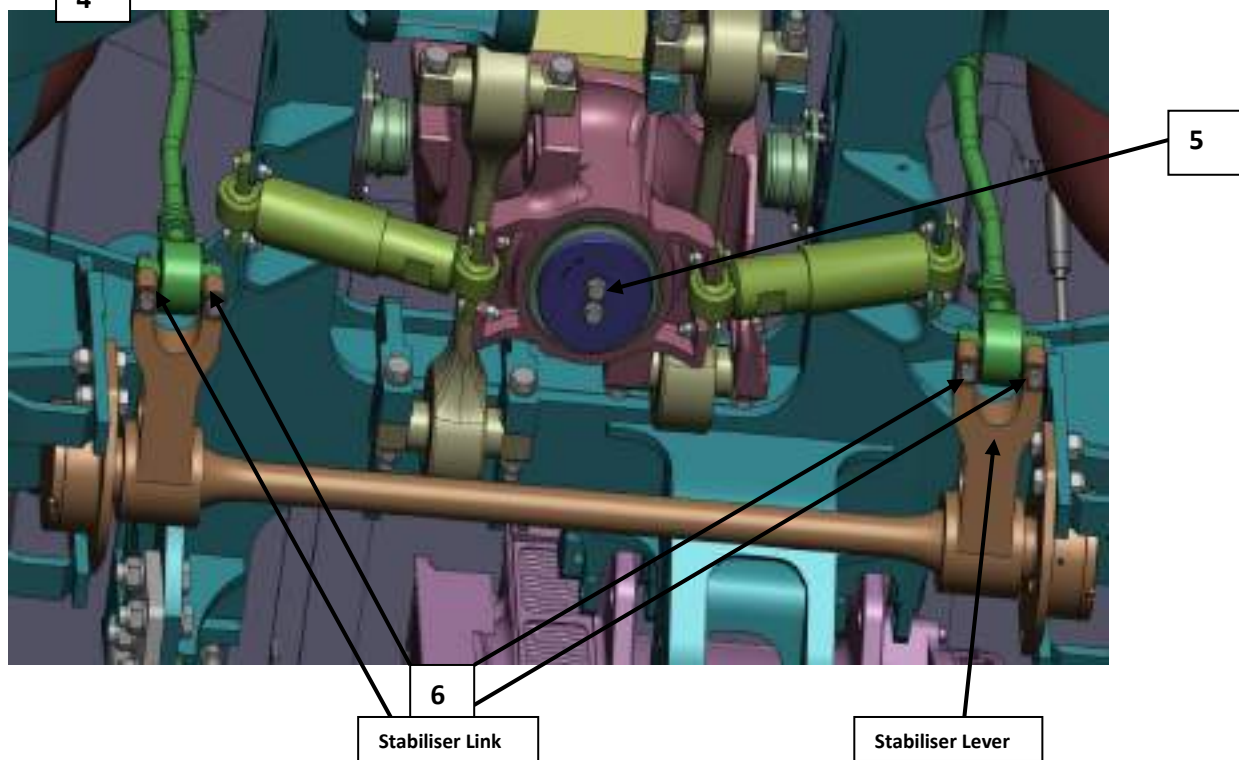


Figure 5

5.1.6.3 MECHANICAL DISCONNECTING

Under-frame and Bogie are connected with each other through following mechanical links and joints:

- a. Centre pivot pin bottom cover – 1 no. 5
- b. Safety wire rope – 2 nos. 1
- c. Air Spring- 2 nos. 4
- d. Secondary vertical damper –2 nos. 3
- e. Yaw Damper – 2 nos. 3
- f. Stabiliser Link – 2 nos. 6

**Figure 6****Figure 7**

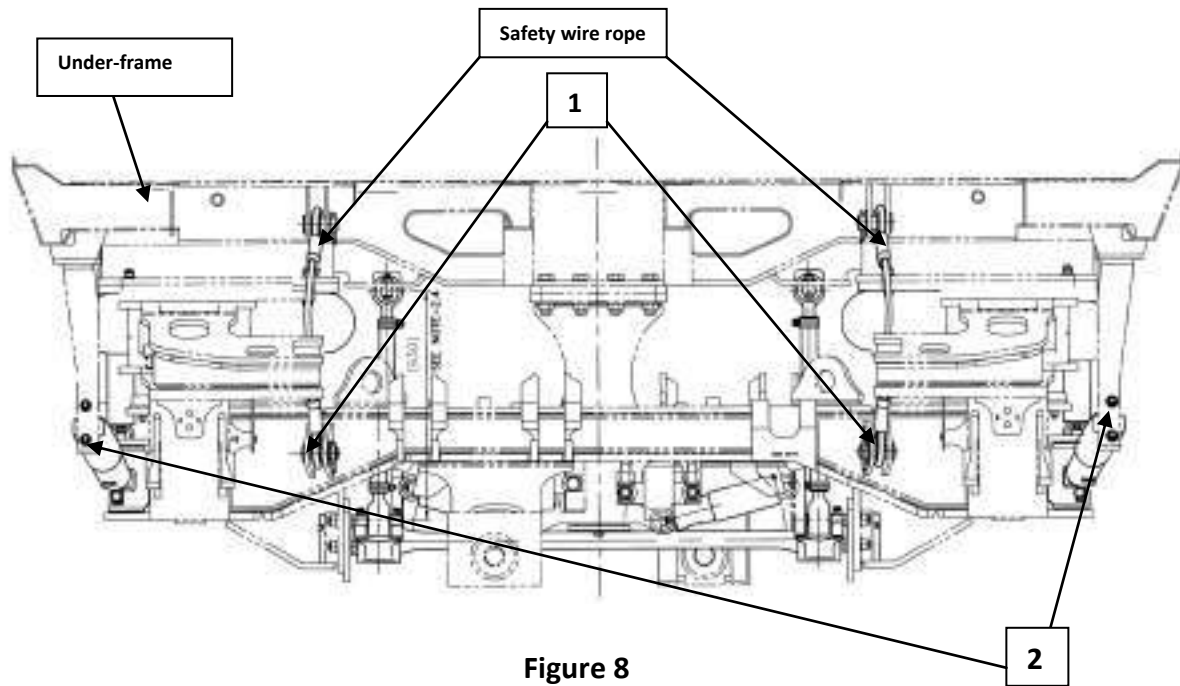


Figure 8

Remove all connections given in numeric code above from **1 to 6**. To remove connection between air-spring and under-frame, four fitment screws are to be opened. Two numbers of Yaw damper and vertical dampers are connected with under-frame. Similarly two numbers of safety wire rope and stabiliser link are connected with under-frame.

5.1.7 REMOVING BOGIES FROM THE VEHICLE

- Ensure all components / cables / hoses / screws as detailed above are removed on both the bogies.
- Suitably rotate stabiliser lever away from stabiliser link and secure with suitable rope / wire (with bogie) to avoid hitting on ground.
- Suitably push wire rope away from bracket & ensure it not entangles / damages any bogie bracket / component.
- Suitably & slowly (preferably inching up control to be used) lift the car body using synchronized jacks on all four lifting positions.
- While lifting, suitably ensure air spring's spigot is relieved from car body. If necessary, use suitable lever / wedge in between air spring top plate & car body to push down air spring.
- Run out both the bogies and suitably place in pit line. Provide suitable packing on all 4 wheels to arrest bogie movement.

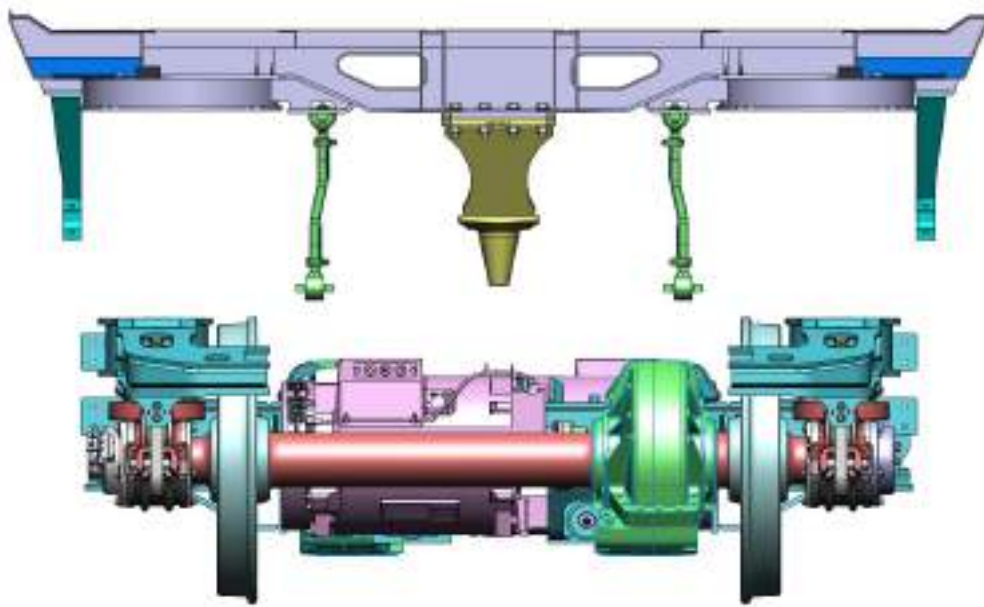


Figure 9 : Coach Body and Bogie after complete disconnection

5.1.8 ATTACHING BOGIES TO THE VEHICLE

Warning!

As a general rule, all safety devices such as lock-nuts, split-pins, cotters etc., must be replaced with new parts.

Attaching the bogies is accomplished in the reverse order to removing them. The following Working instructions are to be observed, and the torque limits must not be exceeded. When re-attaching the bogie to the vehicle body, various measurements must be checked. See table of measurements at Table 2 and Figure 10 & 11.

Wheel tread dia. & range of dia.	Brake caliper mounting surface from RL'A' in mm	Air spring seating from RL 'C' in mm	Shim thickness below air spring in mm	Air spring height (with air) + shim thickness (Machined area of bogie frame to machined area of body bolster)	Coupler height from RL in mm	CBC height from RL in mm (for driving end of DTC only)
At 952 (Ne wheel) (above 932 to 952)	701 ±3	688 ±3	NIL	300 +5/-0	940 +0/-5	1105 +0/-10
At 932 (above 912 upto 932)	601 ±3	678 ±3	10	(300 air spring height + 10 shim) 310 +5/-0	940 +0/-5	1105 +0/-10
At 912 (above 892 upto 912)	591 ±3	668 ±3	20	(300 air spring height + 20 shim) 320 +5/-0	940 +0/-5	1105 +0/-10
At 892 (above 877 upto 892)	591 ±3	668 ±3	30	(300 air spring height + 30 shim) 330 +5/-0	940 +0/-5	1105 +0/-10

Table 2 : Various Clearance and height adjustment

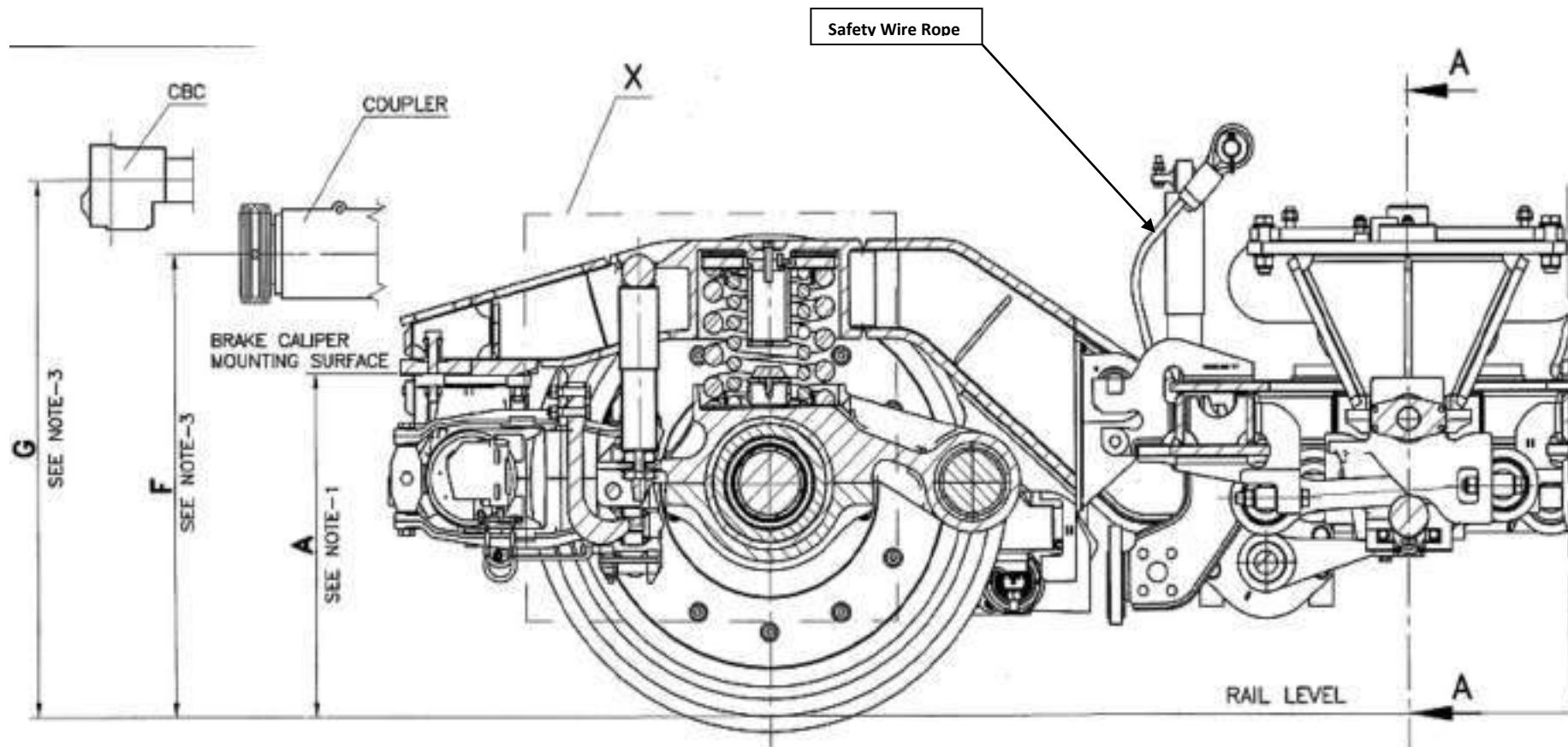


Figure 10

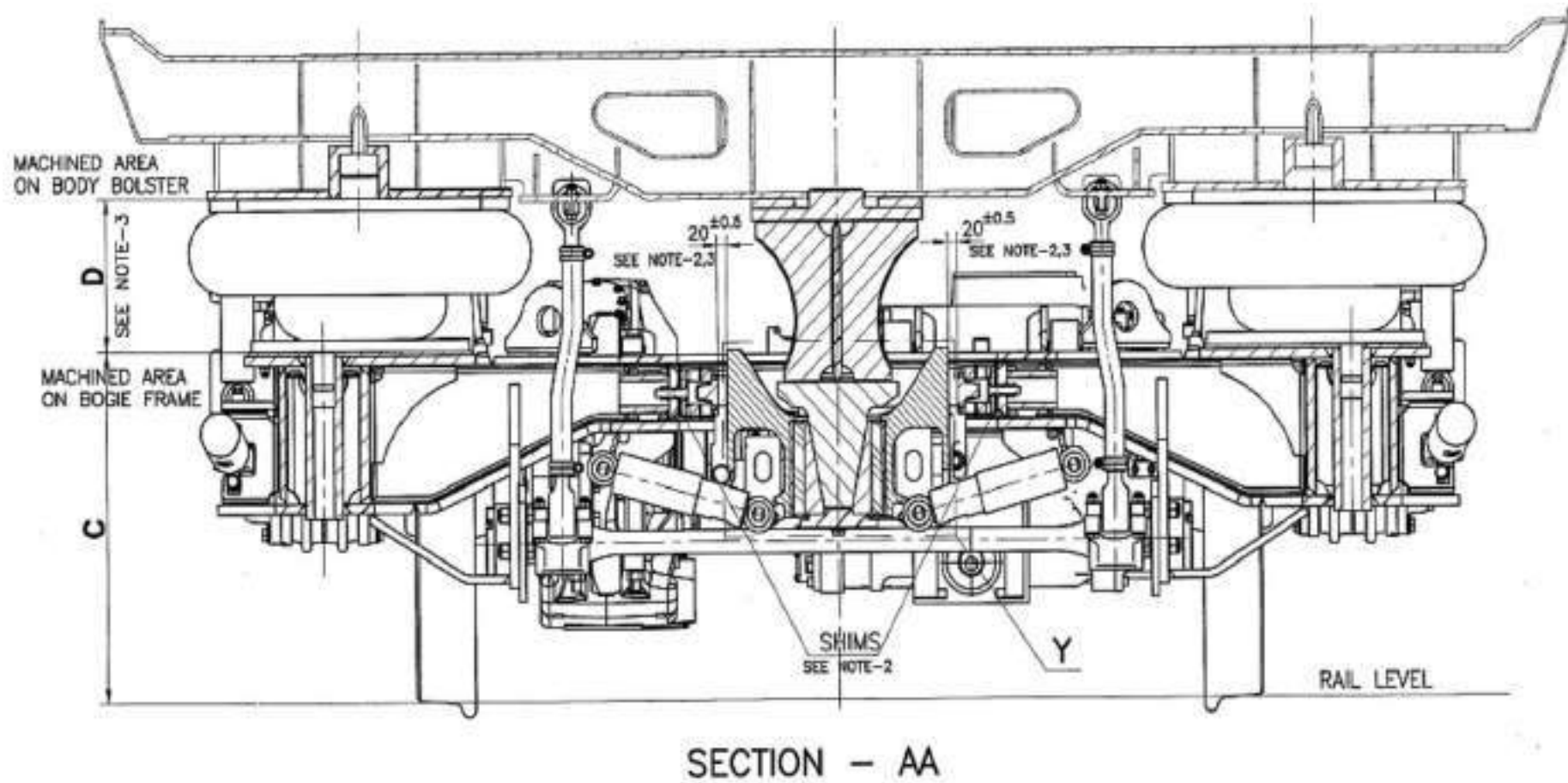


Figure 11

5.1.9 TORQUE TABLES

Designation	Figure	Torque
Tightening Bogie / vehicle body	Figure 7, Item 5,6 Figure 6, Item 4	174Nm, 242Nm 192Nm
Tightening dampers	Figure 6, Item 2,3	192Nm, 80Nm

Table 3

5.1.10 FINAL INSPECTIONS

All components must be tested for perfect functioning. All bolted items must be checked for tightness.

A brake test must be carried out, in accordance with the brake manufacturer's instructions.

Content - Coupler

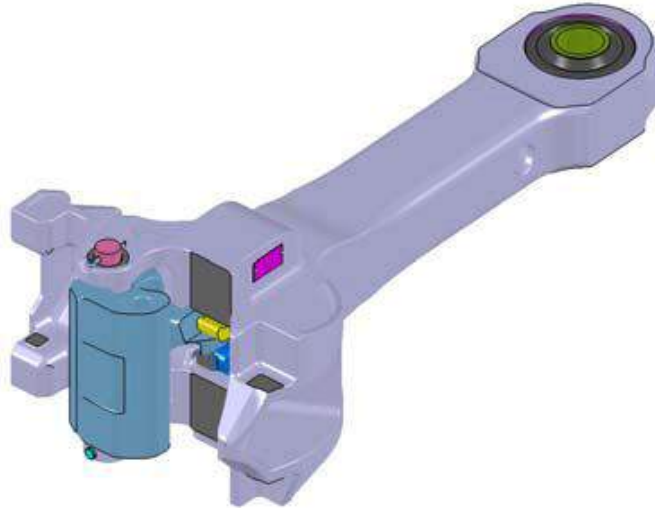
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5.2. COUPLERS - TIGHT LOCK COUPLER HEAD TYPE 'H'

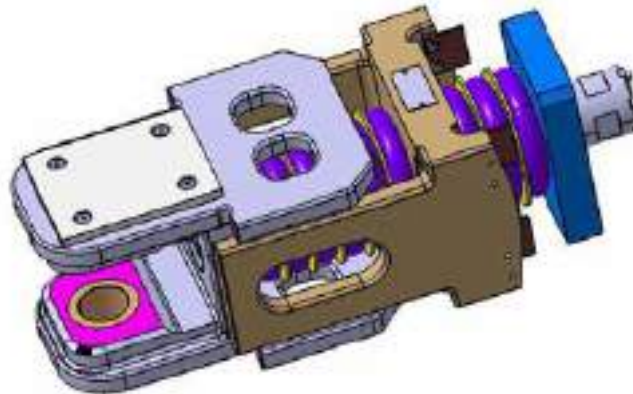
5.2.1 CONSTRUCTION

The coupler consists of the following main parts:

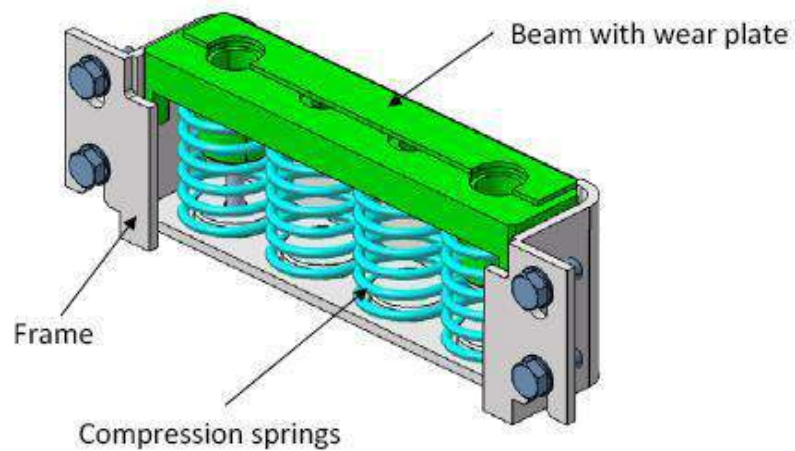
I. Tight lock Coupler head Type "H"



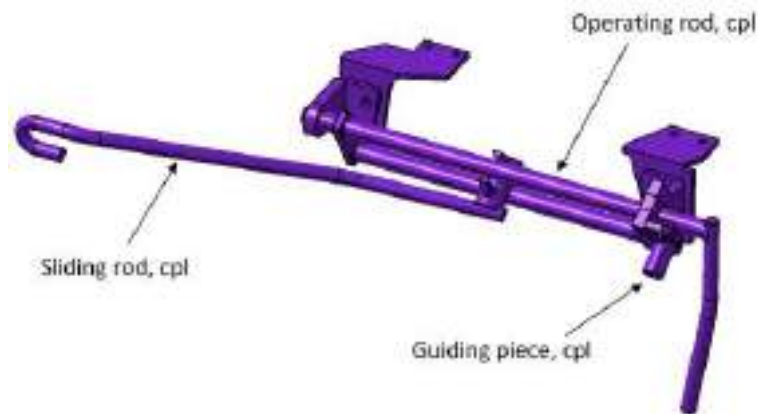
II. Balanced Draft gear



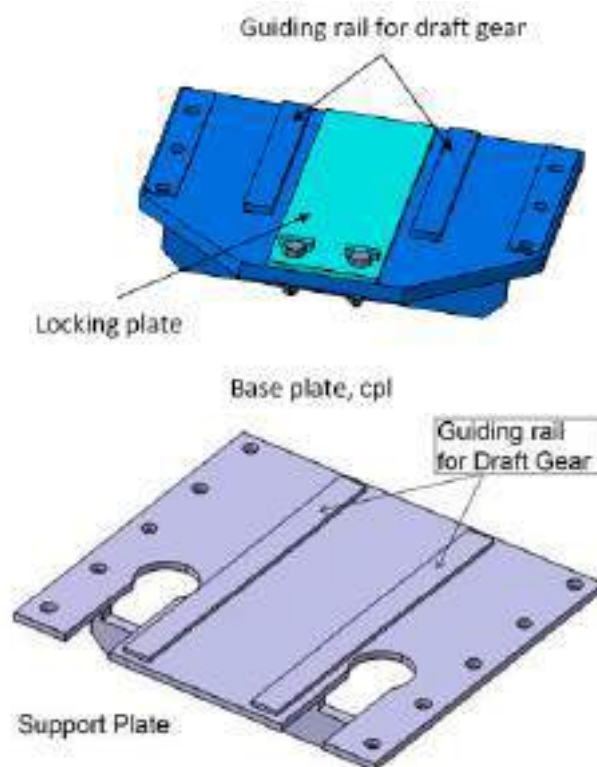
III. Supporting device :



IV. Manual uncoupling device :



V. Mounting plates



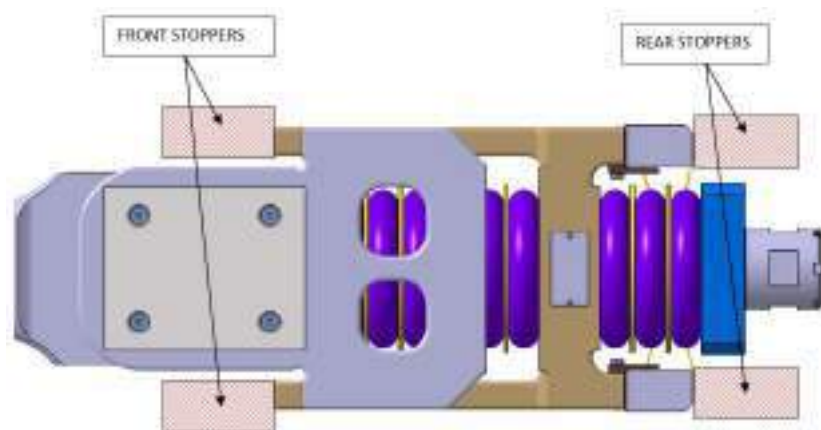
5.2.2 COUPLER MOUNTING

I. Preparation of the vehicle

- The dimension of draft gear pocket on coach has to conform to that shown as per OEM document.
- Apply adequate grease on all bearing surfaces of Balanced draft gear (except in Pads fitment area) and in the draft gear pocket in the car-body, before mounting the Balanced draft gear.
- The coupler parts delivered are ready for mounting to the vehicle under frame.
- Mounting procedure/sequence to be followed for installation of coupler on the vehicle as described below.
- For lifting the coupler parts, a standard hydraulic lifting table is to be used.

II. Mounting of the Balanced draft gear

- The elastomer pads of the Balanced draft gear is pre-compressed to the defined distance. Wedges and Mounting Bolt-M27 and washer-M27 are required for Balanced Draft Gear.



Note: Before mounting the Balanced Draft Gear into the pocket, measure and confirm the dimension of the pocket length and height in the car-body.

- The Balanced draft gear is to be lifted from underneath the car into the draft pocket by means of a standard hydraulic lifting fixture.

Note : Balanced Draft Gear should be 6mm (min) inside from the car body pocket bottom surface, where Base plate and Support plates will be fitted.

- Fix the bottom wedges and bolt them with the Torque of 400-500 Nm. Tie the bolts with the locking wire. This torque is to be checked during periodic inspection.
- Fix the Base plate and Support plate with M16x55 Hex. head Bolts, Grade 10.9 and are to be tightened to the torque of 180-200 Nm. This torque is also to be checked during periodic inspection. Use of loctite as a thread locking agent is recommended.

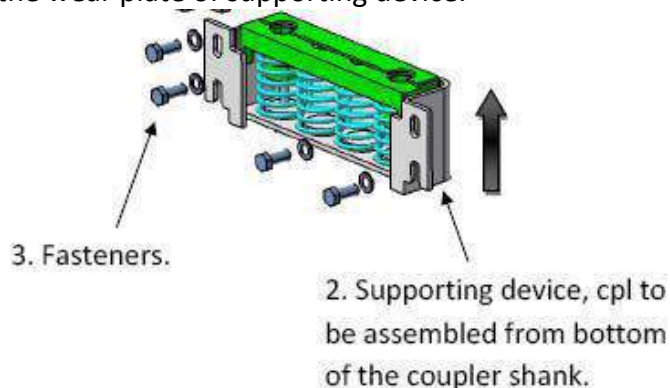
III. Mounting of the Coupler head

- First mount the Supporting device and fix with four no's of Hex head bolt M20x50mm – grade 10.9.
- The coupler head has to be placed on hydraulic lifting fixture or on the forklift and insert into the Balanced Draft Gear from front end of coach to connect the coupler head linkage to the Balanced draft gear by means of the central pin.
- Fix the base plate sub assembly at the bottom side of under frame of the coach.
- The position of central pin has to be secured by the locking plate in between the base of central pin and base plate. Locking plate is secured by two M16 bolt/nut and locked with spring dowel/split pin and torque up to 180-200 Nm.

IV. Mounting of the supporting device

- Hold the coupler head in lifted position (above horizontal), the supporting device position is to be adjusted to make the coupler head in horizontal position.

- Ensure the torque of 450 +50 Nm in the mounting bolts M20x50mm – grade 10.9. This torque is also to be checked during periodic inspection. Use of loctite agent 243 is recommended.
- Apply grease on the wear plate of supporting device.



V. Mounting of the manual uncoupling device

- Mounting brackets (LH & RH) are to be fastened on the vehicle structure.
- Manual uncoupling device, bearing brackets (LH and RH) are to be fastened to these mounting brackets.
- Use of loctite and tightening with adequate torque (for M16 Bolt, 180-200 Nm and for M12)
- Bolt, 60-80 Nm) is recommended and this torque is also to be checked during periodic inspection.
- Fix the Sliding rod to the coupler head rotor assembly, before fastening the device to mounting bracket.
- Fix the Operating rod with Sliding rod 'H' piece and then fix the both ends of the operating rod in the bearing brackets.
- Uncoupling will be done by lifting and turning operating rod handle in clockwise direction

VI. Final check of coupler installation

After completion of coupler installation the following functional checks are to be executed:

- Proper fastening and securing of all bolt connections to recommended torque.
- Free movement of the coupler head in horizontal and vertical direction.
- Free movement of the lever system of the manual uncoupling device.
- Functional check of the uncoupling device on coupler head by operating manual uncoupling device.
- Coupling and uncoupling test.

5.2.3 COUPLER DISMOUNTING

I. Dismounting coupler head

- Remove sliding rod from the rotor assembly of coupler head by removing operating rod from the mounting brackets fitted on coach.
- Coupler head is dismounted first by pulling out central pin with central pin puller. To access the central pin, remove the Locking plate fitted in base plate. If not feasible remove the Base plate assembly and take out the Central pin.

Note : Support coupler head on a hydraulic lifting fixture while removing the central pin.

II. Dismounting of Balanced draft gear from the coach

- Remove the Base plate and put a hydraulic trolley below the Balanced Draft Gear and hold it.
- Now remove the Support plate.
- Using ratchet and socket to suit M27 Bolt, loosen the bolts fitted in Wedges.
- Now takeout the Bottom side wedges.
- Slowly lower the hydraulic table ensuring that the Balanced draft gear also slides down the pocket.
- Take out the top side wedges.

Note : In any case, if the wedges are struck / jammed in the assembly and couldn't able to remove, follow the below steps to take corrective action :

- Remove M27 Bolt from the wedges.
- Take 1 ¼" – 7UNC threaded Bolt / Screw and fix at the Bottom wedges.
- Shake and Drag / pull the Bolt down to loosen the wedges.
- Once the wedges got loosened, Balanced Draft Gear can be removed easily.

5.2.4 COUPLING AND UNCOUPLING PROCEDURE

I. General Information

To facilitate the safe operation of building up trains and coupling of coaches by the tight lock couplers it is absolutely necessary to follow the instructions given below.

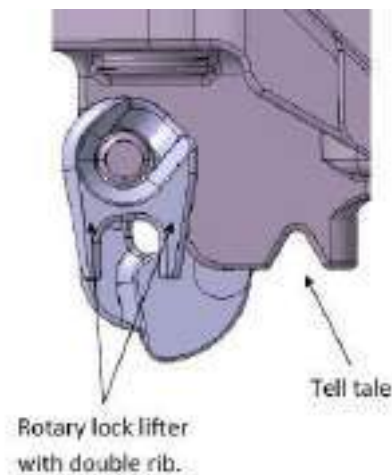
The specified coupler head is a tight lock coupler head according to the AAR standard type "H". This coupler head for the IR - Coaches has the following gathering range as specified in technical specification RDSO-2011-CG-03 issued by RDSO:

- Horizontal: ± 110 mm
- Vertical: ± 90 mm

Proper coupling procedure is recommended to achieve an easy and safe coupling/uncoupling of vehicles in practical service. During coupling and uncoupling, care should be taken that no person stands between the vehicles. Coupling is automatic. For uncoupling - unlock, lift and rotate manually the handle of manual uncoupling device in a clockwise direction.

II. Coupling procedure

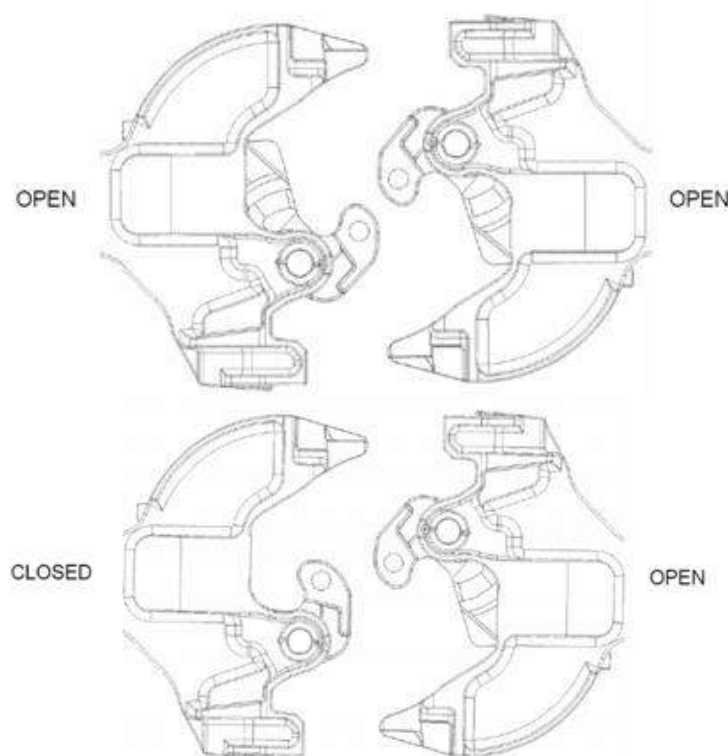
- Bring the vehicles near to each other at a slow speed (approx. 2-3 km/h) and stop the vehicles at approximately 1-2 meter distance of each other.
- Check alignment and position of coupler centres. Couplers must stand within the gathering range as given above.
- If required pull the couplers manually towards each other and make sure that they are in the gathering range of the coupler geometry.
- For coupling, move the Locomotive with a speed of 3 - 5 kmph.
- Check the position of tell-tale area to ensure proper coupling. It should be free. Also ensure that, the Double Rotary Lock lifter rib should be vertical.
- Make sure, that the handle of manual uncoupling device is locked after coupling.



Tell-tale position in coupler

Note : Coupling cannot be done when both the knuckles are closed. Coupling can be done when

- Two Knuckles are in open condition or
- One knuckle in open condition and other one in closed condition or vice versa
- After coupling, reverse the power to pull (snatch) the vehicles apart. This is a typical pull test to reconfirm a positive coupling.



Vice versa position of couplers

III. Uncoupling procedure

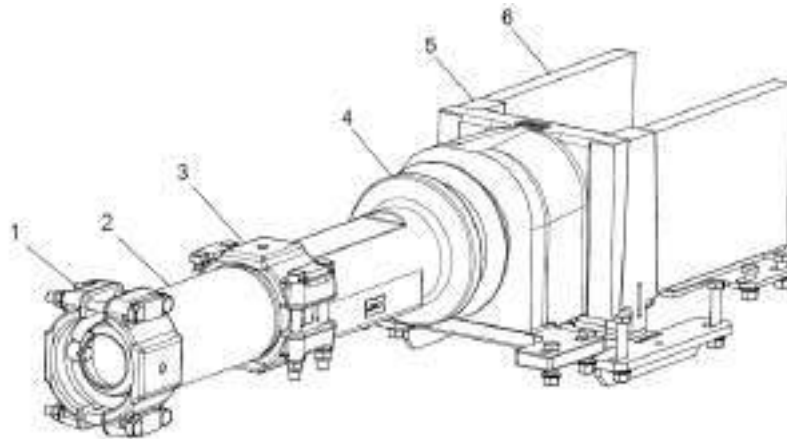
- For uncoupling, use the uncoupling lever of the Operating rod which is accessible from the trackside.
- Unlock the handle by rotating the locking screw with a special key.
- Lift and turn the handle in clockwise direction to a horizontal position (minimum 90°) and pull the coaches apart.

Note : Before uncoupling make sure that the couplers are not subjected to any tensile load and the uncoupling lever is fairly free to turn. A common practice for this uncoupling operation is also to push the vehicles together (with one vehicle applied with parking brake) to avoid excessive binding in the system.

For further details, please refer OEMs manual.

5.3. COUPLERS – SEMI PERMANENT COUPLER

5.3.1 CONSTRUCTION



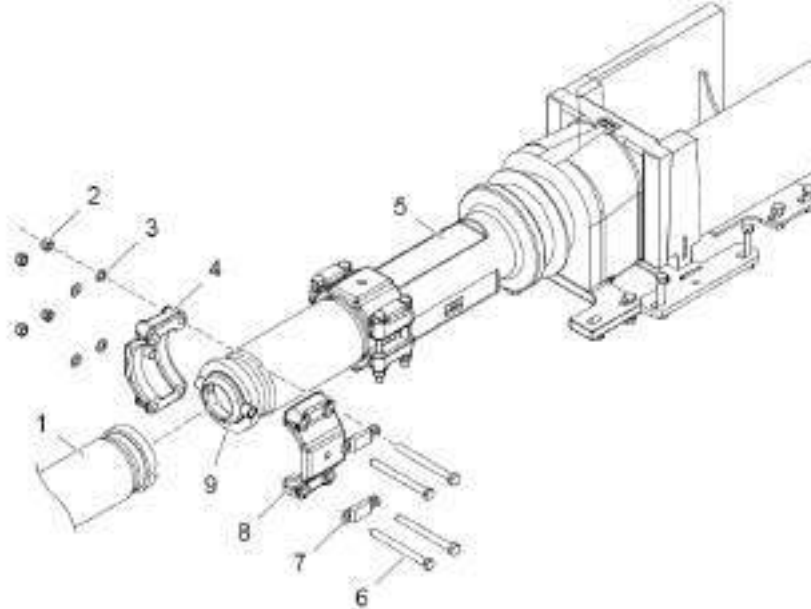
No	Component
1	Socket joint
2	Tube
3	Socket joint
4	Draft gear
5	Locking wedge
6	Clamping device

5.3.2 COUPLING

- I. Make sure that the semi coupler half (5) is equipped with the guide cone (9).
Note If a socket joint is being reused the screws (6), washers (3) and nuts (2) shall be replaced with new ones.
- II. Grease the contact surfaces of the flanges and both socket joint halves (4 and 8) with Lagermeister 3000+.
- III. Slowly bring cars together. Note Make sure to align the two coupler halves accurately, both vertically and horizontally, before bringing the vehicles together.
- IV. Gently knock the socket joint halves (4 and 8) into place over the flange joint. Make sure that the guide pins on the socket joint halves are correctly positioned in corresponding recess in the guide cone (9).
- V. Check that both socket halves are parallel within 2 mm, equal distance. If they are not parallel remove one of the socket joint halves and start the procedure again.
- VI. Apply Molykote 1000, to the screw threads and fit screws (6), lock washers (7) to the socket joint half (8).
- VII. Fit the washers (3) and nuts (2) to the socket joint (4) and tighten nuts (2) by hand,

without tools.

- VIII. Again check that both socket joint halves are parallel within 2 mm, equal distance and apply 60 Nm torque to the nuts in a crosswise pattern.
- IX. Verify that both sockets halves are still parallel and apply 120 Nm torque to the nuts continuing with the crosswise pattern.
- X. Verify that both sockets halves are still parallel and apply the total 185 Nm torque to the nuts in a crosswise pattern. Repeat the sequence of torque nuts to 170Nm in a crosswise pattern until there is no further rotation of the nuts.



Coupling/Uncoupling

No	Component
1	Mating coupler
2	Lock nut
3	Washer
4	Socket joint half
5	Semi-Permanent Coupler
6	Screw
7	Lock washer
8	Socket joint half
9	Guide cone

5.3.3 UNCOUPLING

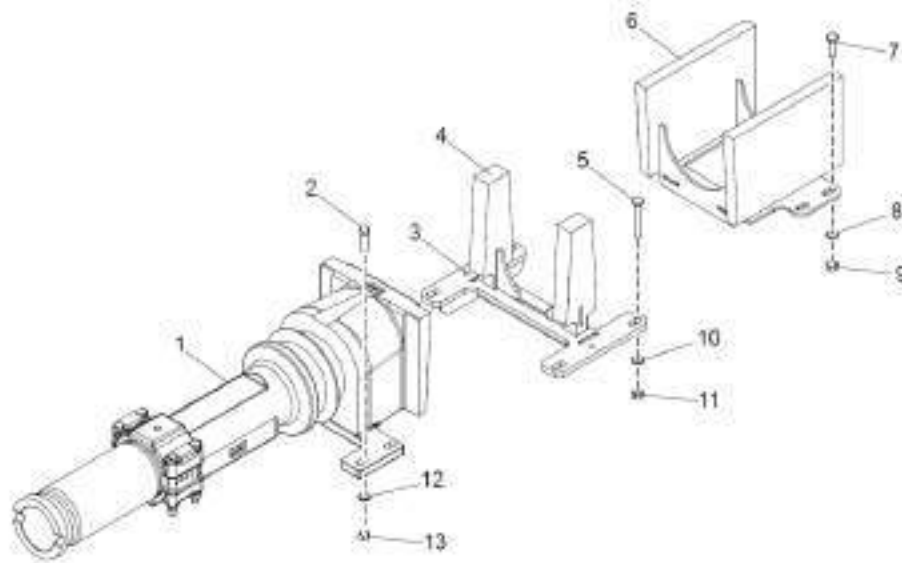
- I. Remove the socket joint halves (4 and 8) by removing the nuts (2), washers (3) and screws (6).
- II. Separate the cars.

5.3.4 REPLACEMENT

REMOVAL

- I. Loosen the locking wedge (4) by removing screws (5), washers (10) and nuts (11).
- II. Fit M16 screws to the holes (5) in the locking wedge (6).

- III. Remove the locking wedge (6) from the vehicle by tightening the M16 screws.
- IV. Remove the screws (2), washers (12) and nuts (13) and carefully remove the draft gear(1) from the vehicle.
- V. Remove the clamping device (6) by removing screws (7), washers (8) and nuts (9).



Replacement of Semi-Permanent Coupler

No	Component
1	Draft gear
2	Screw
3	M16 hole
4	Locking wedge
5	Screw
6	Clamping device
7	Screw
8	Washer
9	Nut
10	Washer
11	Nut
12	Washer
13	Nut

Replacement

Replace all fasteners and rubber parts if applicable.

- I. Carefully fit the draft gear (1) to the vehicle using a suitable lifting device.
- II. Mount screws (2), washers (12) and nuts (13).
NOTE: Do not fully tighten the screws, only tighten the screws so that the draft gear is loosely fitted.
- III. Fit the clamping device (6) to the vehicle and mount screws (7), washers (8) and nuts (9).

NOTE: Do not fully tighten the screws, only tighten the screws so that the clamping device is loosely fitted.

- IV. Make sure that the distance between the clamping device and draft gear is smaller than the space needed by the locking wedge. This action provides a tight interface between the locking wedge and draft gear, and locking wedge and clamping device.
- V. Fit the locking wedge (4) to the vehicle, push it upwards to fit it in between the draft gear (1) and clamping device (6). Mount screws (5), washers (10) and nuts (11). Tighten screws (5) to 170 Nm and mark screws with torque seal.
- VI. Fasten the draft gear: tighten the screws (2), washers (12) and nuts (13).
- VII. Fasten the clamping device: tighten the screws (7), washers (8) and nuts (9).

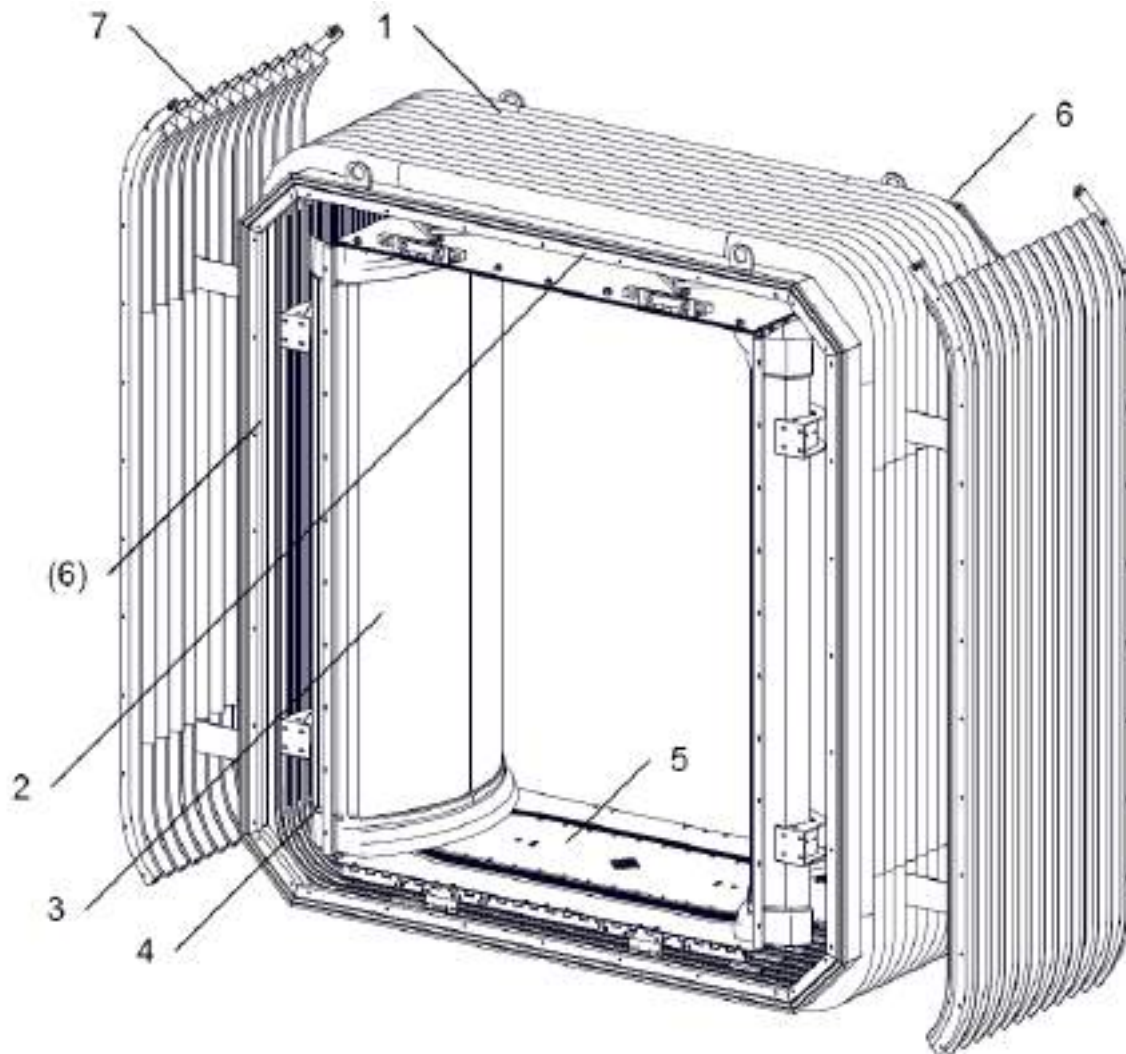
Content - Gangway

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5.3. GANGWAY

5.3.1 CONSTRUCTION

The gangway consists of the following main parts:



No	Component
1	Corrugated bellows, assy., mounted
2	Linking ceiling, assy.
3	Side wall, assy. inner covering
4	Covering brush, assy.
5	Combination bridge, assy:
6	Screw-on frame
7	Folding wall, assy.

5.3.2 MOUNTING COMPONENTS/ASSEMBLY GROUPS

Mounting the loose parts – Overview

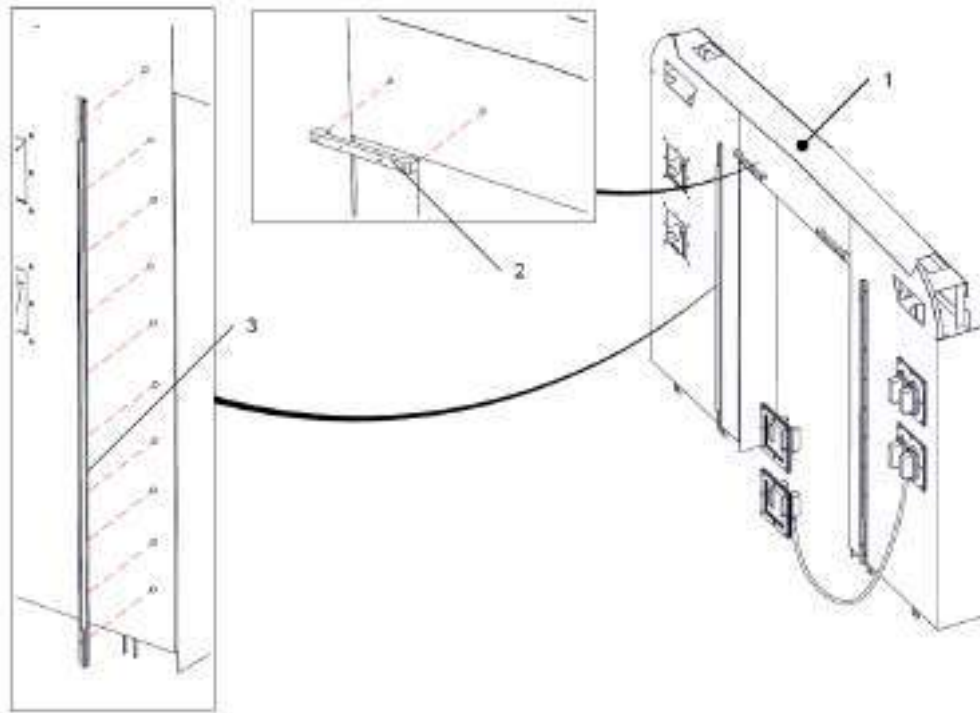
Both wagon-interfaces have to have the hole pattern to receive:

- the screw-on frames of the “corrugated bellows, assy. final mounted”

- the folding wall
- the combination bridge,
- the covering brushes,
- the guiding bodies and
- the shackles.

Mount the following components to each wagon-interfaces

- 4 pc. Covering brush, assy.
- - 4 pc. Shackle, assy.



Mounting parts – Wagon-interface No. 1 and No. 2 (No. 2 = opposite side)

No	Component
1	Wagon-interface
2	Shackle
3	Covering brush

The covering brushes to the wagon-interfaces

- Bolt the covering brushes to the wagon-interfaces (each 10x M6).

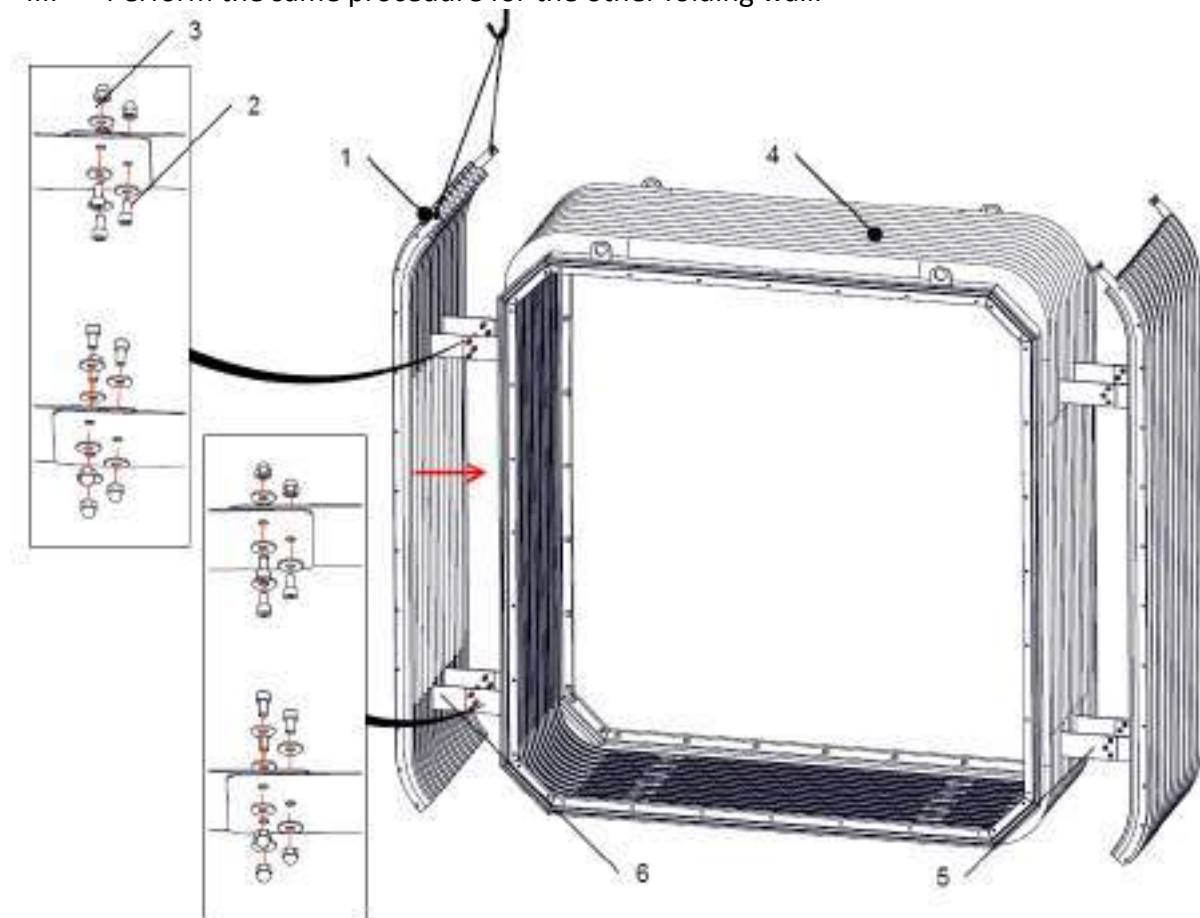
The shackles to the wagon-interfaces

- Bolt two shackles (receiving later-on the linking ceiling) to each wagon-interface.
Each 2x M10

The folding wall, assy. to the corrugated bellows

- Lift the folding walls by means of a crane and bring it into approximate mounting position.

- II. Bolt with screws, washers and nuts the connecting plates of the folding wall with the connecting plates of the corrugated bellows.
- III. Perform the same procedure for the other folding wall.



Mounting folding wall, assy. on corrugated bellows

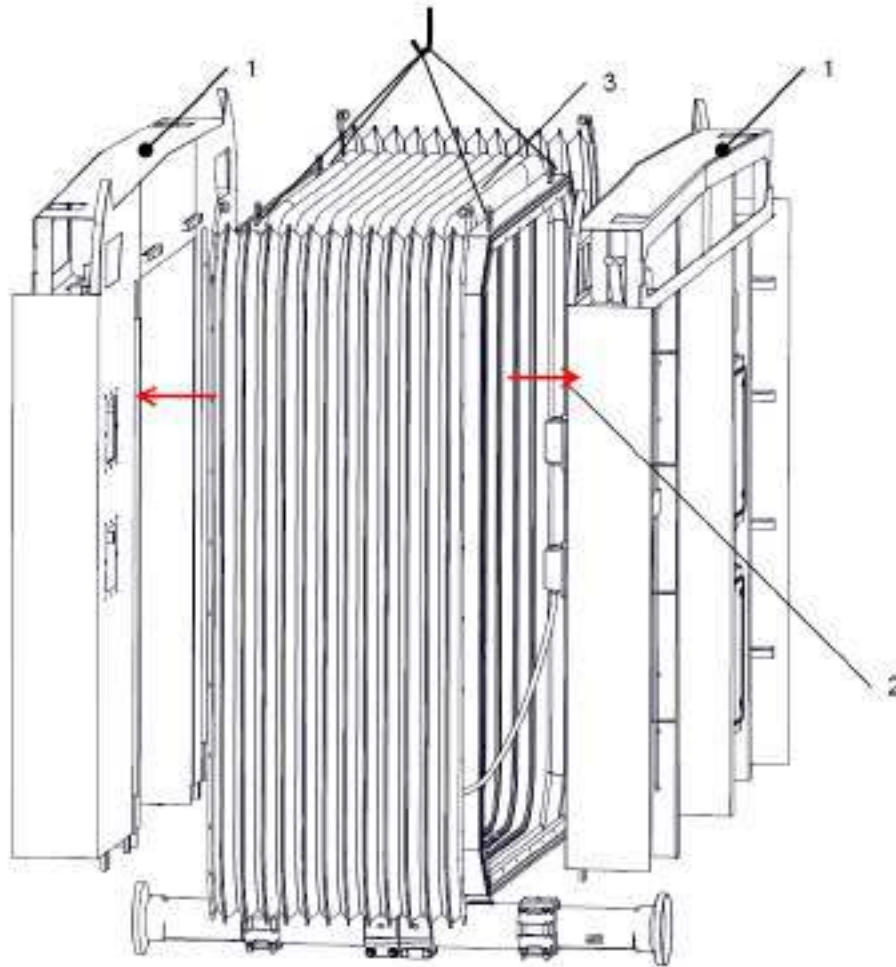
No	Component
1	Folding wall, assy.
2	Screw and washer
3	Nut and washer
4	Corrugated bellows, assy., final mounted
5	Connecting plate (bellows)
6	Connecting plate (folding wall)

The corrugated bellows, final mounted to wagon interfaces

- I. Couple the wagon coupling of the cars.
- II. Lift the corrugated bellows by means of a crane and bring it into approximate mounting position between the wagons.
- III. Align the hole pattern of the wagon-interface and the screw-on frame. Screw the screw-on frame of the corrugated bellows to the wagon- interface.
- IV. Repeat the previous step at the other wagon-interface.
- V. Bolt on the screw-on frames of the folding walls to the wagon interfaces.

After mounting the “Corrugated bellows, assy. final mounted” mount the following components to the wagon-interfaces

- 1 pc. Combination bridge, assy.
- 1 pc. Linking ceiling, assy.
- 2 pc. Guiding body, assy. screw-on frame side
- 2 pc. Guiding body, assy. locking side
- 2 pc. Side wall, assy.



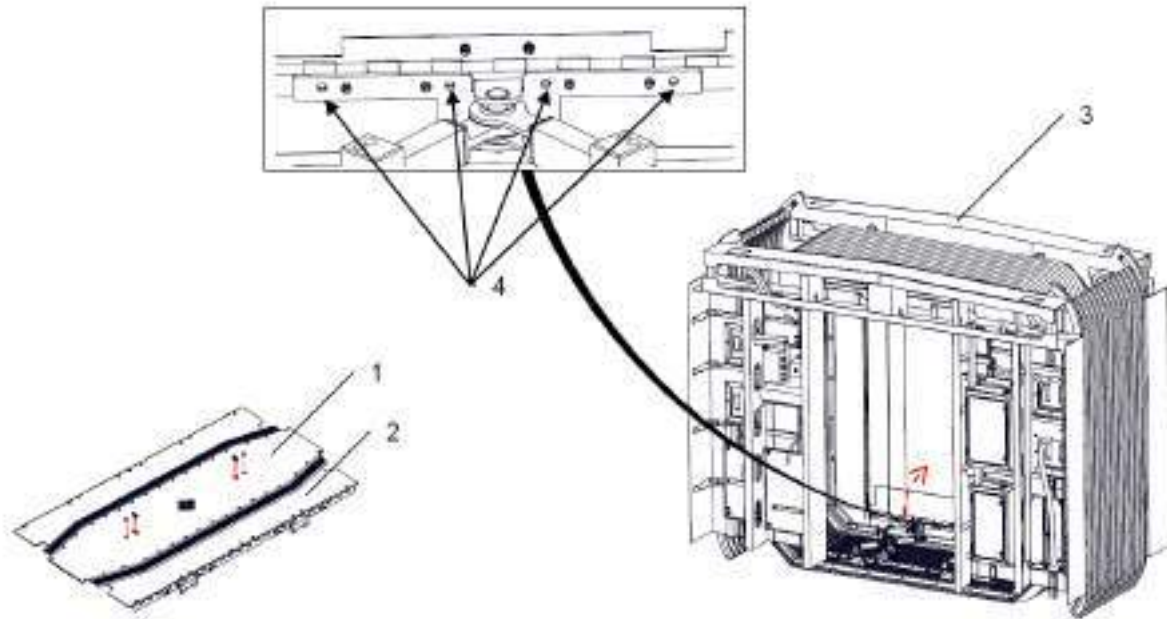
Mounting corrugated bellows on vehicle interfaces

No	Component
1	Wagon-interface
2	Bolt Bellows to hole pattern of wagon-interface all around contour
3	Corrugated bellows, assy., final mounted

The combination bridge, assy.

- Before installing the combination bridge, assy. between the wagon interfaces. Unscrew the six screw of the tread plate and remove the tread plate.
- Insert the combination bridge into the corrugated bellows.
- Flip up the wagon sided bridge plates of the combination bridge.
- Screw the combination bridge to the vehicle interface near the scissors by using appropriated screws.
- Bolt the combination bridge to the vehicle interface on the other side near the scissors using screws.
- Flip down the bridge plates.

VII. Put in the tread plate and bolt it on with the six screws.



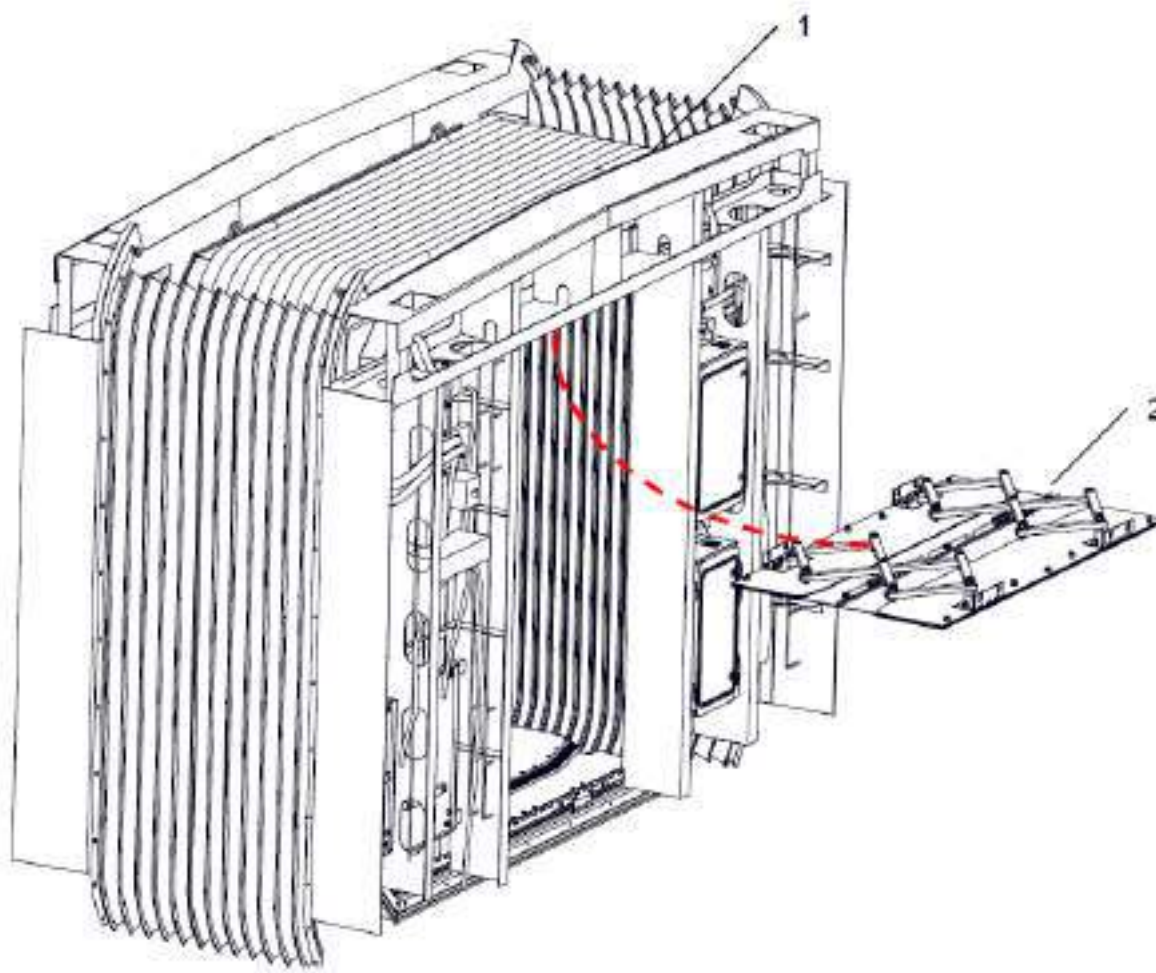
Mounting combination bridge, assy.

No	Component
1	Tread plate, assy.
2	Bridge plate, assy.
3	Wagon interface
4	Holes for screws

The linking ceiling

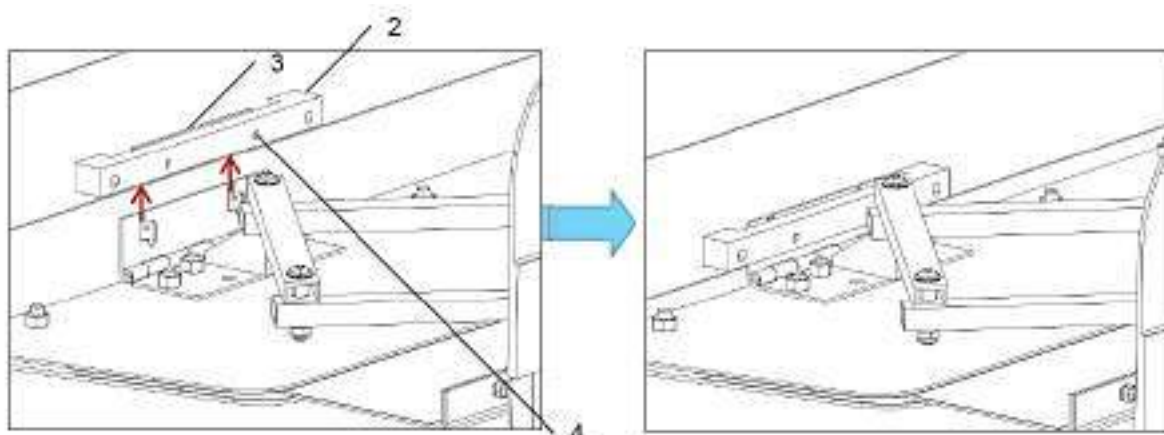
Mounting of the linking ceiling requires two persons.

- I. Compress the unmounted linking ceiling by pushing the outer ceiling plates onto the middle (simple) ceiling plate.
- II. Bring the linking ceiling into mounting position into the gangway area.
- III. Bolt the hinges (per hinge 2x M8) of the linking ceiling to the already mounted shackles of the screw-on frame side No. 1 by sliding the hinges of the linking ceiling in-between the plate of the shackle and the shackle body
Note: The attachment drillings of the rod hinges are slots in order to be able to align the height of the linking ceiling with the interior lining in the respective area. Place (hang) the hinges onto the screws before used to bolt the shackles to the wagon-interfaces.
- IV. Tighten the attachment screws of the linking ceiling (per hinge 2x) by reaching into the gap between wagon-interface and linking ceiling using a flat open-end spanner (Size 13).
- V. Repeat on 2nd wagon-interface.



Mounting the linking ceiling to the shackles already mounted to the wagon interfaces

No	Component
1	Wagon-interface.
2	Linking ceiling.



Mounting the linking ceiling to the shackles already mounted to the wagon interfaces
(schematic)

No	Component
----	-----------

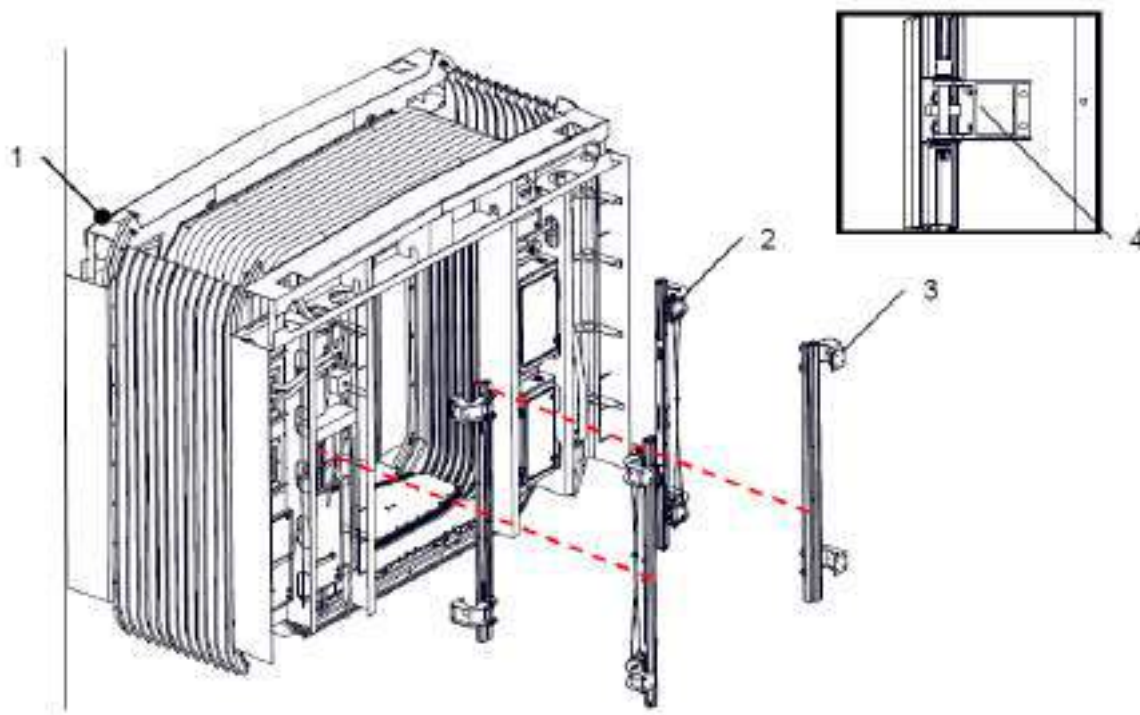
1	Wagon-interface
2	Shackle
3	Plate
4	Screw

Handling – Height adjustment of linking ceiling

- I. The attachment screws of the linking ceiling can be loosened through the horizontal gaps between wagon-interface and linking ceiling element using a flat open end spanner size 13.
- II. Adjust the height of the linking ceiling successively on each side is up to ± 5 mm possible to meet the interior lining. After height adjustment retighten the attachment screws at the required height.

Mounting the guiding bodies to the wagon-interfaces

- I. Bring the guiding body into mounting position into the gangway area.
- II. To each wagon-interface one “screw-on side” and one “locking side” guiding body is mounted.
- III. Align the hole pattern and bolt the cast holders to the wagon-interface (4x M10).
- IV. Repeat for other guiding bodies.



Mounting the guiding bodies to the wagon-interfaces

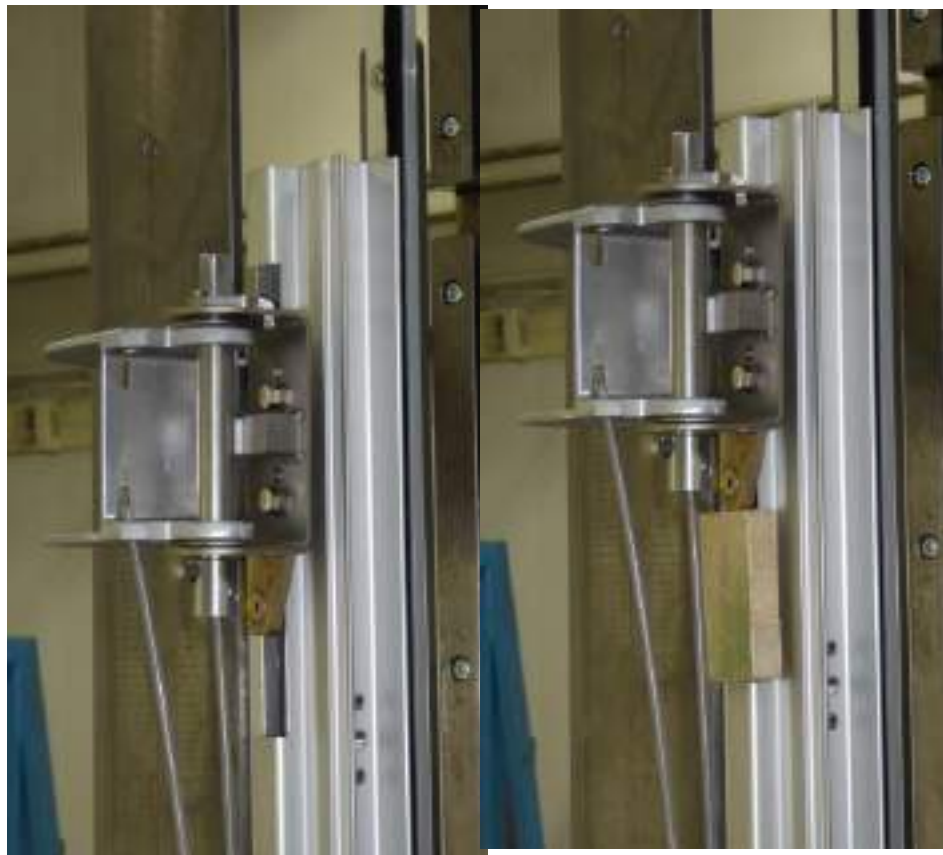
No	Component
1	Wagon-interface
2	Guiding body, locking side
3	Guiding body, screw-on side
4	Holder side wall

Mounting the side walls

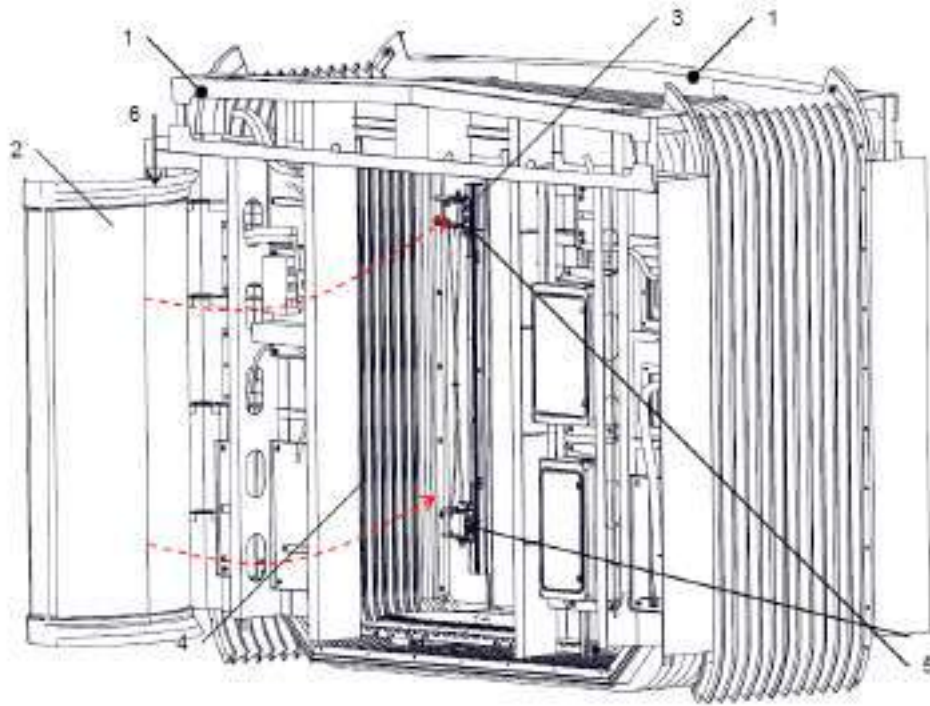
Mounting of the side wall requires two persons.

Pre-condition:

- The bellows is mounted
 - The combination bridge is mounted
 - The linking ceiling is mounted
 - The guiding bodies are mounted to the wagon-interfaces.
- I. At the guiding body screw-on side (right hand side; looking orthogonal to the longitudinal axis of the wagons) pull the guiding body downwards.
 - II. Place a spacer (Size: approx. 100 mm x 50 mm x 20 mm) in the upper opening at the guiding body – (The spacer will pre-tension the spring. It is suggested to secure the spacer with a tape to prevent it from falling into the inside of the gangway).
 - III. Insert the pin of the side wall into the hole of the guiding body screw-on side.
 - IV. Bolt (2x M8x30) the screw-on side of the side wall to the guiding body (screw-on side) which is already mounted to the wagon-interface
 - V. Repeat for opposite side wall.
 - VI. Remove the spacer out of the opening (guiding body).
 - VII. Lock the walls



Guiding body without (left) and with spacer (right) as mounting aid



Mounting the side wall to the guiding bodies, screw-on side

No	Component
1	Wagon-interface
2	Side wall
3	Guiding body – screw-on side
4	Guiding body, locking side
5	Attachment points of side wall at guiding body, screw-on side
6	Screw-on side of side wall

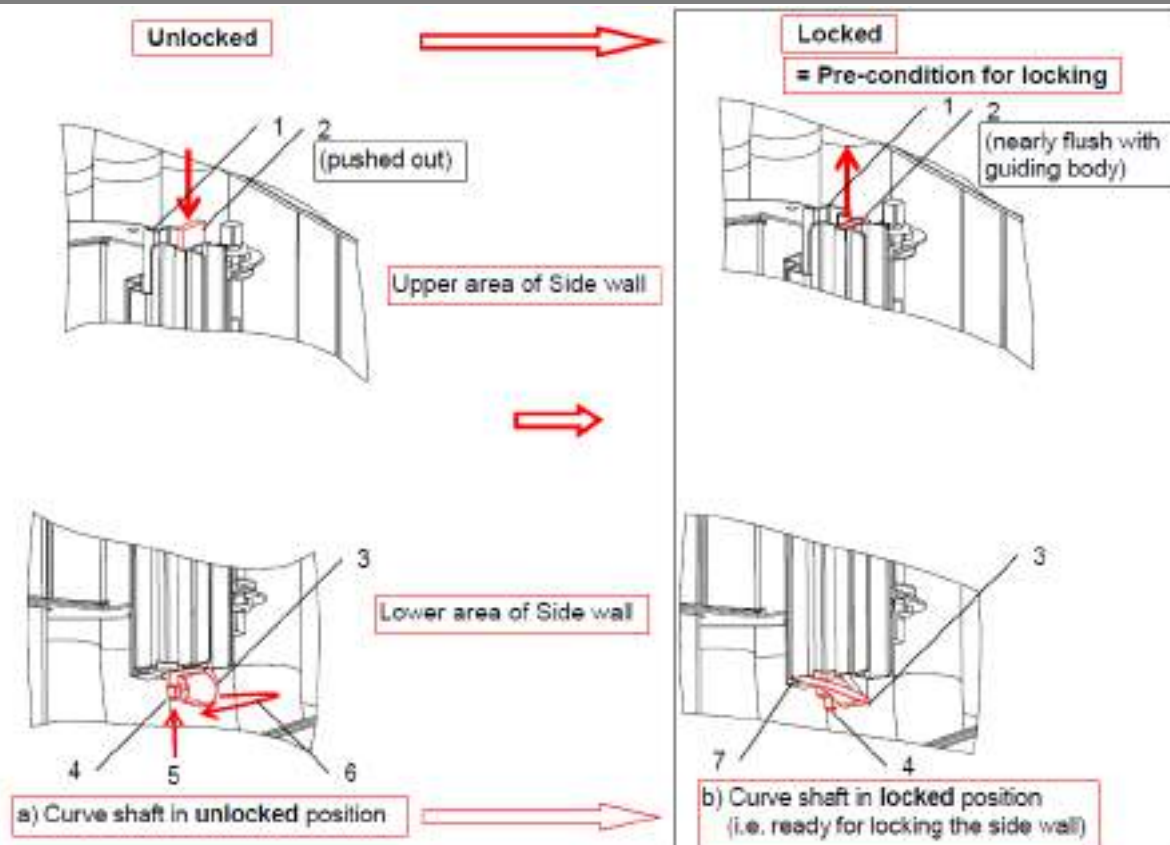
Locking the side wall(s)

Pre-condition:

The vehicles must be in normal position on straight track.

Procedure:

- I. Prior to locking the side wall ensure that the curve shaft and the locking bar of the guiding body are in locked position (Illustration 18b)). For this the curve shaft is turned clockwise to the right until the stop is reached. The locking bar should now be in the lower position. This position of the locking rod is required to make the locking of the side wall possible.
- II. To lock the side walls they have to be turned and guided between brush ledge and guiding body until locked with the locking bar of the guiding body.
- III. Repeat procedure for second side wall.



Locking the Side wall(s) (schematic)

No	Component
1	Guiding body
2	Locking rod
3	Curve shaft
4	Square end of curve shaft
5	Place hollow square spanner onto curve shaft
6	Direction of turning curve shaft for locking
7	Stop (Guiding body)



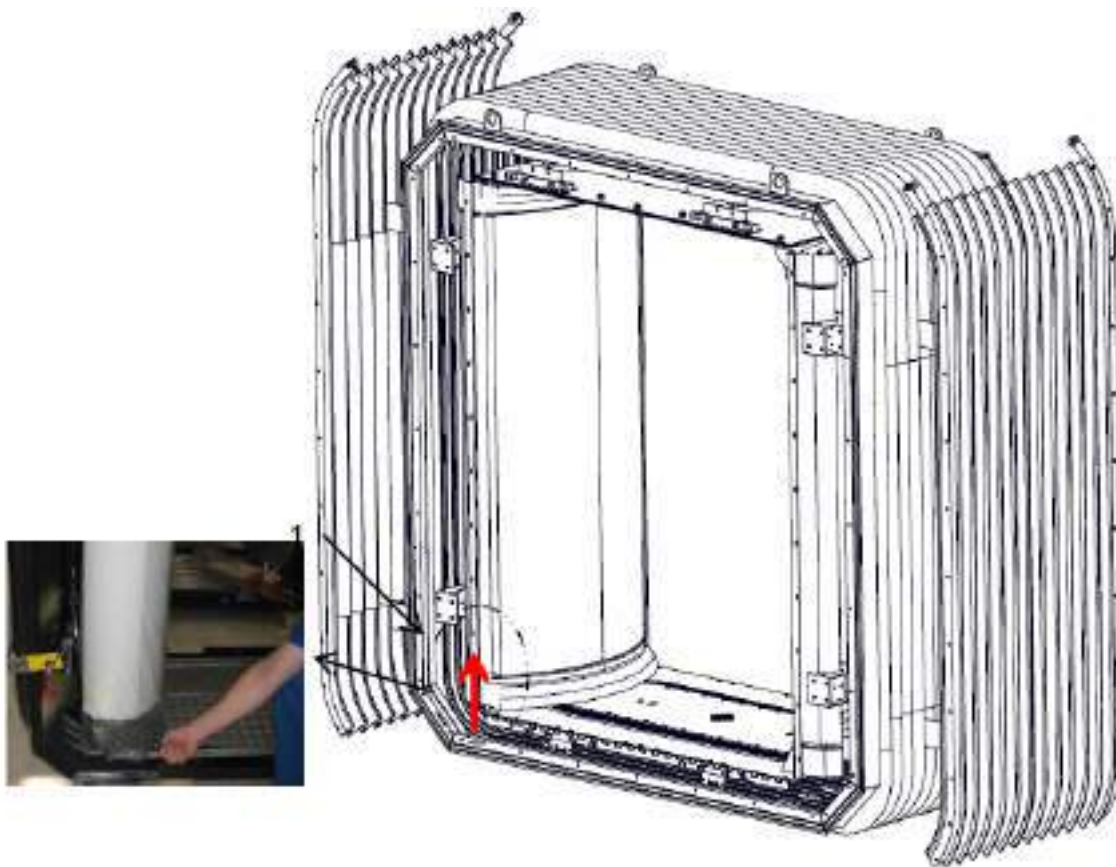
Hollow square spanner – Aid

No	Component
1	Hollow square spanner

Unlocking the side wall(s)

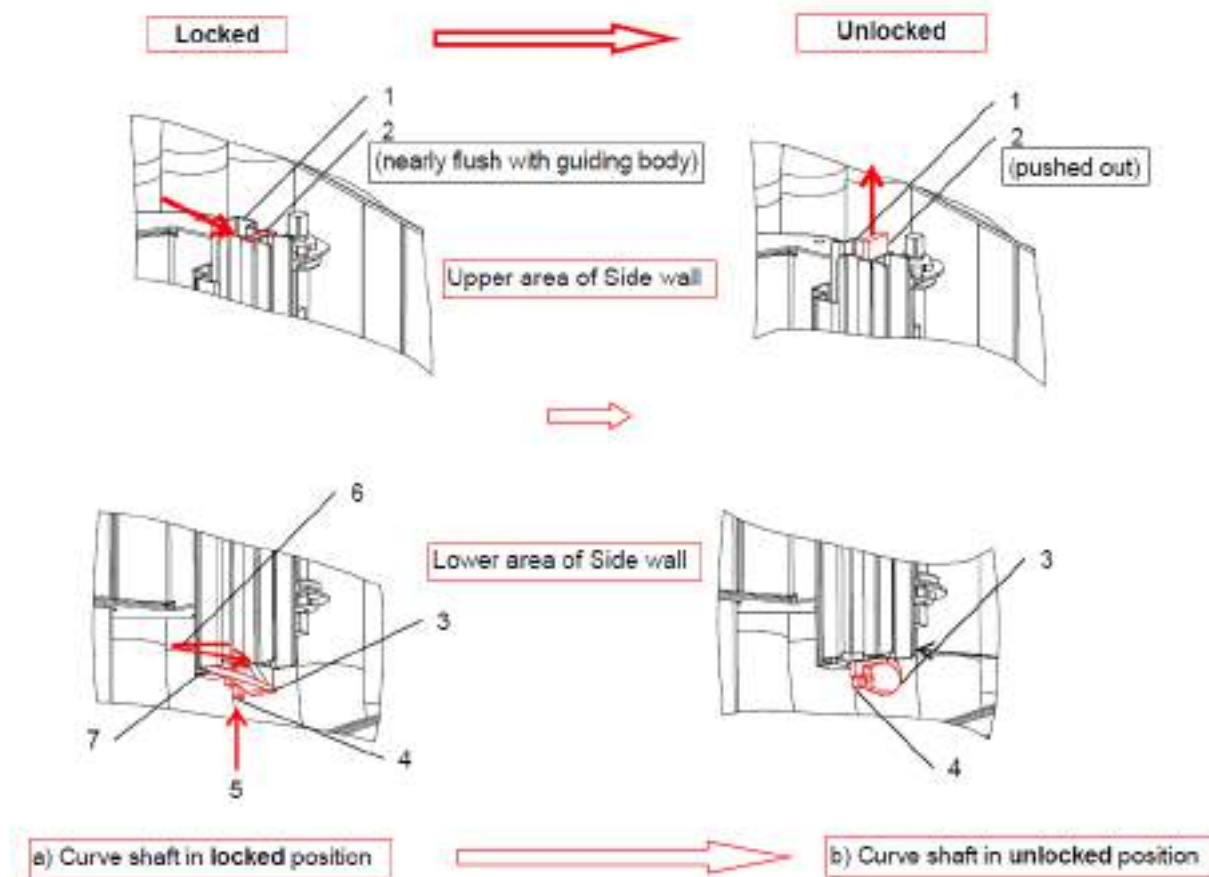
The side walls have to be unlocked and opened prior to proceeding with unmounting maintenance tasks.

- I. Unlocking of the side walls occurs at the lower left hand side of the side wall behind the folds of the gap covering by means of a 9 mm square spanner.
- II. Correct unlocking of the side wall through turning the curve shaft is achieved if the locking rod at the upper end of the guiding body is pushed out by approx. 30 mm



Unlocking the Side wall(s)

No	Component
1	Lower left hand side of side wall



Unlocking the Side wall(s) (schematic)

No	Component
1	Guiding body
2	Locking rod
3	Curve shaft
4	Square end of curve shaft
5	Place hollow square spanner onto curve shaft
6	Direction of turning curve shaft for unlocking
7	Stop (Guiding body)

Contents – Passenger Amenities

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5.4. PASSENGER AMENITIES

The train -18 has better passenger amenities such as on board Wi-Fi infotainment, GPS based passenger information system, plush interiors, Vacuum bio-toilet, diffused LED Lighting, charging points beneath every seat, individual touch based reading lights, intelligent air conditioning system that will adjust the cooling according to the climate /conditions/occupancy ,concealed roller blinds facility Passenger with disability (PWD) to enter the driving trailer coach using their wheel chairs, PWD friendly toilets, auto sensor taps in the toilets modern pantry and food service facilities, rotating seats to match with the direction of the train in executive class automatic sliding doors inside the coach compartments modular luggage rack with glass bottom and many more.

5.4.1. PASSENGER INFORMATION SYSTEM

5.4.1.1. TECHNICAL DESCRIPTION

It is an electronic information system which will provide reliable and relevant information to the passengers regarding the Destination, Present station, Next station using GPS technology.

Warning : When working on the PIS, the vehicle **MUST** be secured against rolling away. Any system components, on which it will be necessary to work. The usual safety rules for electrical equipment must be observed:

- Switch off,
- Secure against re-energising,
- Check that no current is flowing.

Drawing & Part lists

The PIS equipment comprises the Head Code Unit, In Coach Display, Slave Destination Board Unit, Speaker Unit and Ambient Noise Measurement Module. For dismantling and assembling the PIS equipment, the following drawings and parts lists are to be noted

Designation	Drawing number/Part code
Medha equipment's in DTC – Train 18	B-A675U-62946
Medha equipment's in TC – Train 18	B-A675U-63402
Medha equipment's in MC – Train 18	B-A675U-63399
HEAD CODE UNIT for in DTC – Train 18	B-A675U-63425
In coach Display Unit on DTC, MC,TC	90006401401
SPEAKER UNIT	90106416701

5.4.1.2. DISMOUNTING PIS EQUIPMENT

When dismantling the PIS equipment electrical and mechanical disconnection will be necessary.

Dismounting Head Code Unit from car

- Power of the all Circuit Breakers
- Open the cover for HCD access
- Disconnect the Power, Communication and Earthing Cables from the Unit

- Loosen and remove four M6X40LG (4no's) Screws of HCD.
- Remove the HCD from the Cab.

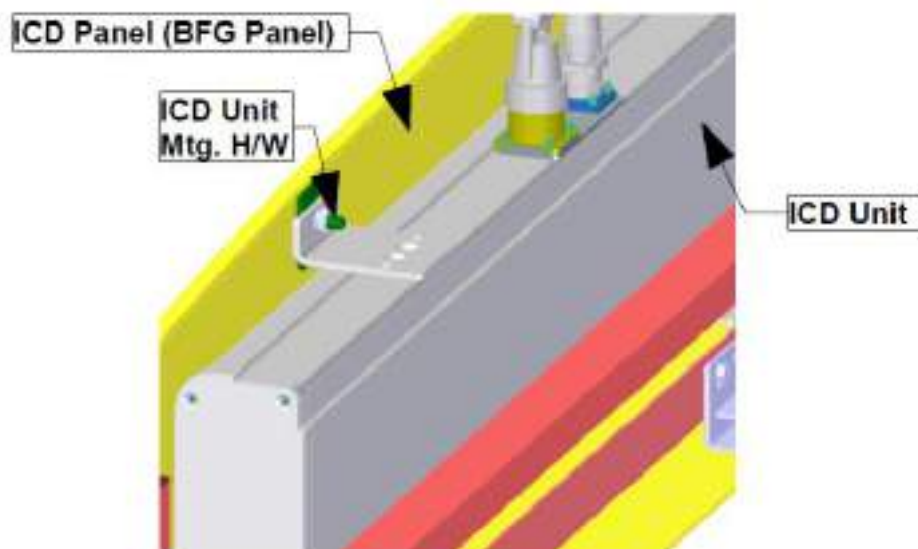
HEAD CODE UNIT



Mounting location of Head Code on DTC shell

Dismounting ICD Unit from car

- Power of the all Circuit Breakers
- Open the ICD Panel
- Disconnect the Power, Comm. and Earthing Cables from the Unit
- Loosen and remove four M6 - HEX NUT M6 (4no's) Nuts of ICD
- Remove the ICD from the Coach



Mounting location of IN COACH DISPLAY on DTC, MC&TC shell

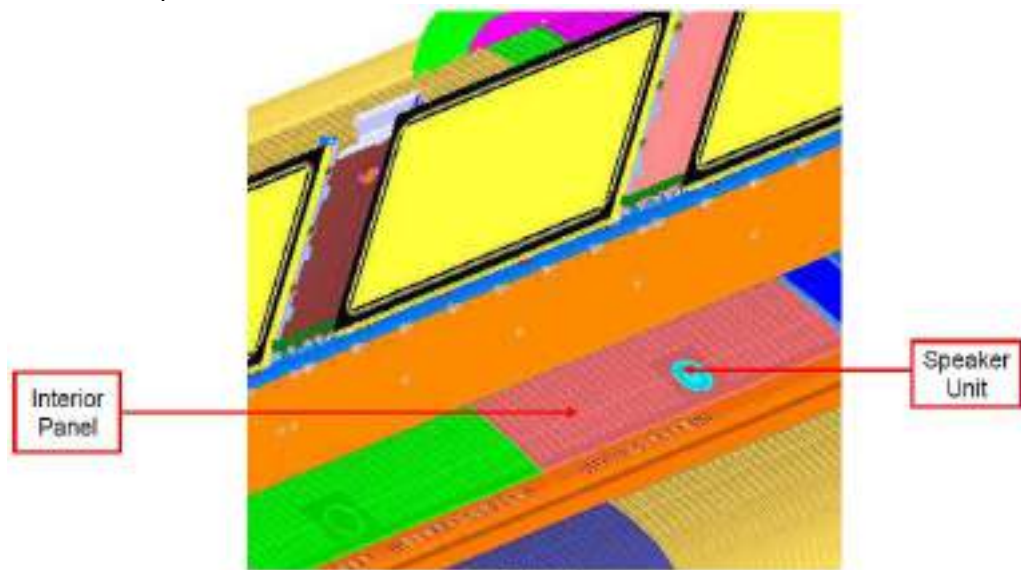
Dismounting SBD from car

- Power of the all Circuit Breakers
- Remove the panel in front of SDB open the luggage rack cover
- Disconnect the Power, Comm. and Earthing Cables from the Unit
- Loosen and remove four M6X15LG (4no's) Screws of SDB
- Remove the SDB from the Cab

Dismounting Speaker Unit from car

- Power of the all Circuit Breakers
- Remove the speaker front plate for accessing the mtg. screws

- Loosen and remove four M5X20LG (4no's) Screws
- Disconnect the Wago and Earthing Cables from the Unit
- Remove the Speaker from the Coach



Mounting location of Speaker unit

Dismounting ANM module from car

- Power of the all Circuit Breakers
- Remove the ANM front plate
- Loosen and remove four M5X20LG (4no's) Screws of ANM
- Disconnect the Wago and Earthing Cables from the Unit
- Remove the ANM from the Coach Power of the all Circuit Breakers

5.4.1.3. MOUNTING PIS EQUIPMENT

Mounting proceeds basically in the reverse order to dismounting. Manufacturer's tips and working instructions for mounting must be observed.

Final Inspection

All components must be tested for perfect functioning. All bolted items must be checked for tightness.

5.4.2. CCTV

5.4.2.1. TECHNICAL DESCRIPTION

Closed Circuit Television (CCTV) Surveillance system is used to capture and record the live view from cameras which are located in Ladies Compartment for post analysis purpose.

Warning: When working on the CCTVs. The usual safety rules for electrical equipment must be observed:

- Switch off
- Secure against re-energising,
- Check that no current is flowing.

Drawing & Part lists

The CCTVs equipment comprises the Dome Cameras, External Cameras, and Display Unit CCTV. For dismantling and assembling the CCTVs, the following drawings and parts lists are to be noted.

Designation	Drawing number/Part Code
Medha equipment's in DTC – Train 18	B-A675U-62946
Medha equipment's in TC – Train 18	B-A675U-63402
Medha equipment's in MC – Train 18	B-A675U-63399
IP DOME CAMERA,1.3MP,2.8MM LENS	30701300003
IP WATERPROOF CAMERA,2MP,6MM LENS	30701300012
Display Unit CCTV	90108021501

5.4.2.2. REMOVAL OF CCTV

When dismantling the CCTVs electrical and mechanical disconnection will be necessary.

- Remove the Rear viewing camera DTC as shown in below fig.2.1
- Remove the Track viewing camera DTC as shown in below fig.2.1
- Remove the CCTV Display Unit in DTC as shown in below fig.2.2
- Remove the Camera dome as shown in below Fig.2.3
- Remove the Camera from Roof as shown in below Fig.2.4
- After removing the camera attach the dome to camera

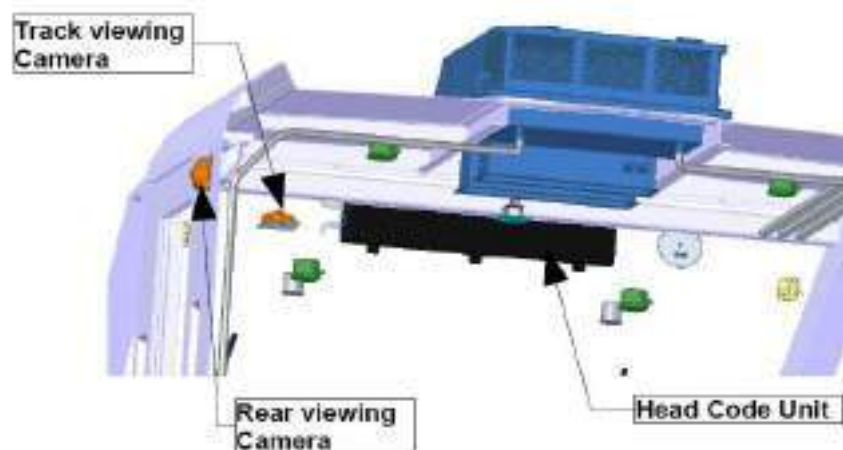


Fig-2.1

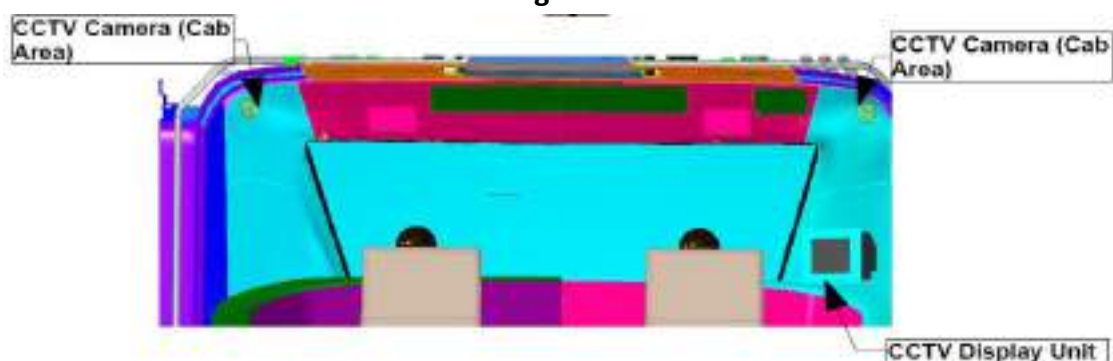


Fig-2.2



Fig-2.3

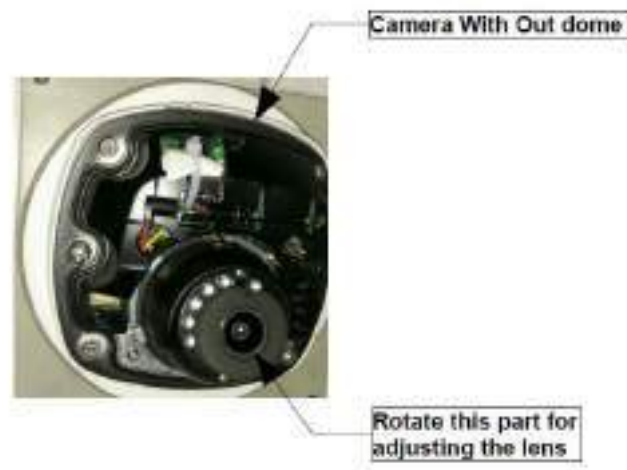


Fig2.4

5.4.2.3. MOUNTING CCTV

Mounting proceeds basically in the reverse order to dismounting. Manufacturer's tips and working instructions for mounting must be observed.

Final Inspection

All components must be checked for perfect functioning. All bolted items must be checked for tightness and security of fixings must be checked before release into service.

5.4.3. AIR CONDITIONING SYSTEM

5.4.3.1. TECHNICAL DESCRIPTION

The RMPU (Roof Mounted Package Unit) is a modular type completely assembled and factory gas charged with hermetically sealed refrigerant. Being a sealed system with short connecting piping, incidence of leakage is almost eliminated. Due to its being mounted on the roof, damage due to flash flooding, cattle runs, flying ballast and condenser clogging is eliminated.

Two microprocessor-controlled roof-mounted compact units Supply conditioned air leaves the air conditioner through a front opening. It is discharged into the supply air duct running above the false ceiling of the passenger saloon. Return air enters the air conditioner through

two opening in the front. The openings interface with the return duct and grilles installed in the passenger saloon. Ambient air enters the air conditioner through two openings in the bottom. Ambient air enters the condensers on both sides of the air conditioner. After passing through the heat exchangers, the condenser fans push the hot air vertically up into the atmosphere.

The electrical couplers are situated on the left side of the unit. There are three couplers for the three phase power supply, DC power supply and control system connections. Attachment points for the protective earth connections are provided on both sides of the unit.

Eight mounting brackets are provided to fasten the air conditioner to the car roof. The side holes interface with the lifting beam when the unit is picked and handled with hoist or crane.

Condensate and rain water drains through openings in the bottom.

Warning: When working on the Air Conditioning, the vehicle must be secured against rolling away. The usual safety rules for electrical equipment must be observed:

- Switch off,
- Secure against re-energising,
- Check that no current is flowing.

5.4.3.2. DISMOUNTING AIR CONDITIONING UNIT

When dismantling the roof-mounted air-conditioner, electrical and mechanical disconnection will be necessary.

Electrical disconnection

When disconnecting the air-conditioning unit, it is essential that the manufacturer's handling instructions are observed.

Warning: Cables hanging loose must be secured both against being damaged and becoming dirty.

- Disconnect the power-supply to the air-conditioning unit
- Disconnect the earthing cable.

Mechanical Disconnection

When dismantling or re-installing the air-conditioning equipment, it is essential that the manufacturer's instructions are observed.

Pick up the air conditioner with a eight-legged lifting beam. Do not use slings. Do not lift up the air conditioner with a fork lift. The air conditioner is fastened in the roof trough with eight M16 screws.

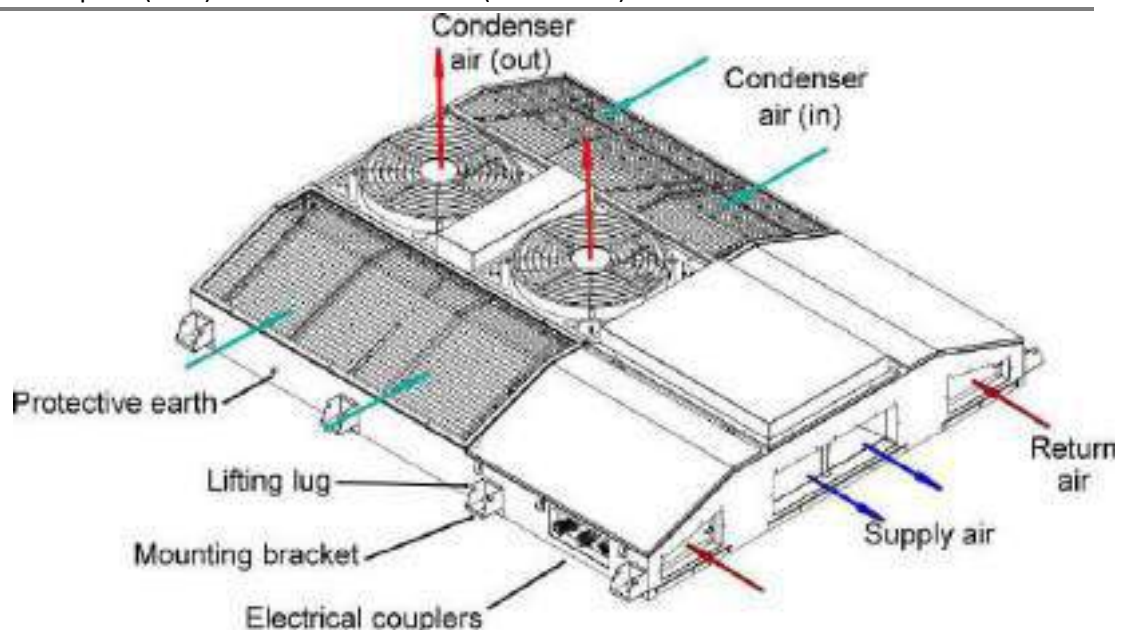


Fig: Roof Mounted Air Conditioner RCAC-2400EF

Final Inspection

Correct function of the air-conditioning equipment and the security of its fastening must be checked before release to traffic.

Note: For further details, please refer to OEM's manual.

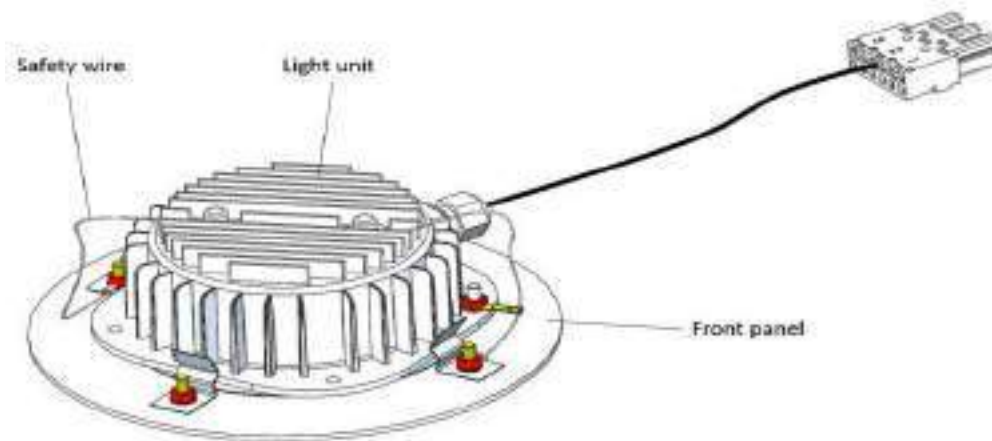
5.4.4. LIGHTING

5.4.4.1. Technical Description

Saloon light 110VDC (TVP2200x): Saloon Light consists of Direct & In-Direct Lighting; it will be mounted on AC grills of all the coaches.



Gangway spot light 110VDC (TVP22003): Gang Way lights will be mounted on Vestibule zone of all the coaches



Lights Quantity in different coaches:

S. no.	Description	DTC	MC & NDTC	TC
1	SALOON LIGHT 110VDC 1948MM	16	32	28
2	DIFFUSER FOR SALOON LIGHT 1948MM	16	32	28
3	SALOON LIGHT 110VDC 1830MM	0	0	4
4	DIFFUSER FOR SALOON LIGHT 1830MM	0	0	4
5	SALOON LIGHT 110VDC 1101MM	4	0	0
6	SALOON LIGHT 110VDC 1652MM	4	0	0
7	DUMMY DIFFUSER 400MM	0	4	0
8	DUMMY DIFFUSER 200MM	0	0	4
9	DIFFUSER SAWING 1213MM	4	0	0
10	DIFFUSER SAWING 1710MM	4	0	0
11	GANGWAY LIGHT 110VDC	13	13	13

Safety Instruction

- Helmets, Hand gloves, Safety Shoes, Goggles should be used for Personal protection.
- Person should not have loose long hair and loose clothes.
- Pay attention while loading equipment to avoid accidents; don't keep hands or fingers in between mounting bracket and equipment while loading

Drawings & Part list

S. no.	Drawing. no.	Part name
1	DRW-1000-2676 REV PRO	SALOON LIGHT 110VDC 1948MM
2	DRW-1000-2674 REV PRO	DIFFUSER FOR SALOON LIGHT 1948MM
3	DRW-1000-2677 REV PRO	SALOON LIGHT 110VDC 1830MM
4	DRW-1000-2673 REV PRO	DIFFUSER FOR SALOON LIGHT 1830MM
5	DRW-1000-3377 REV PRO	SALOON LIGHT 110VDC 1101MM
6	DRW-1000-3383 REV PRO	SALOON LIGHT 110VDC 1652MM
7	DRW-1000-2668 REV PRO	DUMMY DIFFUSER 400MM
8	DRW-1000-2669 REV PRO	DUMMY DIFFUSER 200MM
9	DRW-1000-3384 REV PRO	DIFFUSER SAWING 1213MM
10	DRW-1000-3385 REV PRO	DIFFUSER SAWING 1710MM
11	DRW-1000-2675 REV PRO	GANGWAY LIGHT 110VDC

5.4.5. SEATS

The seats in train-18 providing a high degree of comfort and safety to the passenger. The seats are distributed on both sides of a central aisle. They are composed, by modules, two seats on both sides in the case of executive class and three seats on one side and two seats on the other in the case of chair car. Seats that perfectly match the robustness and rigidity with their comfort, especially suitable for easy maintenance, both in the change of upholstery and in the replacement of components, being able to disassemble these partially, thus lightening the time spent in its conservation.

Out of 16 coaches, 12 coaches are normal chair car type with 78 seats, two coaches are executive type with 52 seats and two driving coaches are normal chair car type.



Seating in normal AC Chair Car



Seating in Executive AC Chair Car

The total seating capacity of the train 18 is 1128.

Coach	Class	No of seats	No of coaches
DTC	II AC	44	2
TC	II AC	78	4

MC	II AC	78	7
NDTC	II AC	78	1
NDTC	Executive AC	52	1
MC	Executive AC	52	1

5.4.5.1. TECHNICAL DESCRIPTION NDTC/EC SEATS

The seats are designed to offer the best ergonomic application, providing them with a controlled recline by sliding the seat forward and the inclination of the backrest, the upper part of the backrest does not slide forward (only the lower one), causing the position of the backrest to be reclined in the relax position or vice versa thanks to the action of the mechanical mechanism that we regulate by pressing the recline buttons, that we find located in the lateral housing of each square. We also have a second system that we operate using the lever that is located under the seat and that advances the seat to 50mm extras regardless of the backrest. One of the particularities of the design is a folding table that is placed in the back structure of the chair (this will always serve for the seat that is behind the chair). All seats have their own power outlet. All elements subject to periodic maintenance or restoration are designed for rapid disassembly within the design's particularities. The seats pivot on a center of rotation, which allows them to turn 180 degrees on always in the direction of the window. To effect the blocking and unblocking of this rotation must be mounted lateral support that contains the mechanism that acts on the seat lock.

Technical Data -NDTC/EC seats

Total width	1209 mm
Maximum total height	1273 mm
Total depth	655 mm
Maximum seat height	459 mm
Space between arms	504 mm
Side armrest	53 mm
Center armrest (2pl)	80 mm
Depth of seats	468 mm
Armrest length	352 mm

General description-NDTC/EC seats

Upholstered and foam sets: They are formed by metallic or plastic reinforcement structures, these serve as a support for adhesion to the cushions, the cushion's is made of cold molded polyurethane foam. There are three independent flutes, the soft backrest, seat, armrest. All three are upholstered with removable fabric covers.

Lateral and central armrests: They are formed by folding metal reinforcement structures that serve as support for the fixings of the fluffs, the fluff is made of cold molded polyurethane foam with a contribution of graphite.

The central armrest will only be found in two-seater seats.

The soft ones of the armrest will be upholstered with some fabric covers.

Power suppliers: Each square, has a 220 V socket with alveoli with child protection, the situation of them is as follows:

One individual shot in the middle central part of the 2-seater and another on the side.

Folding table: The table is folding, each seat has its own, the table is on the back of the chair, this has a security mechanism so that it cannot be opened accidentally.

Aisle grab handle: Some seats are equipped with an aluminum handle on the aisle side, to facilitate the grip of passengers standing or circulating in the corridor.

Reclining control: The recline is made thanks to the action on a special locking mechanism, it acts on the advance, and the inclination of the seat and backrest respectively, the advance of the seat causes the backrest to tilt creating an ergonomic position that we call relax. All this mechanical management is communicated thanks to a special clutch cable. The control over the recline, the user will get through the use of the corresponding buttons, the consoles found in the side cases of the chair.

We also have the possibility of advancing the seat by an extra 50mm by activating the lever located in the lower part of the seat.

Estructure covers: The side fairings are made of magnesium, and are fixed to a rear fairing made of pressed sheet metal, which, when joined by means of special bolts, form the structure of the seat. In this same structure we will fix the following elements: backrest guides, little table, magazine rack, table top, armrests, side cases.

Estructure profiles: the bench is formed by two profiles of aluminium extrusion especially created to house a special fastener that holds the fairing structure on one side, and cantilever on the other. These special aluminium profiles have been designed with the appropriate shapes to obtain, together with the rest of the structural elements, a solid and light armchair.

Turn up system : The seats are attached to the floor of the car by a central structure fixed to the floor by four points; this structure contains the rotation system that is operated with the foot by pressing the actuator located in the lower part of the wall.

Warning : All the assembly and disassembly actions of the seat must be done with the armchair disconnected from the electrical network.

Drawings (NDTC/EC) seats

For dismantling and assembling the seat, the following drawings are to be noted

Designation	Drawing number
NDTC/EC) seats	TraN18/MC/EC/AC 6-1-001

5.4.5.2. Dismounting & Mounting (NDTC/EC) seats

As per OEM's manual.

Technical data Seat 2 places 2CC (Chair car) with accessories

Total width of the module	1010 mm
---------------------------	---------

Useful width	452 mm
Seat height on the floor	455 mm
Plumb	614 mm
Seat deep	454 mm
Total height	1227mm

Technical data Seat 3 places 2CC (Chair car) with accessories

Total width of the module	1496 mm
Useful width	452 mm
Seat height on the floor	455 mm
Plumb	614 mm
Seat deep	454 mm
Total height	1227mm

5.4.6. DOORS

5.4.6.1. INTERNAL SLIDING DOOR

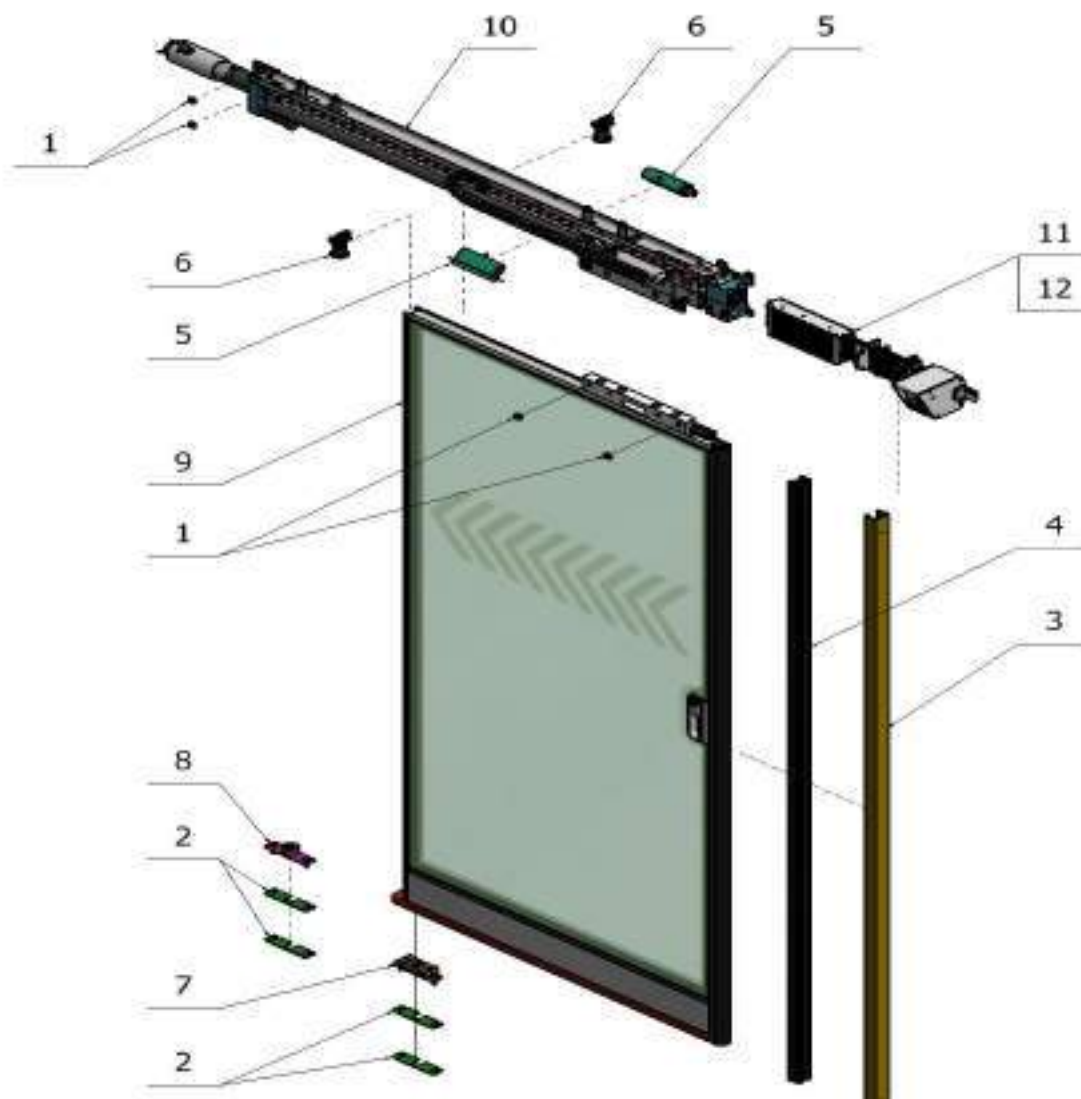
Technical Description

Interior sliding doors consist of a door leaf, drive and carrier mechanism, door leaf bottom guide, bearing counterpart of the doors, electric block, and a pair of emergency disconnecting switches. The left and the right door versions are mirror-opposed.

Technical data:

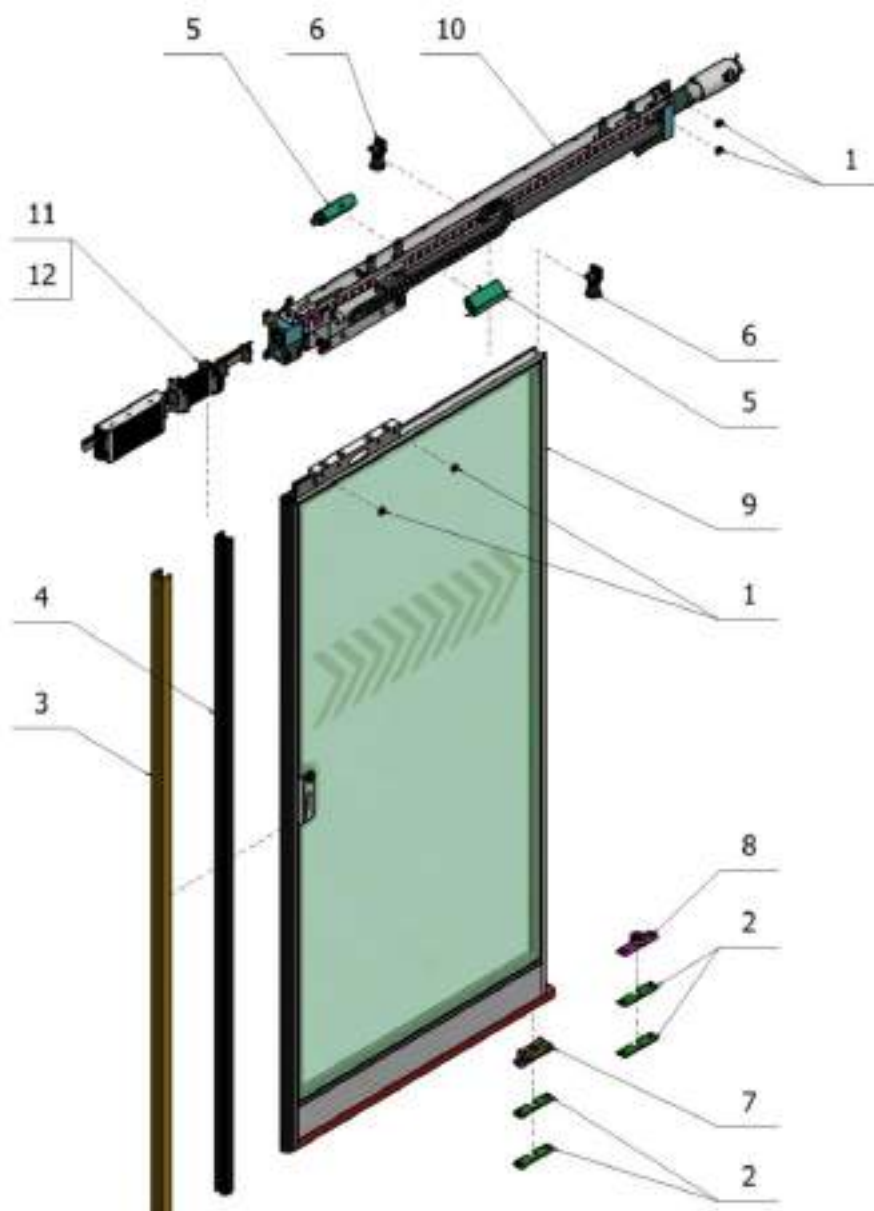
- Internal passing (width) 810 ± 5 mm
- Internal passing (height) -1960 ± 5 mm
- Distance between door posts -900 ± 2.5 mm
- Opening time of the door leaf 3-5 s
- Weight of the door leaf-30 kg
- Weight of the carrier mechanism-18 kg
- Nominal voltage-110 V DC ± 30 %
- Nominal current-0.5 A, max. 2 A

Interior sliding doors Left

**Name of the component:**

1. Circular cam
2. Washer
3. Carrier
4. Padding
5. IR energy sensor
6. Emergency release switch
7. Wire
8. Rare wire
9. Equipped leaf L
10. Complete drive L
11. Terminal block X8 + RJ
12. Main cable harness

Interior sliding doors Right

**Name of the component:**

1. Lower rails
2. Ringlet
3. Cover L
4. Carrier
5. Terminal block console
6. Glass ECE 43R
7. Padding
8. Contact bar
9. Switch
10. Silent-block
11. Wago clamp
12. Leaf frame L

Warning: Before any work on the door system, the power supply of the door has to be Switched off to prevent injury.

- When using noted lubricants, safety instructions of lubricants manufacturer have to be observed to avoid health risks and environmental damage.
- Instructions of manufacturers regarding the processing of lubricants have to be considered to ensure compatibility with other materials

Drawing & Part lists

For dismantling and assembling the internal sliding door, the following drawings and parts

Designation	Drawing number
internal sliding door left	1.0269.36.01.0
internal sliding door right	1.0269.36.02.0

lists are
to be
noted

Dismounting Internal sliding

Electrical and mechanical separation is necessary when dismantling the internal sliding Door.

Electrical Separation

When separating the door, the manufacturer's instructions MUST be observed.

Mechanical Separation

When dismantling Manufacturer's instructions MUST be observed.

Mounting Internal Sliding Door

Mounting is accomplished basically in the reverse order to dismantling. Manufacturer's working instructions must be observed.

Final Inspection Internal Sliding Door

The door must be checked as to correct function and secure fixing before release to traffic.

5.4.6.2. SINGLE LEAF PLUG DOOR

Technical Description

Each car is equipped with 4 electrical single leaf sliding plug doors whereas every door is controlled by the IFE door control unit MDC2-110-I-RS4. The door control unit MDC2-110-I-RS4 controls the door and step motors in open and close position, in accordance with local door control commands (e.g. push button), train control signals (e.g. $v > 5\text{ km/h}$, central close).

Technical Data

- Voltage supply: 110VDC +25/-30%
- Pressure supply: 6 – 9bar (IFE pressure regulator is pre-set at 6bar)
- Door opening time 4 ± 1 seconds
- Door closing time 4 ± 1 seconds
- Step opening time 2 ± 1 seconds
- Step closing time 2 ± 1 seconds
- Average power consumption of the door 140 W (opening and closing sequence)

- Maximum power consumption of the door 500 W (for a time of 500 ms)(locking, unlocking, reopening)
- Free opening width door 800 +5/-0 mm
- Free opening width step 150 +5/-0 mm Maximum motor current: 10A

Warning: Before any work on the door system, the power supply of the door has to be Switched off to prevent injury.

- When using noted lubricants, safety instructions of lubricants manufacturer have to be observed to avoid health risks and environmental damage.
- Instructions of manufacturers regarding the processing of lubricants have to be considered to ensure compatibility with other materials

Drawing & Part lists

For dismantling and assembling the Single leaf Plug Sliding Door Assembly drawing, the following drawings and parts lists are to be noted

Designation	Drawing number
Single leaf Plug Sliding Door Assembly drawing	66408U1AR11

5.4.7. VACUUM BIO-TOILET

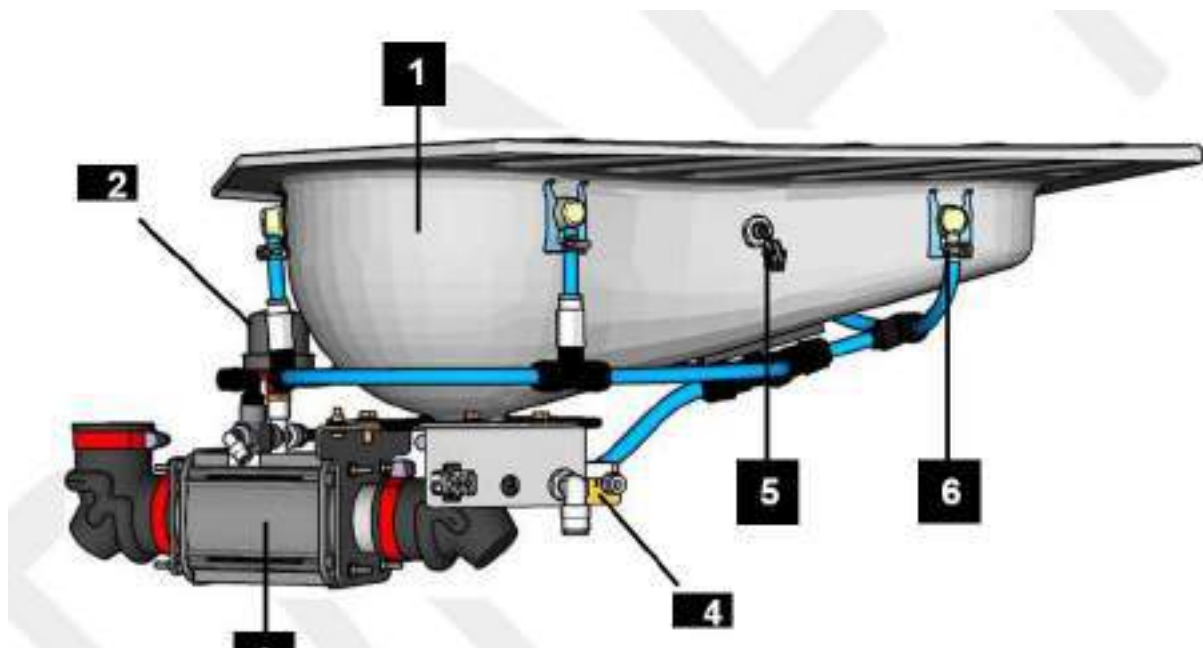
5.4.7.1. Technical Description

Vacuum toilet assembly is designed to transport human waste from the toilet bowl to a waste tank or sewage pipe. Vacuum Bio-toilets are based on vacuum pumps and comprise three main elements: appliances such as toilets, piping, and the collection units. The generation units generate the vacuum in the piping using a vacuum pump. When a toilet is flushed, the lower pressure atmospheric air flows into the higher pressure piping through the toilet. The air travels at high velocity because of the pressure difference, carrying the waste water with it.

Components Description – (Squatting system India):

Vacuum toilet (squatting or western type) equipped with a pinch valve

- Base unit equipped with an sliding gate valve
- Water system
- Pneumatic panel
- Connection set
- Cable set



1	Bowl Unit	2	Pressure Guard
3	Pinch Valve	4	Water Inlet Valve
5	Liquid Level Guard	6	Flush Nozzle (5x)

Technical Data – Squatting Toilet:

- Materials Bowl-Stainless steel
- Weight approx. -12.5 kg
- Supplies Compressed air-6.2 (4 bar to 10 bar), Filter 5 µm max. grain size
- Water Pressure: 0.2 bar to 1.5 bar Filter: 250 µm max. grain size Minimum flow rate: 2 l/min
- Electrical-24 V DC

External connections

- Mechanical-Mounting holes Ø 6.5 mm (8x)
- Compressed air Ø 6 mm
- Water Ø 12 mm
- Outlet Ø 48 mm
- Electrical connections Mini Mate-N-Lok, 4 pol

Warning: When working on the vacuum toilet,

- *Wear protective clothing, do not eat, drink or smoke!*
- *Immediately change and disinfect contaminated clothing!*
- *Thoroughly clean yourself with soap and water after working in a sewage handling area or coming in contact with*
- *sewage handling equipment. This precaution is an absolute requirement before eating, drinking, smoking or performing any hand-to-mouth functions!*
- *Skin abrasions, punctures or any other wounds require immediate and appropriate medical attention!*
- *After coming in contact with sewage, do not handle potable water hoses or work on potable water systems until thoroughly washed!*

- *Sewage spills are to be cleaned up immediately, before they dry. Rinse the contaminated area with water and non-scented disinfectant!*

The usual safety rules for electrical equipment must be observed:

- *Switch off,*
- *Secure against re-energizing,*
- *Check that no current is flowing.*

5.4.7.2. DISMOUNTING VACUUM TOILET

When dismantling the vacuum toilet, electrical and mechanical, air, water disconnection will be necessary.

Electrical disconnection

When disconnecting the vacuum toilet, it is essential that the manufacturer's instructions are observed.

Mechanical Disconnection

When dismantling or re-installing the vacuum toilet, it is essential that the manufacturer's instructions are observed.

5.4.7.3. INSTALLING VACUUM TOILET

Installation proceeds basically in the reverse order to removal. Manufacturer's tips and working instructions for assembly must be observed.

Final Inspection

All items are to be checked for correct functioning, and security of fixings must be checked before release into service.

Note: For further details, please refer to OEM's manual.

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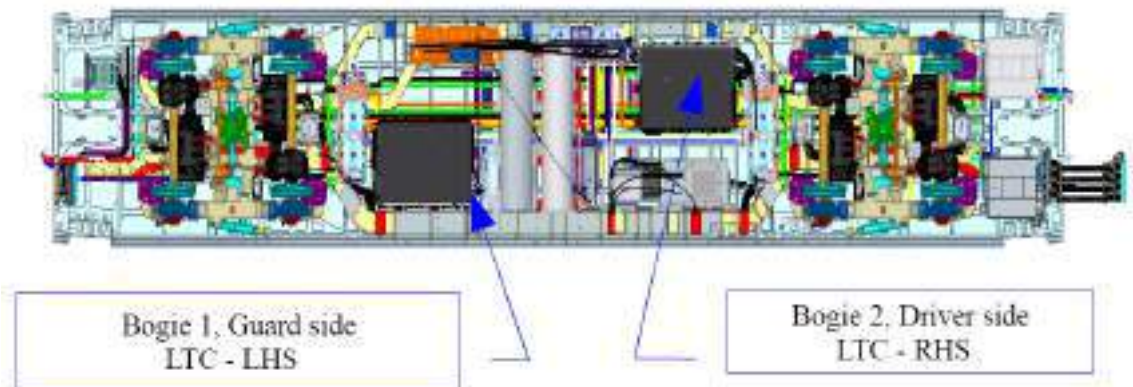
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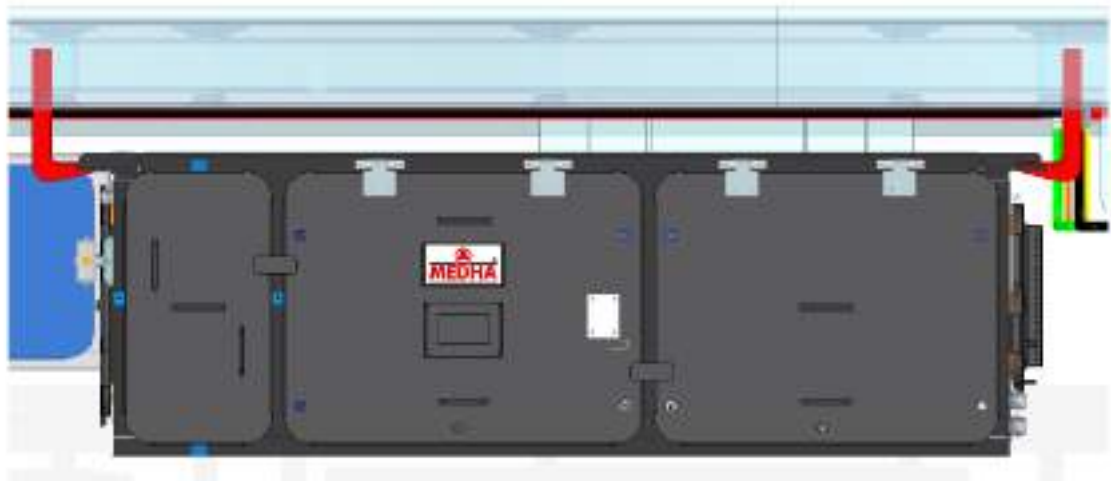
5.5 TRACTION AND CONTROL

5.5.1 Traction Converter

Each basic unit has 2 motor coaches and each motor coach has 4 traction motors. Each motor coach has 2 nos. of line and traction converter (LTC) mounted under slung and each control two traction motors of a bogie.



Input power to line converter comes from transformer kept in adjacent trailer coach. Line and traction converters are forced air-cooled.



5.5.1.1 Important Parameters of LTC

Table 1: Parameters of LTC

<i>Description</i>	<i>Rating</i>
Input voltage	950 V AC at 25 kV AC
Input current	639 A
Weight	<800+/-50 Kg
Dimension	2250*1220*700 mm
Line and traction converter rating	554 KVA

Each traction converter cubicle consists of one-line converter, DC link, one traction inverter and line & traction control unit.

5.5.1.2 Line and Traction Converter

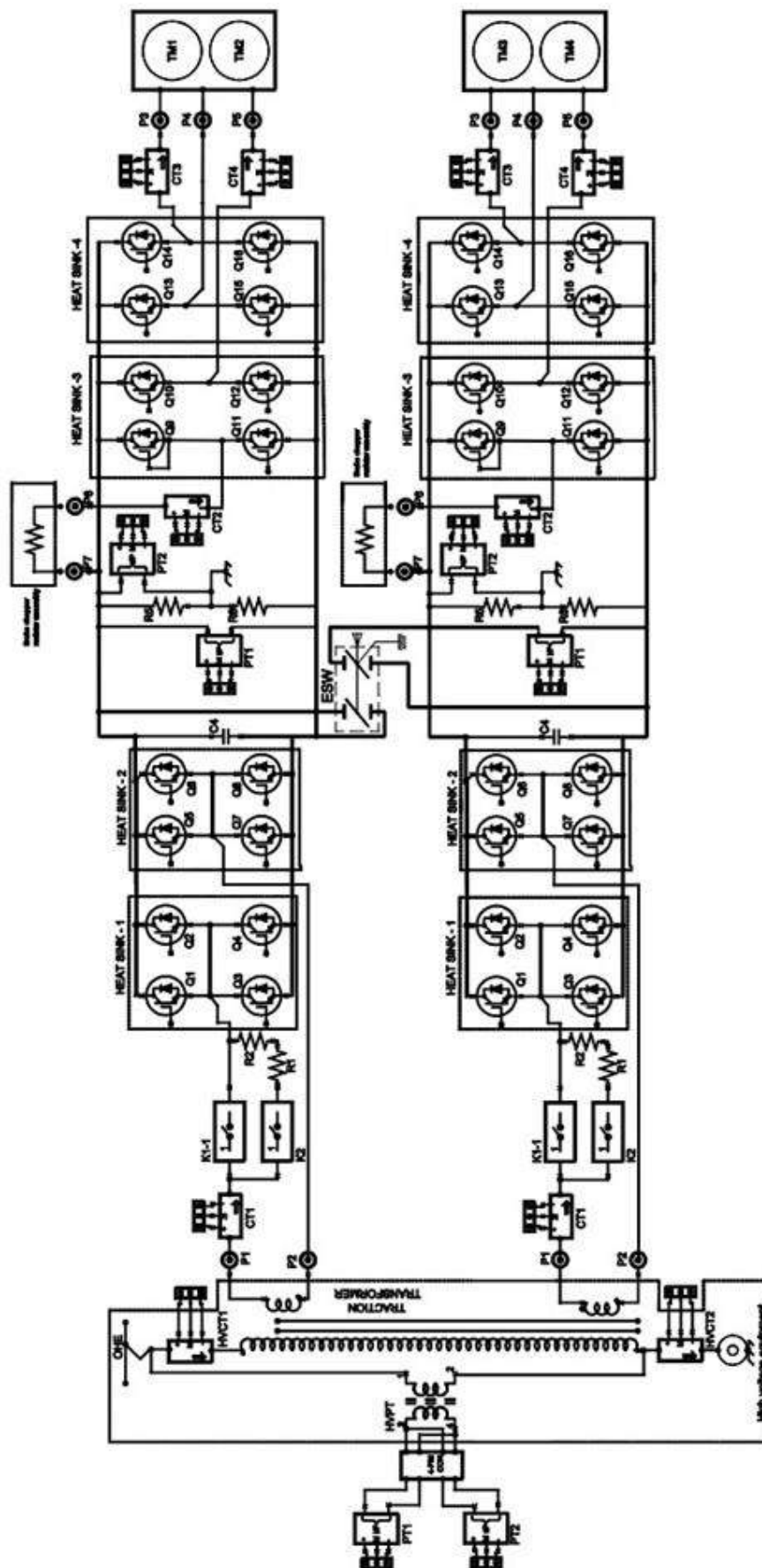


Figure 1: Schematic Diagram of Line and Traction Converter

Line Converter

The line converter interfaces with transformer secondary traction winding AC voltage on one side and DC link on the other side.

Main function of line converter is to maintain stable DC link voltage at 1800 V irrespective of line and load variations at unity power factor.

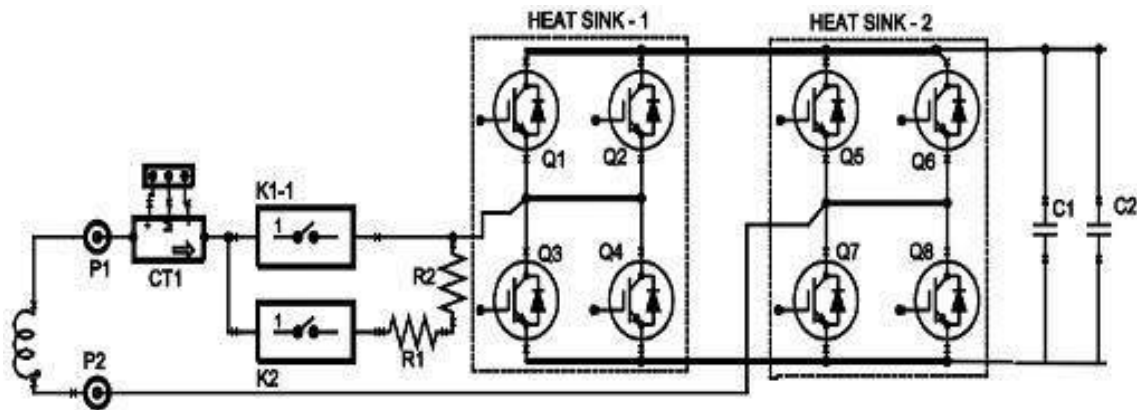


Figure 2: Block Diagram of Line Converter

The line converter consists of single-phase full bridge rectifier with IGBTs as active switching devices.

Line converter consists of input pre-charging circuit and line contactor. It consists of output DC link capacitor.

The DC link consists of earth leakage detection circuit, DC link capacitor bank and brake chopper circuit (for over voltage protection).

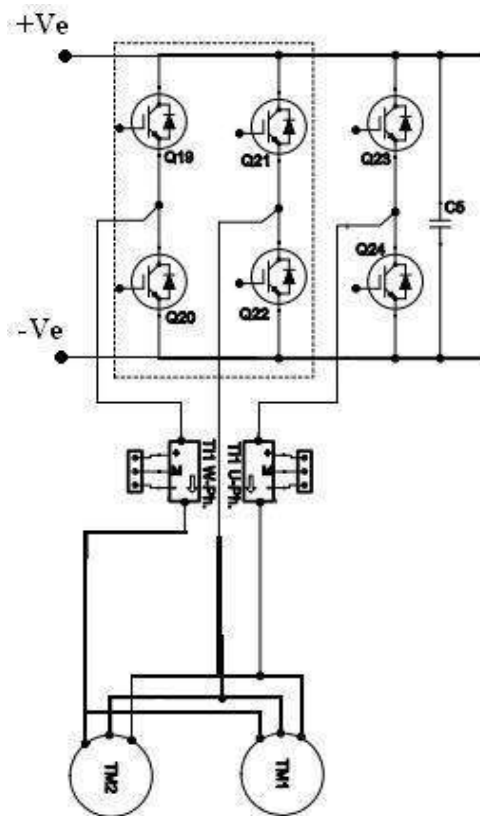
5.5.1.3 Line Converter Protections

- Transformer primary over voltage and under voltage protection.
- Traction transformer secondary over current protection.
- IGBT heat sink over temperature protection.
- Failure of pre-charging contactor / resistor protection.
- Failure of main contactor protection.

5.5.1.4 Traction Inverter

The traction inverter consists of a 3-phase full bridge inverter with IGBTs as active switching devices. Main function of TIC:

- Converts the DC input voltage to 3-phase Variable Voltage Variable Frequency (VVVF) output.
- Controls the traction motor torque in both motoring mode and braking mode.
- Each inverter controls two traction motors in parallel.
- Controls wheel slip/slide.
- Performs various fault diagnostics.



Traction Inverter protections:

- Output over current protection.
- Output short circuit protection.
- IGBT heat sink over temperature protection.
- Traction motor over temperature protection.
- Traction motor over speed protection.
- Phase imbalance protection.

5.5.1.5 Line & Traction Control Unit (LTCU)

Line & Traction Control Unit (LTCU) controls both the line converter and traction inverter and communicate with the Main Control Unit (MCU) through CAN interface. All the LTC's are similar in construction.

5.5.1.6 DC Link Capacitor

DC link capacitor has following functions:

- DC link capacitor is used to buffer the energy differences between line-side and motor-side of the converter.
- DC link capacitor absorbs the harmonic currents produced by line side and motor-side of the converter, thus reducing the ripple voltage.
- DC link capacitor is used to limit the switching over voltages of IGBTs. These over voltages occur due to loop inductance.
- Two DC link capacitors of 2mF value are connected in parallel and forms the DC Link and are directly connected to the IGBT Phase modules.

5.5.2 Auxiliary Converter

Auxiliary Converter is used to supply power for 3-phase 415 V loads, 110 V DC and Battery charger. Auxiliary Converter Unit is provided under slung in each TC coach of a Basic unit (to supply all power supply requirements in that Basic Unit).



Auxiliary converter generate 415 V AC and 110 V DC to provide supply to various loads. A 20 kVA isolation transformer is provided in each coach to convert 415 V AC supply to 230V AC and 110 V AC. 230 V AC supply is used for pantry related loads and toilet related loads like shaver and hand drier. 110 V AC supply is used for laptop and mobile charging for passengers.



5.5.2.1 Auxiliary Power Supply

- All auxiliaries and controls of coaches are required to work on two voltages **415VAC, 3phase, 50Hz and 110VDC.**
- Auxiliary converter unit is required to generate these types of voltages to serve these loads.
- It gets power directly from 2 nos. of secondary windings of transformer.
- Transformer and auxiliary converter are mounted in trailer coach (TC).
- It is mounted under-slung and forced air cooled system type.
- Auxiliary converter is a PWM based IGBT converter, which converts 285VAC – 450V AC into two outputs:
 - i. Output-1: 415 V ac (line to line), 3 phase, 50Hz
 - ii. Output-2: DC output is isolated from input by using DC -DC isolation transformer. DC output is connected to BN Bus.

415VAC, 3phase, 50Hz loads

- RMPU
- CAB AC

- Main compressor
- Traction converter cooling blowers
- Transformer radiator fan
- Transformer oil pump
- Water pump for toilet tank
- Aux converter cooling blower.

110VDC Loads

- Battery charging
- Coach, vestibules and driver cabin normal lights
- Coach and driver cabin emergency lights
- Twin beam/ auxiliary head light, marker light, tail light, flasher light, cluster light, spot lights, passenger alarm
- Indication light, electronic signal bell
- Control electronics loads: PIS, CCTV, Relays, Contactors,
- Driver desk, brake systems and all other control units
- Auxiliary compressor for pantograph
- Emergency ventilation blowers
- 110Vdc toilet loads, seat lights & doors.

5.5.2.2 Functional Description

Auxiliary power supply consists of two physical cubicles in each basic unit.

(i) Auxiliary Converter Unit (ACU) - Each ACU consists of below modules

- AC1 module (415VAC 3-phase inverter module)
- AC2 module (415VAC 3-phase inverter module)
- 110 VDC converter module

(ii) Battery Charging System (BCS)

5.5.2.3 Important Parameters of Auxiliary Converter

Table 2: Parameters of Auxiliary Converter

Requirement	Parameters
AC input voltage	285 V to 450 V, 1 phase, AC input from auxiliary secondary winding of main transformer
Control supply	77V to 137.5 V DC from battery (110Vdc nominal)
AC-1 output capacity	275 kVA, 415V \pm 5% (L-L), 50 Hz \pm 3%, 3 Phase, Sine wave (at >19kVac OHE) at <19kVac OHE, output voltage shall drop by maintaining V/F ratio constant.
AC-2 output capacity	235kVA, 415V \pm 5% (L-L), 50Hz \pm 3%, 3 Phase, Sine wave (at >19kVac OHE) at <19kVac OHE, output voltage shall drop by maintaining V/F ratio constant.
DC converter output capacity	115 V to 130 V DC (It is varying as per DC load sharing current requirement) DC Power: 30kW at 110V DC (BN, BD & battery charger loading on this).
Efficiency	92%

Schematic description of ACU

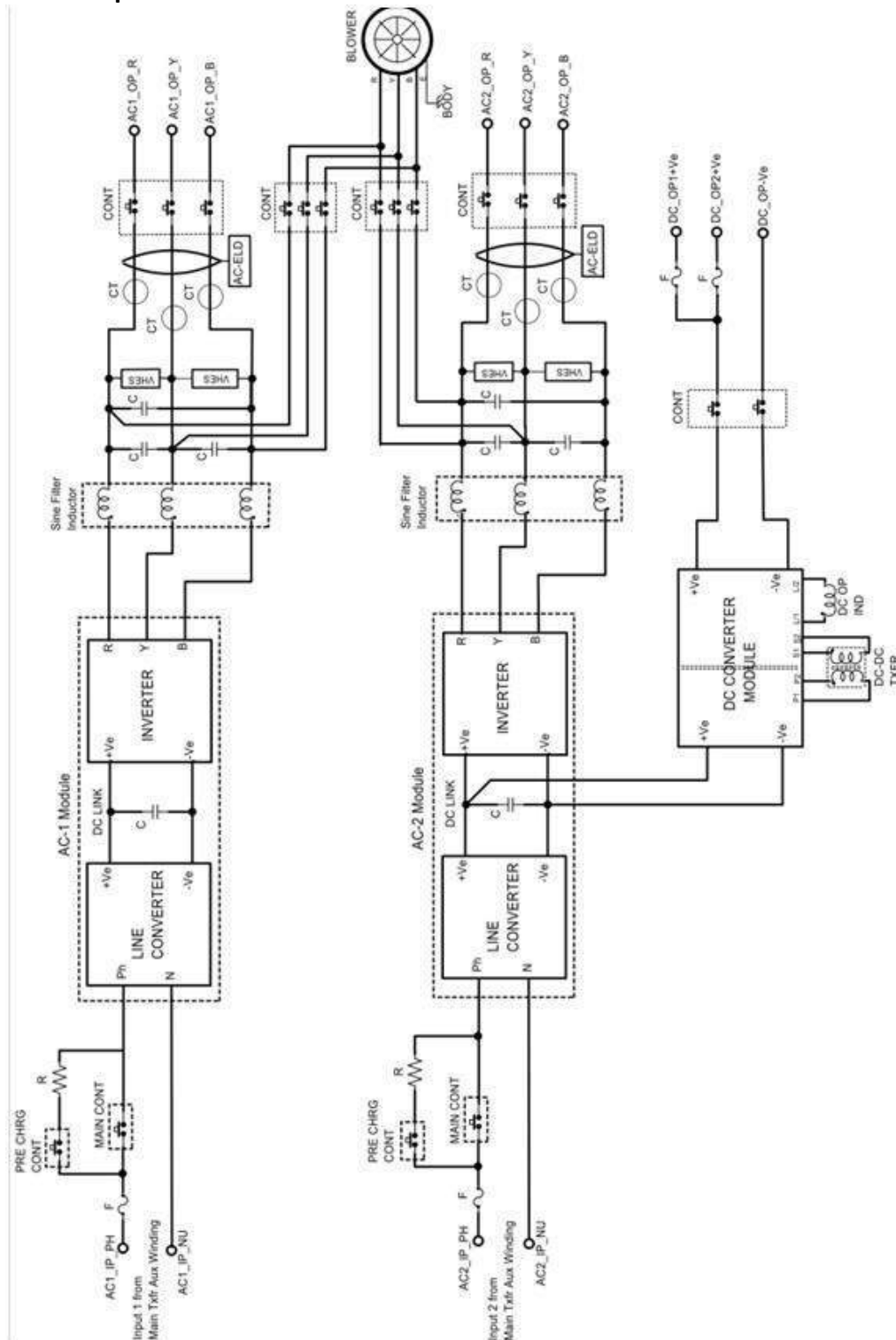


Figure 3: Auxiliary Converter Schematic Diagram

5.5.2.4 ACU consists below modules/ sections:

- Input section
- AC-1 module (line converter & inverter section including master control)
- AC-2 module (line converter & inverter section including master control)
- 415VAC output section
- DC converter module

- DC output section
- DC link voltage indicators
- Control & communication connectors
- Blower section
- Isolation switch.

Input section

- The input of the auxiliary converter is taken from the independent secondary windings of main transformer.
- Input section consists of input fuse, input main & pre- charging contactors & input ac current sensor.
- The purpose of input fuse is to protect DC link from over current.
- The purpose of input ac current sensor is to control the line converter for regulating DC link voltage & to maintain unity power factor at input.
- The purpose of pre- charging contactor & resistor is to limit the DC link capacitor charging current at source sudden ON. It will be switched off when DC link voltage reaches to defined value.
- The purpose of input main contactor is to isolate the unit from source if any abnormalities in ACU.

AC-1 & AC-2 Modules

AC-1 & AC-2 modules consists of below sections:

- i. Line converter section
- ii. Inverter section
- iii. Master & module control section (both control & communication)

Line Converter Section

- The line converter section takes the input (variable single phase AC input) from secondary winding of main transformer and converts to fixed DC-link by controlling pulses of the IGBT's by using DSP controller.
- Line converter maintains unity power factor at AC input. Full bridge architecture is used for the line converter.
- Transformer primary, secondary, DC link voltages and input AC current sensors are used for feedback control, display the parameters and protect the line converter.
- Line converter output is connected to common DC link.

Inverter Section

- The inverter takes the input from common DC link. The IGBT based inverter section is provided after DC link capacitor. A three phase full bridge architecture is used for the inverter.
- An IGBT based inverter is controlled by using DSP. Input voltage and output current sensors are used for feedback control, display the parameters and protect the inverter.
- Temperature sensors are provided for sensing the heat sink temperatures of the IGBT modules and for protecting it.
- DSP controller is used for PWM control of line converter & inverter.

Master Control Section

- There is a controller which controls the line converter & inverter. It is also responsible for monitoring and protecting the complete auxiliary converter unit and records the faults in the memory.
- It also interfaces to TCMS to get commands and to send status to display at driver cabin through ethernet communication.
- It is also responsible for driving the contactors & to monitor its healthiness by taking their feedbacks.
- It is also responsible for handling & processing the hardwired signals which are coming from LCC.

ACU 415VAC Output Section

- It consists of sine filter inductor, capacitor, current transformers, ELD sensor & output contactor.
- 3Ph 415V AC, which is passing through Sine filter capacitors for filtering PWM Sine waveform to pure Sine waveform. After filtering, the output is connecting to output terminal through output contactor.
- ELD sensor is used to measure the earth leak current if any AC output live terminal touches to the body & to isolate the faulty section by tripping the contactor.
- Current transformer is used to feedback control, display the output AC current and protects the inverter.
- The purpose of output contactor is to isolate the AC module from load when AC module fails.

ACU DC Converter Module

- DC converter takes supply from common DC-link of AC2 and converts DC link voltage to isolated and regulated 110Vdc output by controlling pulses of IGBTs by using DSP controller.
- DC converter consists of H-bridge converter, isolation transformer, rectifier and filter.
- DC converter shall also regulate output voltage to maintain current share at output.
- An IGBT based DC-DC Converter is controlled by using DSP. Output voltage and output current sensors are used for feedback control, display the parameters and protect the DC Converter.
- Temperature sensors are provided for sensing the heat sink temperatures of the IGBT modules and for protecting it.
- It communicates with AC-2 module through CAN Communication.

ACU DC Converter Output Section

- DC converter output section consists of DC output contactor, DC output reverse polarity sense & BN-bus voltage indication (for both forward & reverse direction).
- The output of DC converter is fed to BN (Battery Normal) loads, BD (Battery Direct) loads as well as battery charger.

- DC converter output is connected to BN bus terminals through DC output contactor. It is used to isolate the DC converter module from load when DC module fails and if any reverse connection at BN bus.
- Contactor driving, monitoring, DC output reverse polarity check is done by AC-2 master controller.
- Voltage indication card is used for visual indication of BN bus voltage availability & if any reverse connections on BN bus.

ACU DC Link Voltage Indicators

- Voltage indicators are used to indicate voltage availability at DC link of AC-1, AC-2 & input of DC converter module by visual to avoid touching the power modules while servicing.

ACU Cooling System

- Self-contained blower is used for air cooling of the auxiliary converter.
- This blower takes 3phase 415V ac supply from AC-2 inverter output.
- Blower will take supply from AC-1 inverter output if AC-2 inverter fails.
- This action will be done by using change over contactors based on health feedback of other AC.

5.5.2.5 Auxiliary Loads

Auxiliary systems in all coaches work on two different voltages- 415VAC 3-phase, 50Hz and 110VDC. Major equipment working with these power sources are as below-

Table 3: Auxiliary Loads - 415V AC, 3 phase

S.no	Load Name	Description
1.	RMPU	Air conditioning unit for coaches. Cooling rating - 8TR
2.	CAB AC	Air Conditioning unit for driver cabin. Cooling rating - 2TR
3.	Main compressor	Main compressor for brake system. FAD – 920 lpm
4.	Traction converter cooling blower	Blower for cooling of traction converter unit
5.	Transformer radiator fan	Radiator fan for cooling of main transformer
6.	Transformer oil pump	Oil pump for cooling of main transformer
7.	Water pump for toilet tank	For water pumping for toilet tank
8.	230V supply for coach Wi-Fi and TV	TV screen (4nos.) Wi-Fi control unit (1no.) Wi-Fi router (2nos.)
9.	Pantry appliances load at 230V	Microwave Oven (1no.) Hot case (1no.) Soup Warmer (1no.) Mini Refrigerator (1no.) Water Boiler (1no.)

10.	Toilet Loads at 230Vac	Per Toilet loads are as below- Hand drier (1no.) Shaver socket (1no.) Exhaust fan (1no.)
11.	110Vac sockets for Mobile & Laptop charging	110Vac single phase sockets in coaches for Mobile and Laptop charging.

Table 4: Auxiliary Loads - 110 VDC

S.no	Load Name	Description
1	Battery Charger	Battery charger is provided in Converter unit to charge the battery with C/10 rate.
2	Coach, Vestibules and Driver Cabin normal lights	Coach, Vestibules and Driver Cabin lights
3	Coach and Driver Cabin Emergency lights	Coach and Driver Cabin Emergency lights
4	Twin Beam/Auxiliary Head light, Marker Light, Tail Light, Flasher light, Cluster Light, Spot Lights, Passenger Alarm Indication Light, Electronic signal bell	Twin Beam/Auxiliary Head light, Marker Light, Tail Light, Flasher light, Cluster Light, Spot Lights, Passenger Alarm Indication Light, Electronic signal bell
5	Control Electronics Loads	PIS, CCTV, Relays, Contactors, Driver desk, Brake systems and all other control units.
6	Doors	Doors
7	Auxiliary compressor	Auxiliary compressor for Pantograph.
8	Emergency Ventilation Blowers	Emergency Ventilation Blower for coaches when RMPU is not working.
9	Toilet Loads at 110Vdc	Vacuum toilet Loads
10	Seat Lights	Seat Lights for reading

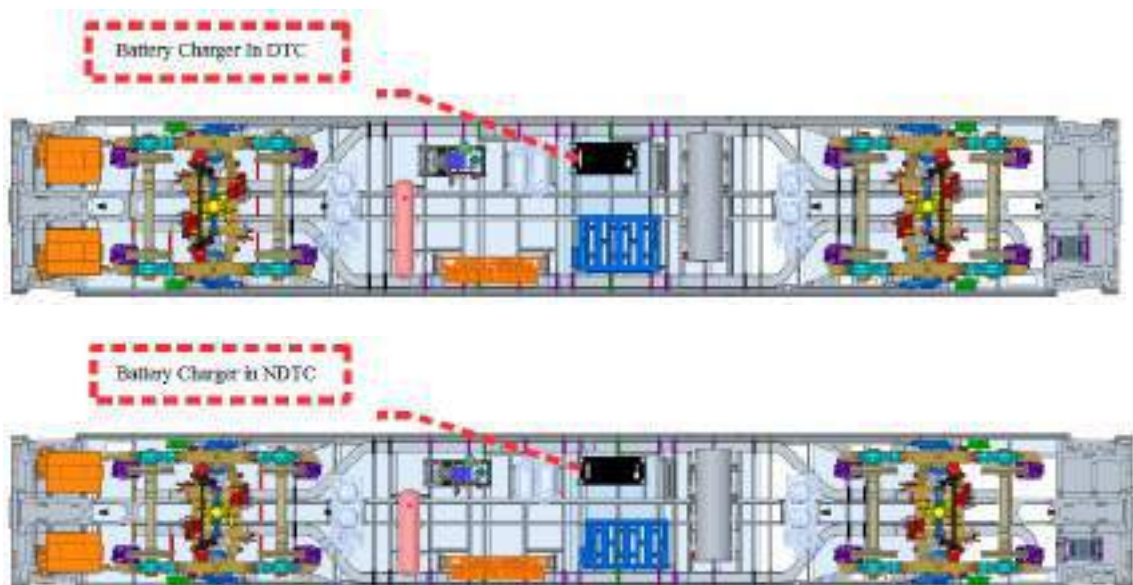
5.5.2.6 Cooling

The ACU is forced-air cooled. Blower air is used for POWER MODULES and magnetics cooling. Auxiliary converter cooling is achieved by means of forced convection. Air will be drawn from outside through air inlet filter panel. Inside the Auxiliary converter one blower is used for cooling of modules and magnetics, it draws air from the inlet air filter on front and Right side of unit and forces it over module heat sinks, the air then flows over the magnetics and finally leaves outside through two louvered doors.



5.5.3 Battery Charger

Battery Charging System (BCS) is a PWM based IGBT converter, which is getting supply from BN bus and charge the battery with constant voltage & constant current limit topology.



Battery charger is used to charge 110 V batteries. One battery charger unit is provided in each DTC and NDTC coach of a basic unit. Battery charger unit is made natural cooled design.



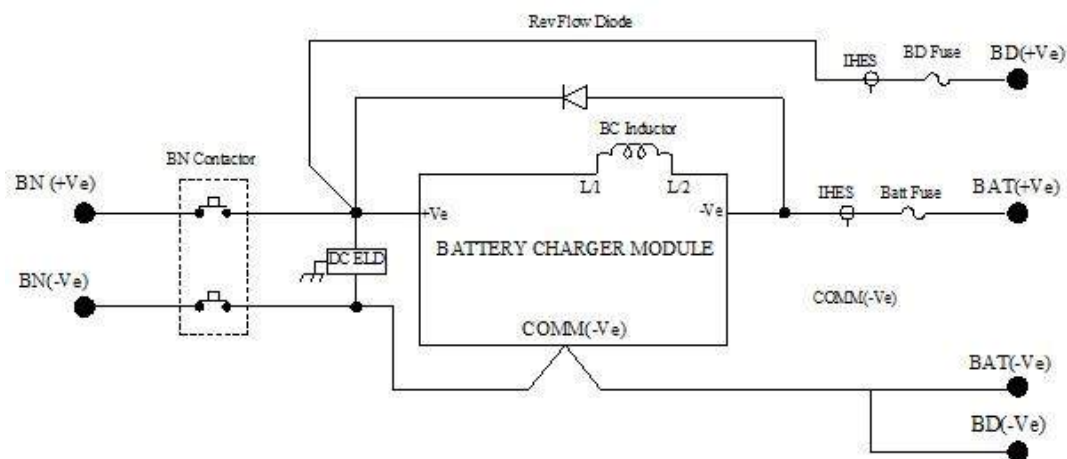


Figure 4: Bloc Diagram of Battery Charging System

5.5.3.1 Sections of Battery Charger

BCS consists of below sections:

BN Contactor:

- BCS is having one contactor called BN contactor. It is used to isolate the BN bus from battery. BN contactor can be turned ON/OFF from driver cabin.

Battery Charger:

- Used to provide the 110Vdc supply for battery charging by taking supply from BN bus (115Vdc-130Vdc).

Reverse Flow Diode:

- It is used to provide the conductive path at the time of battery backup.

Controller Section:

- There is a controller used which is responsible for monitoring and protecting the complete battery charger and records the faults in the memory and also it interfaces to TCMS to get commands and to send status to display at driver cabin.

Fuses Section:

- ❖ Consists of battery fuse, BD fuse, battery charger input & out put fuse. These are used to isolate the BCS from loads or source if any short circuit happens.



Figure 5: Battery Charger

5.5.3.2 Technical Data

Table 5: Technical Data of Battery Charger

Item	Parameters
Input Voltage	115 V to 125 V DC (From BN Bus i.e. from DC output of BC)
Control Supply	77 V to 137.5 V DC from battery (110 Vdc nominal)
Output capacity	77 V to 115 V DC (It is varying as per battery charging current requirement) Current: Charging current limit is provided at 30 A. Whereas, BCS is designed with 10% margin i.e. 33 A.
Short time rating	Short time rating Current limit topology is used so there will not be any short time rating.
Efficiency	> 95%
Noise Level	< 70dB(A)
Converter Size	1310X576X450 (LXBXH)
Cabinet	SS-409M
Mass	130 kg (approx)
Degree of protection	IP65

Component Layout in the Cabinet

The following diagram shows the position of the major components in the BC.

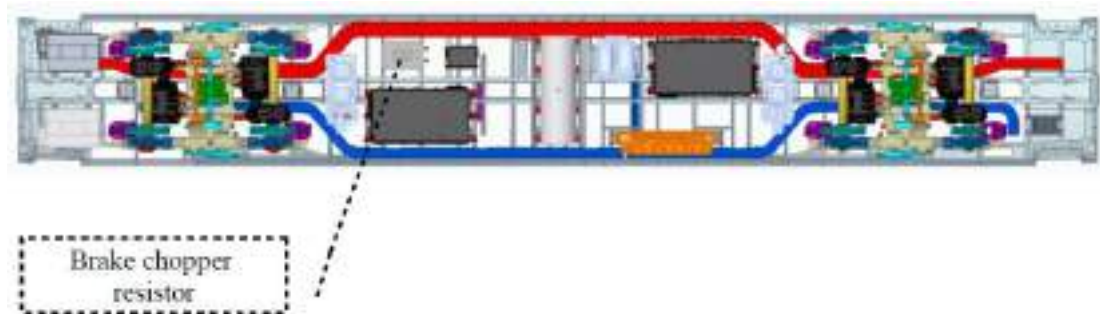


Figure 6: BC Heat Sink Assembly

5.5.4 Brake Chopper Resistor

Brake chopper Resistor is used to limit the DC Link voltage during dynamic conditions leading to over voltages, partial braking load is dissipated during blended braking and full braking load is dissipated during braking operation between stations.

Each Motor Coach has two independent Brake Chopper Resistors. But both these resistors are placed in a single cubicle. Each Resistor is connected across DC link of Line and Traction Converter unit. The Brake chopper resistor unit is under-slung mounted.



Brake chopper circuit comprises of BCH IGBT module and BCH resistor. The Brake chopper circuit is used to limit the over-voltages in DC link capacitors during abnormal conditions or during transients.

Over voltages in the DC link capacitors may occur due to:

- Non receptive OHE during regeneration
- Transient load conditions.

Table 6: Parameters of Brake Chopper Resistor

Sr.No.	Description	Value
1.	Resistance (nominal)	3.6 Ω
2.	Resistance (minimum)	3.42 Ω
3.	Resistance (Maximum)	3.85 Ω
4.	Power Rating	719 kW for 2.5 sec
5.	Energy Rating	1.8 MW-sec



Figure 7: Brake Chopper Resistor

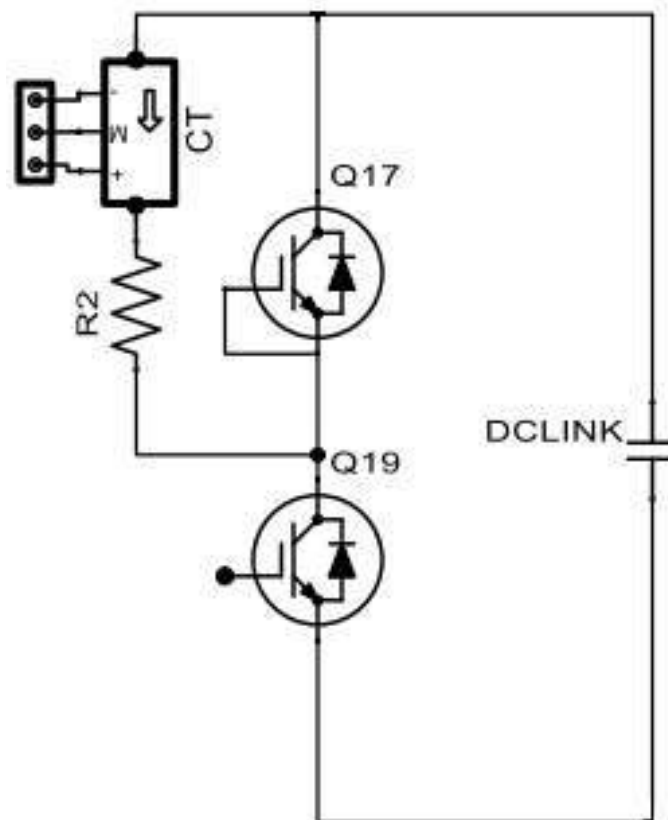


Figure 8: Block Diagram of Brake Chopper Resistor

5.5.4.1 Brake Chopper Description

There are two sets of resistor branches connected in series (their equivalent resistances are R1 and R2) between DC link terminals. R1 and R2 are different resistances each of values 66 k Ω and 20.4 k Ω respectively.

- Brake Chopper unit is mounted directly to under frame.
- Unit outline dimensions are 884 mm(L) x 648 mm (W) x 475 mm (H).
- Unit Max.weight is 100 Kgs.

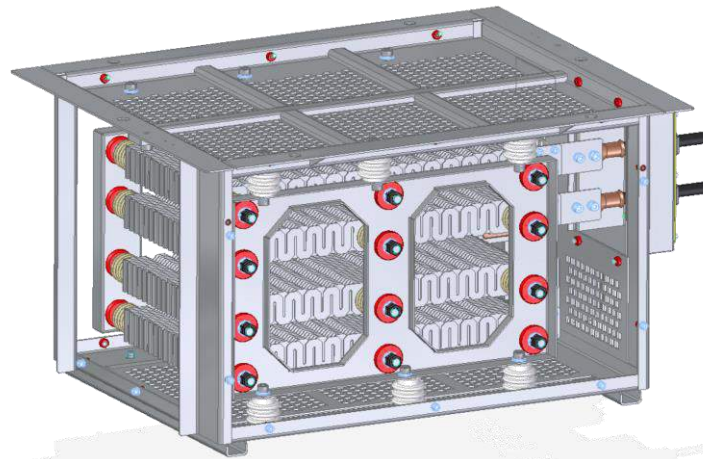


Figure 9: Brake Chopper Unit without Covers

Measurement of Cold Resistance Value

The cold resistance value, measured corresponds to 20°C ambient temperature shall be in between 3.42Ω to 3.85Ω. The resistance can be measured by an LCR meter or with a digital multimeter. Usually if the resistor is failed and open then reading will show infinite resistance (OL on the display) and in case if the resistor is short, then it shows almost zero or very low value.

If the resistance is measured by digital multimeter, then the measurement cable resistance shall be subtracted from the measured value.

5.5.5 D.C. Link Earthing Switch Unit

Each motor coach has two LTC units and has one common DC link earthing switch to protect the operating personnel from high voltage during maintenance activity.



Figure 10: DC Link Earthing Switch

One Earthing switch has four poles. Two LTC units DC link +ve and -ve are connected to a common earthing switch.

The operation is through a key interlocking system similar to the EMU. When the earthing switch is in open condition, all four poles are completely independent.

5.5.5.1 DC Link Capacitor

DC link capacitor has following functions:

DC link capacitor is used to buffer the energy differences between line-side and motor-side of the converter.

- DC link capacitor absorbs the harmonic currents produced by line side and motor-side of the converter, thus reducing the ripple voltage.
- DC link capacitor is used to limit the switching over voltages of IGBTs. These over voltages occur due to loop inductance.
- Two DC link capacitors of 2mF value are connected in parallel and forms the DC Link and are directly connected to the IGBT Phase modules.

5.5.6 Pantograph

In electric traction vehicles, pantograph acts as mobile current carrying equipment which is mounted on the roof. It collects power from the overhead equipment under both static and dynamic conditions and transfers it to traction transformer.

In train-18, the Single Arm Pantograph model WBL 22.03 is mounted on the roof of Trailer Coach (TC). The main purpose of pantograph is to collect the supply from overhead OHE for train propulsion system and to send back energy to the OHE during regeneration braking.



Figure 11: Pantograph at the Roof of Trailer Coach

One auxiliary compressor is mounted under frame in TC coach to build pressure in panto reservoir for pantograph electro pneumatic control initially. During normal run, main compressor is used to maintain the pressure for panto operation.

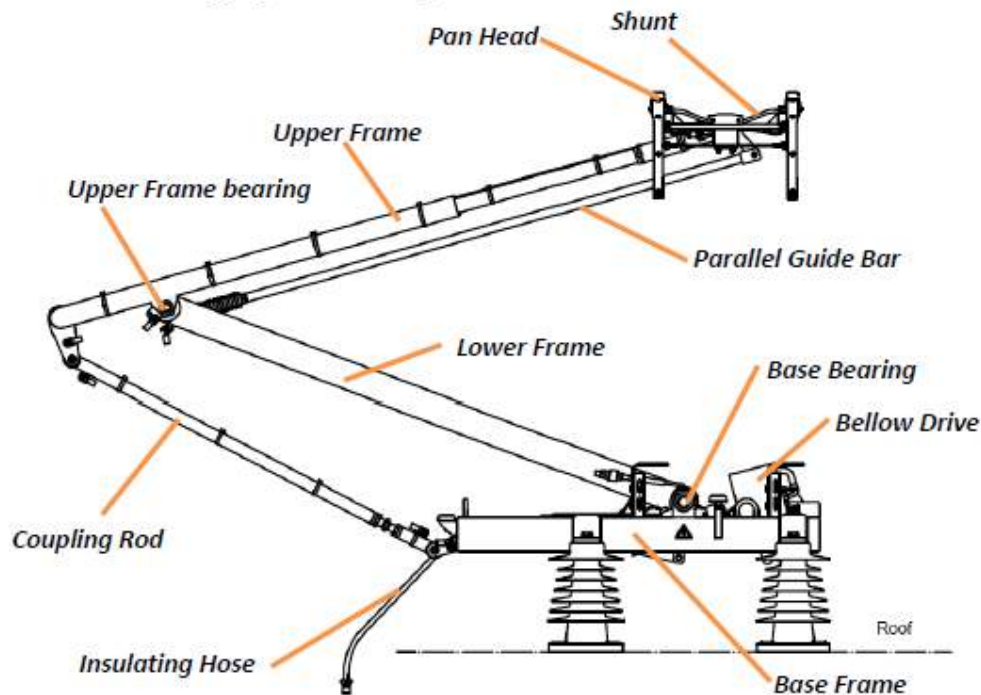
5.5.6.1 Technical Details

Table 7: Technical Details of Pantograph

Description	Parameter
Standard	IEC 60494-1
Minimum height with insulators	585 ± 10 mm
Insulating distance	250mm
Minimum working height over resting position	100mm
Maximum working height over resting	Min2290mm

position	
Maximum Extension	Min2400mm
Width of pan head	1800 ± 10mm
Height of pan head	310 ± 10mm
Total length in resting position	2335 ± 10 mm
Total weight without Insulators	approx. 150 kg
Current collector strips - Length	1030 mm
Current collector strips - spacing	390 ± 10 mm
Current collector strip – material	Metalized Carbon
Frame Insulators (4)	25 kV
Frame Insulators Height	320 mm
Nominal voltage	25 kV
Nominal current	60A at 25kV
Lateral deflection at max. working height & lateral force of 300N according to IEC 60494-1	Max.30mm
Static upward force of pantograph	75 N +5-0 N (modified for train-18)
Pan head	Individual suspension of carbon strip, parallel mounted
Spring rate of pan suspension	8750 N/m ± 10%
Maximum speed under good overhead wire conditions	Max.160 km/h
Speed according specification	Max.120 km/h
Ambient temperature	-10 to +50°C
Air pressure supply from vehicle for raising of pantograph	min.5.5 bar
Air pressure for continuous operation (dry and oil-free air because of isolating characteristics)	min 6 bar
Raising time to maximum working height	6 to 10 s
Lowering time from maximum working height	6 to 10 s
Air-pressure connection-High voltage insulating hose	1000mm

5.5.6.2 Description of Pantograph Components



i. Base Frame

The base is a welded structure of closed rectangular hollow steel profiles. The following component parts are located on the base frame:

- Basic bearings for the lower frame
- Resting buffer for upper and lower frame

Mounting fixtures for:

- Air bellow
- Coupling rod
- Hydraulic damper
- Insulators
- High voltage hook-up
- Valve unit ADD
- Support spring
- Shunts

ii. Lower Frame

The lower frame is a welded structure. Its seating is located on the base frame. The following component parts are mounted to the lower frame:

- Cam disks with suspension fixture for the bellow-drive cables
- Parallel guide bar
- Hydraulic oscillation damper
- Shunts

iii. Upper Frame

The upper frame is a welded structure made of seamless tubes. Necessary lateral stability is achieved through a cross wire-rope construction. Following component parts attached to the upper frame are the:

- Pan head
- Coupling rod
- Lower frame
- Bearing blocks for the knuckle joint bearings
- Shunts

iv. Air Bellow

The pneumatic bellow drive allows the pantograph to rise. It is mounted between the base frame and the lower frame. A pneumatic line connects the bellow drive with the pneumatic control, and then continues via the solenoid valve on to the compressor. The contact pressure is adjusted through the pneumatic control system.

v. Coupling Rod

The coupling rod consists of two individually welded round-tubes. Both tubes are then connected through a control element. Through this control element the geometry of the pantograph will be adjusted and fine tuned.

vi. Parallel Guide Bar

The parallel guide bar prevents the pan head from distorting, while the pantograph is raised or lowered.

vii. Pan Head

The pan head is located at the crest of the upper frame and uses leaf springs for the suspension of the carbon strips. They are affixed in the rocker box, and carry at each end bearing supported mounts to which the carbon strips are then attached. Parallel guiding links assure that the carbon strips operate parallel to the catenary.

viii. Damper

The pantograph damping is attained through the oscillating damper between base frame and lower frame. This guarantees a good contact between the carbon strips and the overhead wire.

ix. Shunts

All bearing locations are by-passed by shunt connectors. These prevent the current from flowing through the bearings. The shunts are consisting of flexible copper cables with clamped end pieces. The current connectors are greased with copper grease to achieve good conducting properties between the shunts and the frame parts.

x. Base- and Upper frame bearing

The bearings of the pantograph are maintenance free and greased for life. At each bearing, in a certain distance on an axle arranged, two ball bearings are

used. To avoid condensation the gap between the ball bearings is filled with grease. The outside of the bearings is protected with cover plates against mechanical damage.

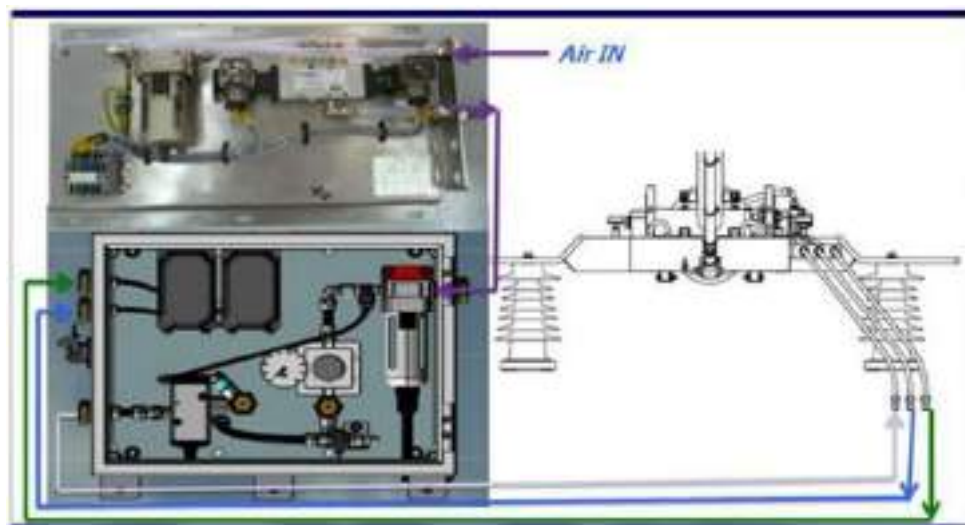
xi. ADD Valve unit (Auto Drop Device)

The pantograph is equipped with a pneumatic carbon monitoring system to minimize damages of catenary and pantograph through worn or damaged carbon strips (e.g. broken carbon pieces).

For this purpose, the pantograph is fitted with special suitable carbon strips, a valve unit is fixed on to the base frame consisting of the rapid exhaust valve, cut off cock and an air hose leading from the base frame, lower frame and upper frame to the carbon strips.

xii. Over Reach Detector (ORD)

The pantograph is equipped with a ORD system to avoid damages to pantograph when pantograph reaches un wired section. The overreach detection provides a pneumatic signal (pressure) to the vehicle in the case that the pantograph reaches a certain height (preferred by Customer) The overreach detection mainly consists of a 3/2 way valve mounted on the base frame, a clamp with a cam clamped to the lower frame and an insulating tube.



5.5.6.3 Pneumatic Control (Valve plate)

The pneumatic control (Valve plate) consists mainly of a filter, 5/2-Way valve and Phoenix connector. The main part of the valve unit is the 5/2-Way valve, it is responsible for raising and lowering control of pantograph. Phoenix connector is responsible to transfer electrical signal from the system to 5/2 way valve.

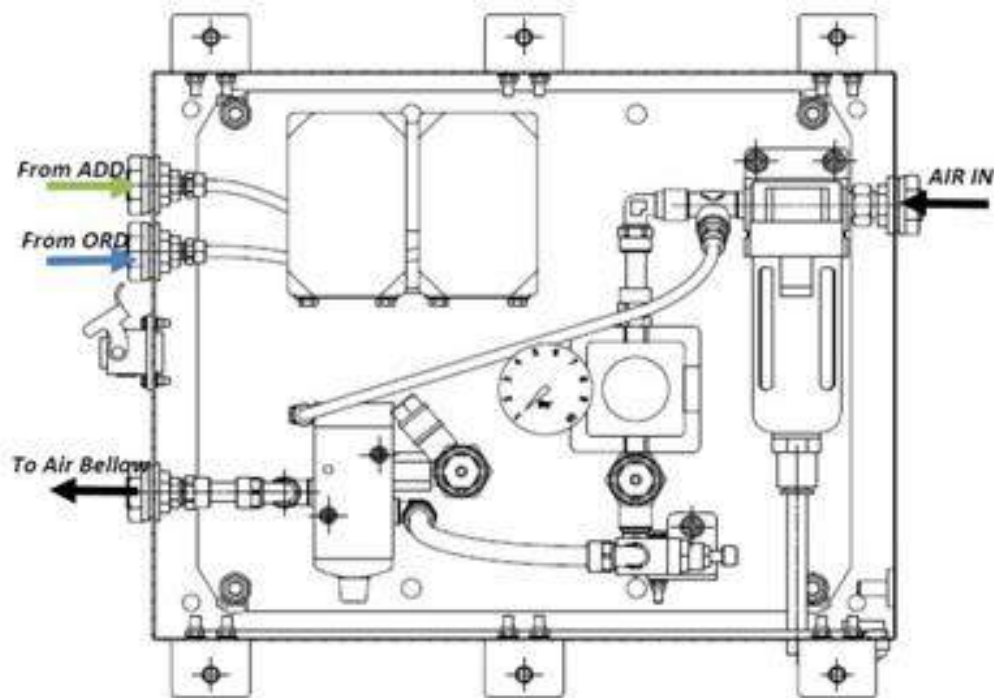
5.5.6.4 Pneumatic Control

The pneumatic control consists mainly of a filter, two throttle valves, two safety valves, a 3/2-Way valve, pressure regulator, two pressure switches and Harting connector.

The main part of the valve unit is the pressure regulator, it is responsible for a constant pressure for the air bellow during all service conditions. The pressure regulator has a high sensitivity and is adjustable in a range of 1 to 8 bar. Pressure switches mounted inside the pneumatic control box to monitor ADD and ORD

For the connection to the pneumatic system three connections available:

- One for the pressure supply of the air bellow
- One for the pressure supply to the Pressure switch from the ADD Valve
- One for the pressure supply to the Pressure switch from the ORD Valve



5.5.6.5 Panto Control

i. Panto control at Train level

In case of normal mode, CCC shall derive panto up/ down commands and send to all the basic units and MCC units for final action.

In case of panto momentary switch is operated toward 'up' in the occupied cab, CCC drives panto up command by checking the 'Panto up' digital input signal pulse status and sends to all MCC units through ETB communication for final action. Likewise, CCU detects all momentary inputs based on a pulse read for a specific time.

Similarly in case, panto momentary switch is operated toward 'down' in the occupied cab, CCC drives panto down command by checking the 'down' digital input signal pulse status and sends to all MCC units through ETB communication for final action.

At the same time, corresponding train lines are generated from occupied cab. MCC also determines up, down commands through train lines. MCC ignores these commands in case of normal mode. Train line commands are accepted only during RDM mode.

ii. Panto control at Basic unit level

Based on panto related commands received from ETB (in case of normal mode) or panto related commands derived from train lines (in case of RDM mode), EPCC drives panto up digital output by considering following conditions.

- Panto selector switch mode
- No EOL loop condition triggered
- No Panto low pressure switch is detected
- Panto up command detected
- No basic unit isolation is selected and
- No VCB contactor stuck at high-level condition occurred.

EPCC drives the panto down digital output based on panto down command detected or if any above conditions are not satisfied.

In case VCB trip condition occurs in the basic unit, EPCC downs the pantograph when VCB contactor stuck at high condition is detected (unable to open VCB condition).

5.5.6.6 Pantograph status Indication Lamps

In driver desk, one lamp is available related to pantograph status name it as 'min 1 panto up'. This lamp is driven through state of panto hard-wired train line.

This state of panto hardwired train line is driven by any of EPCC unit in MC coach based on panto up status and OHE voltage available information.

In DDU rake screen and individual basic units screens, panto symbol is available. DDU gets each basic unit Panto status from EPCC, based on panto status will be displayed on DDU.

5.5.6.7 Auto Drop Down (ADD) feature

ADD feature, available in pantograph design is used to lower the pantograph automatically in case of any break or damages of the collector strip. This feature helps to avoid further damage of pantograph as well as catenary.

- ADD feature status can be detected by EPCU through ADD pressure switch.
- In case of pantograph healthy condition, which means no ADD detected, pressure switch status becomes ON (pressure is greater than 3.0 bar).
- In case pantograph lowers by ADD feature, the pressure switch status becomes OFF (pressure is less than 2.7 bar).
- With the detection of pressure switch status as OFF by EPCU, EPCU opens VCB immediately and generate fault message and send the same information to CCU.
- EPCU disables pantograph UP control operation G.

5.5.6.8 Over Reach Detection (ORD) feature

- ORD feature, available in pantograph design is used to lower the pantograph automatically in case pantograph raises beyond the set height limit.
- This ORD feature status can be detected by EPCU through ORD pressure switch.

- In case pantograph healthy operation, which means no ORD detected, pressure switch status becomes ON (pressure is about 0 bar).
- In case, pantograph lowers by ORD feature, the pressure switch status become OFF (pressure is greater than 1 bar).
- On detection of pressure switch status OFF by EPCU, EPCU opens VCB immediately and generate fault message and sends the same information to CCU.
- EPCU disables pantograph UP control operation until fault can be reset by maintenance person.

5.5.6.9 Panto mode

- On driver desk Panto mode selector switch is provided with 2 selection positions to select Panto 1-4 mode or Panto 2-3 mode.
- In corresponding position one train line will be generated, which can be used during RDM mode.
- Based on the selection, corresponding Pantos will made UP.
- In case of one panto failure of corresponding mode, corresponding panto UP lamp indication (Either Panto 1-4 UP or Panto 2-3 UP lamp) will start blinking.
- Based on this driver need to move the switch to other position to select the other 2 pantos.

5.5.7 Vacuum Circuit Breaker (VCB)

VCB is used as a line circuit breaker to close and open the power circuit and also to break the circuit under overload and short circuit conditions or any other abnormal working conditions defined and implemented for the application. It provides connection between catenary and propulsion equipment.



Figure 12: Vacuum Circuit Breaker

In Train set it is mounted in roof of Trailer Coach (TC).It is an electro pneumatic control. EPCC drives one digital output to energize VCB on relay, only if pantograph has already raised, providing supply to electro pneumatic valve for VCB close operation.

The Vacuum Circuit Breaker (VCB) type VCBA25.10Tr, make Autometers Alliance Ltd. is provided on Train-18. It is a single phase 25kVAC circuit breaker used to protect power circuit.



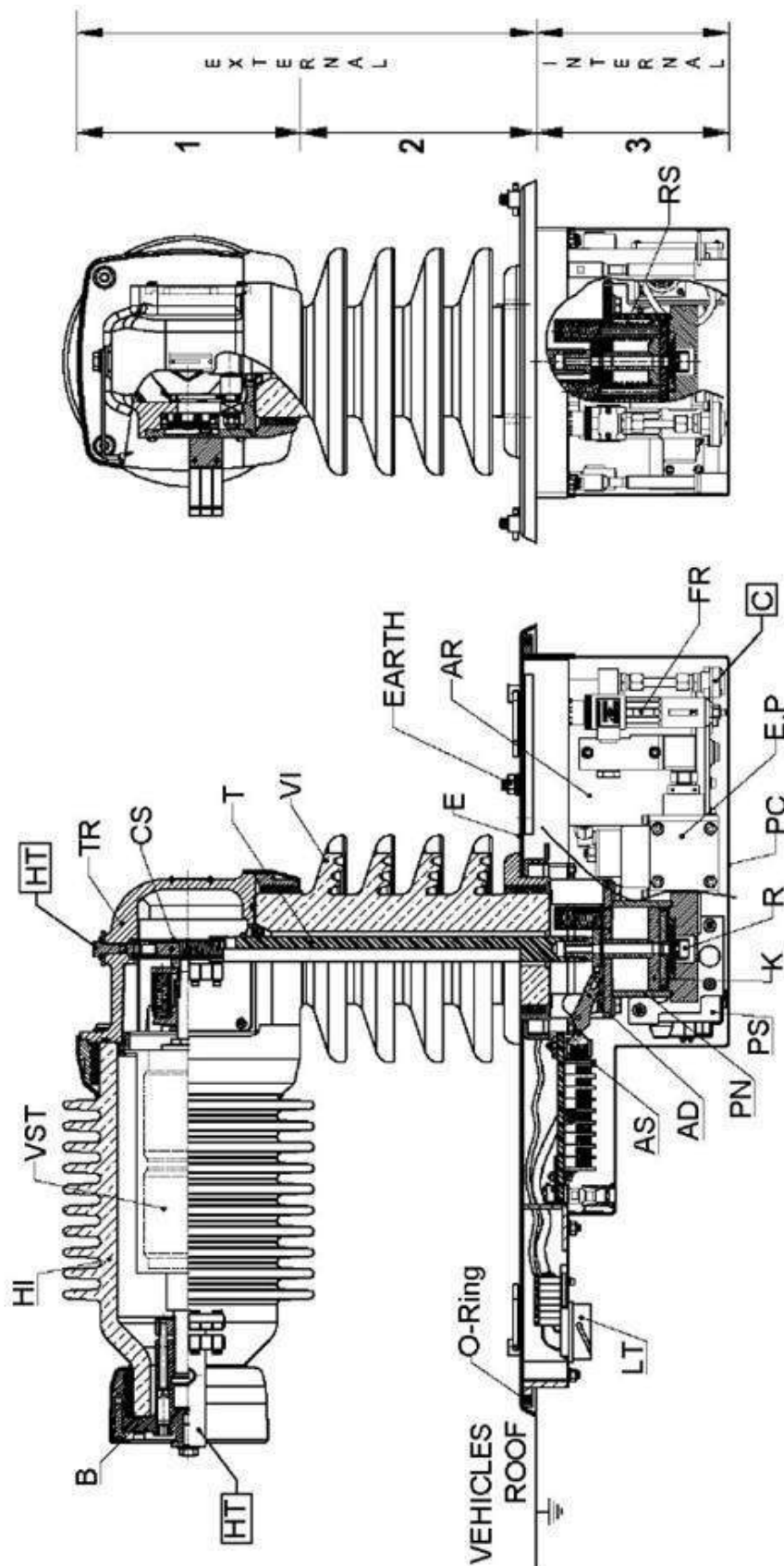
5.5.7.1 Technical Details

Table 8: Technical Details of Vacuum Circuit Breaker

Description	Details	
Make	Autometers Alliance Ltd.	
Type	VCBA25.10 Tr	
Maximum rated voltage	kV	30
Nominal rated voltage	kV AC single phase	25
Power frequency withstand voltage (dry & wet)	kV	75
Lightning impulse withstand voltage	kV	175
Rated current	A	1000
System frequency	Hz	50
Short circuit rupturing capacity	kA	16 (440 MVA)
Making current	kA	40
Short time current capacity	kA (3 sec.)	16
Opening time *	ms	≤ 60
Closing time	ms	< 100
Control voltage	VDC	110
Auxiliary contacts (type & no.)	NO/NC (Fish bone type)	4NO + 4N Configurable contacts for external circuit and 1 NO for internal use.
Input air supply pressure	Kg/cm ²	4.5 to 10

Rated operating sequence	--	O-3min-CO-3 min-CO
Weight	Kg	App. 150
Power consumption (max.)	W	23

5.5.7.2 Constructional Features



The vacuum circuit breaker comprises three main parts which are:

1. The upper part, which is the high voltage circuit (HT)
2. The intermediate part, which assures isolation from earth
3. The lower part with the electro-pneumatic and the auxiliary circuit (LT)

Upper Part

It is outside the vehicle, on the roof, and comprises:

- A vacuum switch tube (VST), which houses the main switching contacts
- A horizontal ceramic insulator (HI) which is fixed
- To a shafting head (TR), which converts the vertical movement of the drive system into horizontal movement. One of the electrical connections (HT) is mounted on this conductive part.
- A rear flange (B) which closes and seals the horizontal insulator and carries the second electrical connection (HT).
- A vacuum switch tube moving contact is fitted with pushed screw, flexible shunts to carry the current from moving contact to shafting head. Spring box houses the contact springs and operating cam to transfer the vertical motion into Horizontal direction.

Intermediate Part

Serves to isolate the upper part (HT) from the lower part (LT) i.e. it isolates the vehicle roof, which is earthed with the high tension part of the circuit breaker.

It comprises:

- A vertical insulator (VI) supporting the upper part and fixed to base plate (E) which is mounted on the vehicle roof by means of 6nos. M12 hex screws. The lifting hooks 4nos. are fitted in this base plate permanently.
- To ensure waterproof sealing between traction vehicle roof and the base plate of circuit breaker, an o-ring is provided.
- An insulating drive rod (T) is connected between operating mechanism of vacuum switch tube and drive mechanism.

Lower Part

This is inside the vehicle in a protection cover (PC) which includes the control and the drive mechanism which consists of:

(a) The Pneumatic Circuit

It comprises:

- Air inlet connector (C)
- An air pressure regulator with filter (FR)
- An air reservoir (AR)
- A pressure switch (PS) for monitoring minimum pressure
- An electro-pneumatic valve (EP)
- A regulator (R) whose flow is proportional to the movement of the drive system

(b) The Drive Mechanism

It comprises:

- Pneumatic cylinder (PN)
- Piston (K) which is guided inside the cylinder to transfer the movement to
- insulating drive rod
- Spring system (RS/CS) provided to keep the circuit breaker in open position.
- Non-return valve (N) is fitted with air cylinder for exhaust throttling.

(c) The Auxiliary Circuit (LT)

It comprises:

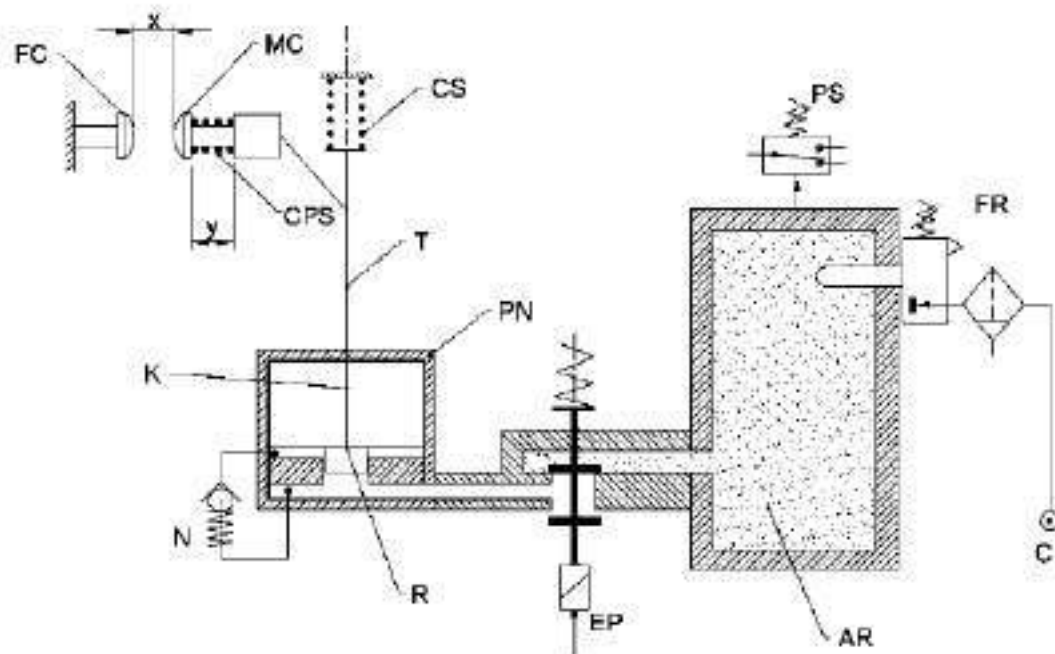
- Polarized circular connector (LT) for fail safe connection to the electrical circuit of the vehicle.
- Auxiliary switch (AS) which changes its status depending on the circuit breaker position. Auxiliary switch is configurable and is of proven fish bone type.
- Auxiliary switch drive (AD) mechanism which is linked with the drive rod (T).
- An electro-pneumatic valve assuring closing and opening function.

5.5.7.3 Operation of VCB

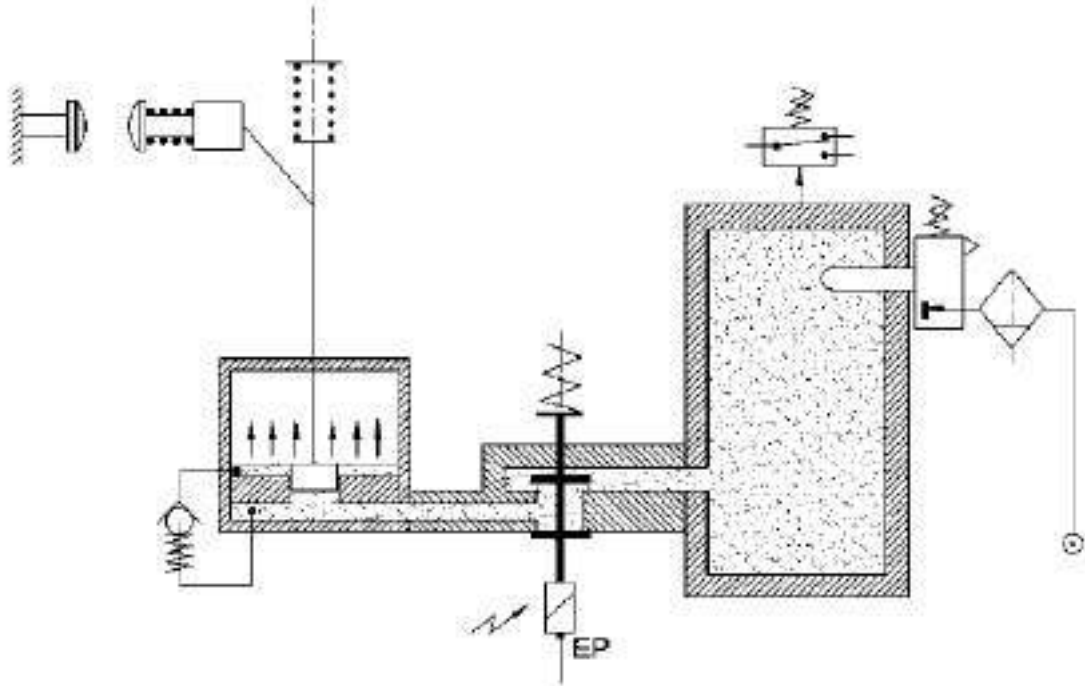
The method of operation of the circuit breaker is described in the following different sequences:

Closing of VCB**(a) VCB Open**

- Status of VCB in open condition.

**(b) Order (Pulse) to Close the VCB**

- Energizing of the electro-pneumatic valve solenoid coil.
- Operating of the electro-pneumatic valve (EP).
- Air flows from air tank (AR) to the piston drive.

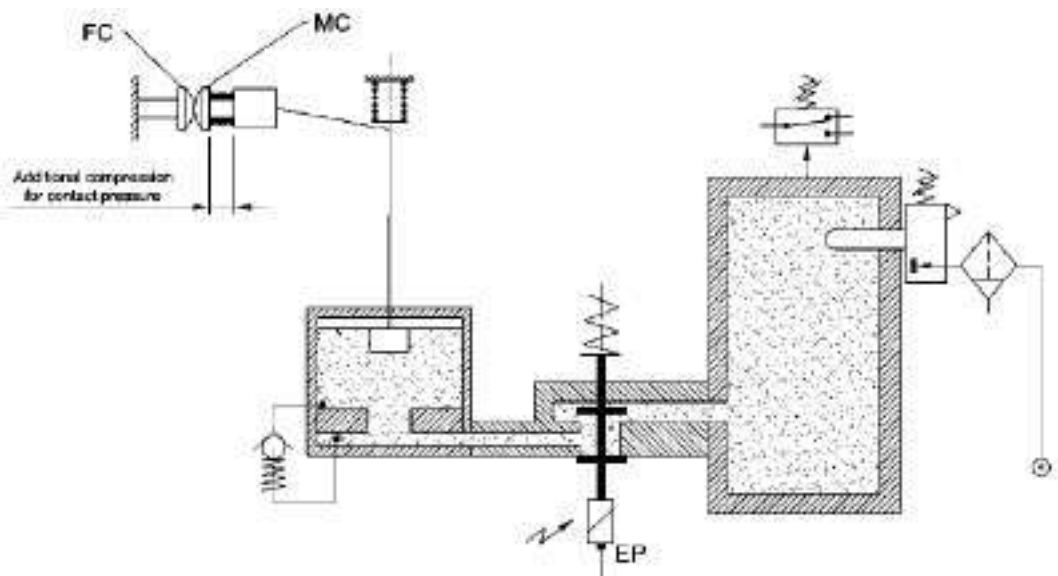


(c) Mechanism Movement

- Movement of the closing piston (K), the insulating rod (T) and the moving contact(MC) along horizontal distance (X).
- Closing of the main contacts inside the vacuum bottle.
- Exerting extra pressure on the contact pressure spring (CPS) for desired contact pressure.

(d) Holding of VCB in Close Position

- Holding of VCB in close position is achieved by the compressed air.
- VCB switched ON.



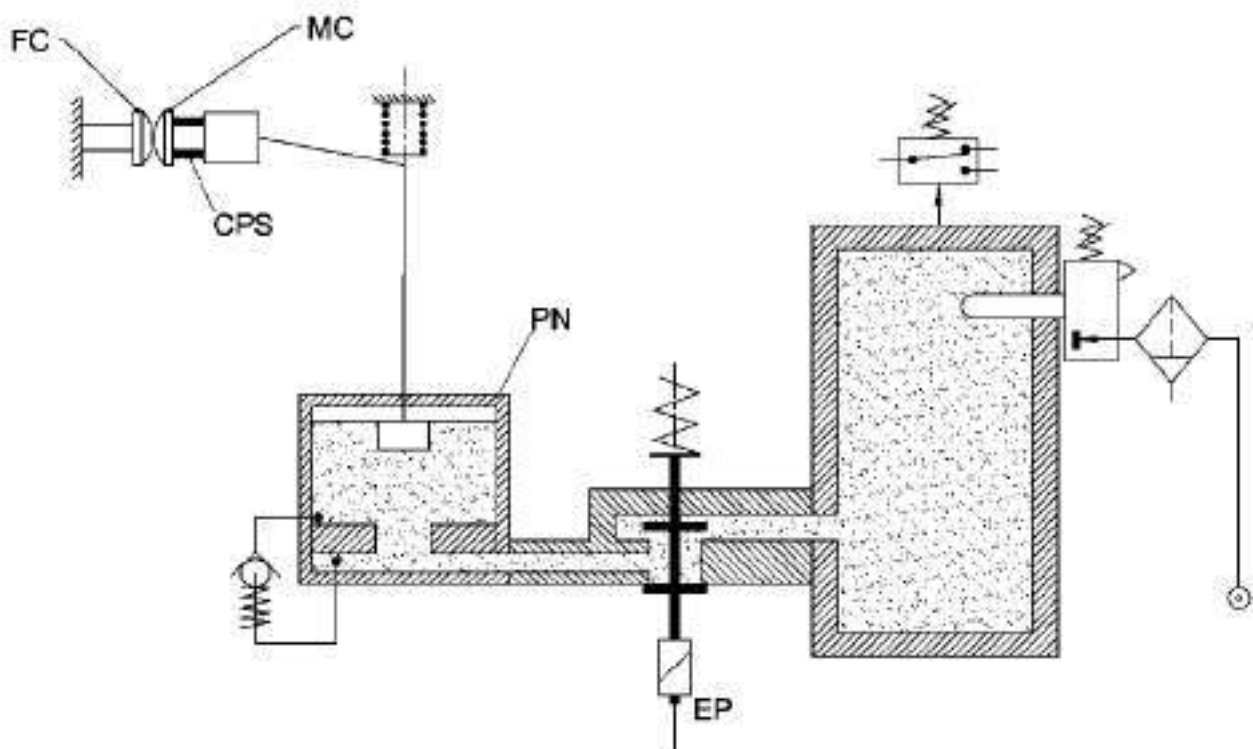
5.5.7.4 Opening of VCB

(a) VCB Closed (Figure-1.5)

- Status of VCB in close condition.

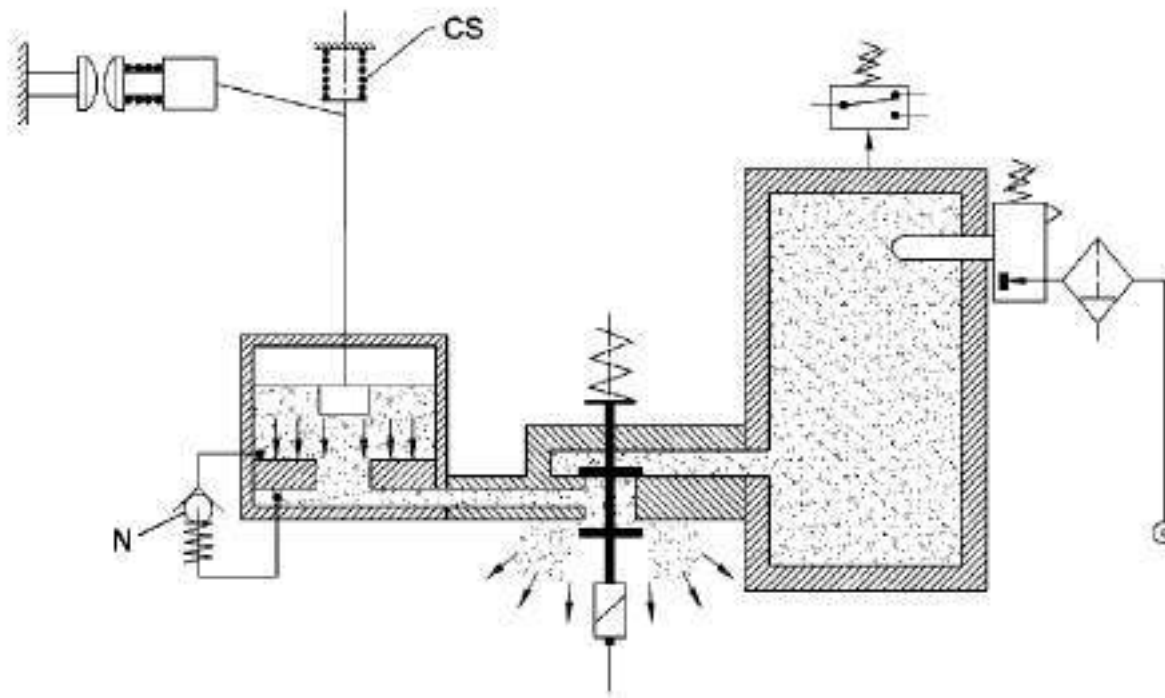
(b) Interruption of Current Supply of EP Valve Solenoid Coil

- De-energisation of EP valve solenoid coil results into changes in the status of the valve.
- Air supply from air tank is blocked and exhausts port open of the EP valve.
- Exhaust of compressed air available in pneumatic cylinder (PN).
- The compressed springs release their store energy which acts as returning force to the piston.
- Start of return of piston stroke through above mentioned action ensures safe opening of the contacts.



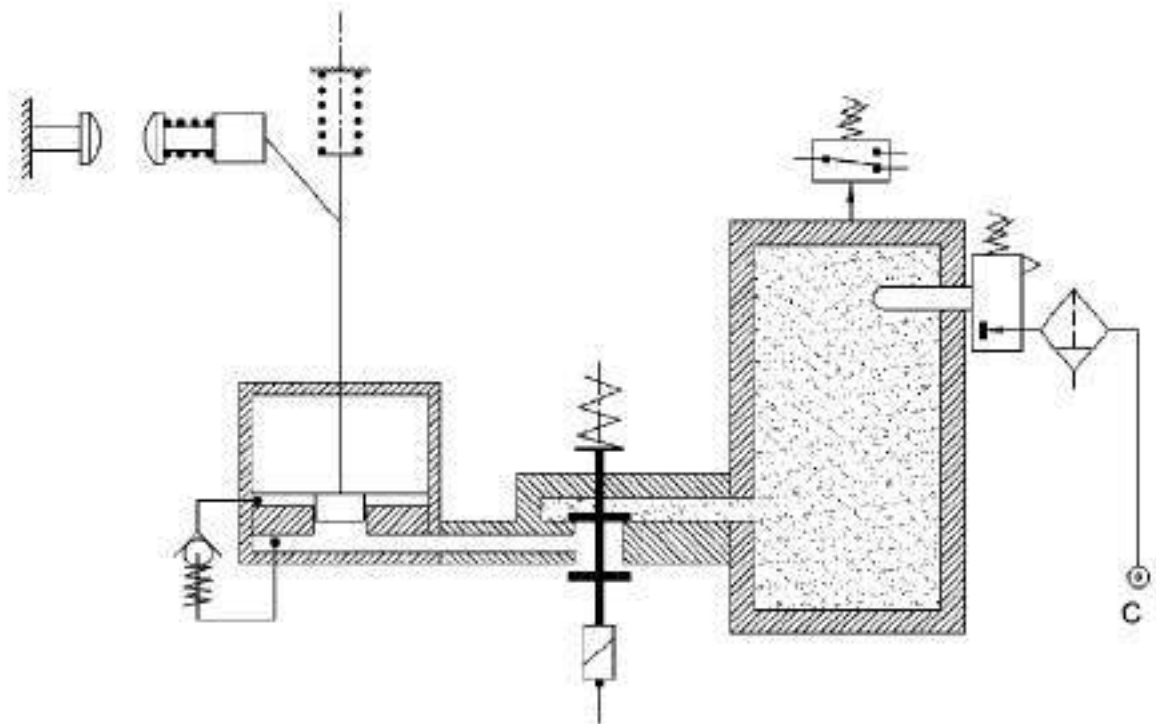
(c) Rapid Movement of Piston

- The piston is accelerated by the release of the air pressure and release of contact pressure springs stored energy.
- The air displaced by the piston escapes fast via exhaust port of electro-pneumatic valve (EP).
- The arc caused by the opening of the contacts is extinguished by the vacuum inside the vacuum switch tube.
- Just before the end of piston travel, the piston travel is cushioned by the function of non-return valve (N).



(d) End of Piston Stroke

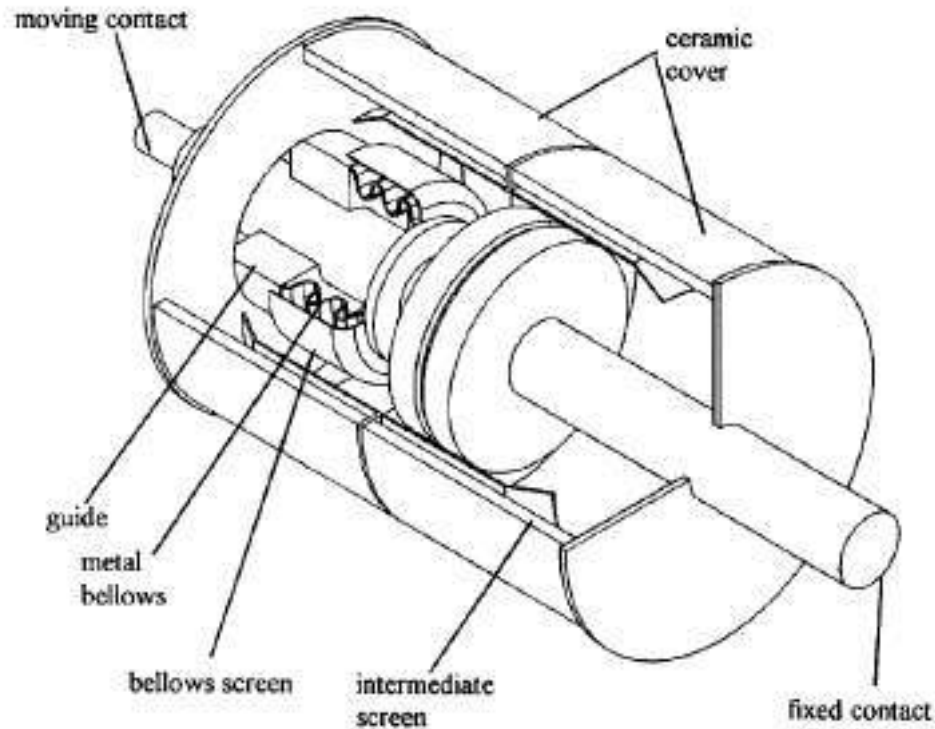
- VCB switched OFF (open position).



5.5.7.5 Vacuum Switch Tube Construction

- The vacuum switch tube comprises two copper alloy contacts, one fixed and the other moving.
- The fixed contact is mounted on a metal flange which carries the ceramic outer cover of the chamber.
- The ceramic cover is generally in two parts with a metal screen fixed between them. This screen protects the ceramic parts against deposition of metallic vapour produced by the arc when the contacts open.

- The moving contact travels in a guide who assures its axial positioning and correct angle.
- Sealing of the moving contact is assured by a metal bellows which is welded both to it and to the end flange which is integral with the external cover. A metal screen is also provided around the bellows.



5.5.7.6 VCB Control

Train level VCB control

- In case of normal mode, CCC derives VCB close or open commands and send to all basic unit EPCC units for final action.
- In case VCB momentary switch is operated toward 'ON' position in the occupied cab, CCC derives VCB close command by checking the 'ON' digital input signal pulse status and sends to all EPCC units through ETB communication for final action.
- Similarly In case VCB momentary switch is operated toward 'OFF' position in the occupied cab, CCC derives VCB open command by check the 'OFF' digital input signal pulse status and sends to all EPCC units through ETB communication for final action.
- At the same time corresponding train lines are generated from occupied cab. EPCC also determines VCB close, open commands through train lines. But EPCC ignores these commands in case of normal mode, but considers only in RDM mode.

Basic unit level VCB control

Based on VCB related commands received from ETB (in case of normal mode) or panto related commands derived from train lines (in case of RDM mode), EPCC drives VCBON digital output by considering following conditions.

- No EOL loop condition triggered
- No Panto low pressure switch is detected
- Panto up command detected
- No basic unit isolation is selected and
- No VCB contactor stuck at high-level condition occurred.

EPCC opens VCB based on the VCB open command detected or any of the above condition are satisfied.

In case VCB trip condition occurs in the basic unit, EPCC opens VCB.

VCB status indication lamps

- In driver desk one lamp is available related to VCB on status name it as 'min 1 VCB close'. This lamp is driven through state of VCB hard-wired train line.
- This state of VCB hardwired train line is driven by any of EPCC unit in MC coach based on VCB on feedback status.
- In DDU rake screen, individual basic units screens, VCB symbol is available. DDU gets each basic unit VCB status from EPCC, based on this VCB status will be displayed on DDU.
- EPCC will know the status of VCB by read redundant feedback auxiliary NO, NC contacts.

5.5.8 Earthing Switch for VCB

Earthing switch for VCB is provided on the roof of Trailer coach (TC) adjacent to VCB to protect the operating personal during maintenance schedule from OHE Voltage.

This two poles earthing switch is used to earth the circuits on both sides of the air operated vacuum circuit breaker (VCB) of electric traction vehicle, to ensure the safety of the loco pilots and maintenance personnel safety during checking and fault finding operations.





Figure 13: Earthing Switch for VCB

- The upper casing of the earthing switch is mounted on the roof of the traction vehicle, this houses the main shaft on which the two break blades are fitted.
- To make the earth connection, these blades establish the contact between the frame and electric circuits on both sides of the air operated main circuit breaker.

The lower casing which houses the operating and inter-locking mechanism of the earth isolating switch is installed inside of vehicle.

5.5.8.1 Technical details

Table 9: Technical Details of Earthing Switch for VCB

Make	Patra& Chandra
Type	PCE.VES.25.4
Rated voltage	25 kV ac
Rated current	400 A
Poles	2
Weight	26Kg. (Approx.)
Place of mounting	Roof

5.5.8.2 Constructional Features

- The operating lever of the earthing switch is connected through the arrangement of uni-ball joint to the main shaft. Two isolator blades are fitted on the both sides the shaft.
- The operating lever mechanism is kept in the lower casing of the switch. The main shaft along-with the blades are kept in the upper casing. Both upper and lower casing are fitted with the bolts.
- At the earthing position these blades establish the contact between the frame and electric circuits on both sides of the vacuum circuit breaker.

- Operator/Driver can operate the switch by operating the interlocking arrangement from the machine room through operating lever.



5.5.9 Lightning/ Surge Arrester

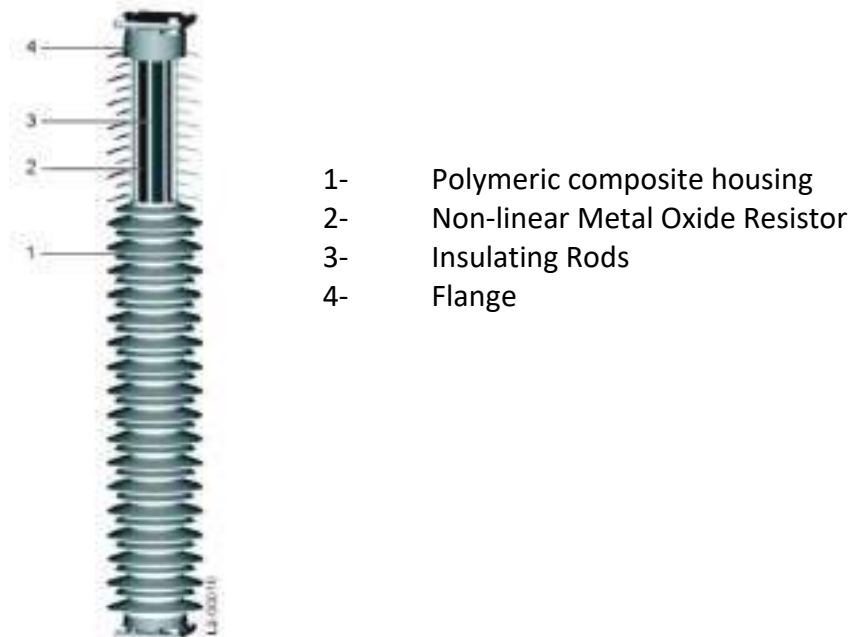
Two nos. Surge Arresters Type 3EL2 are provided on the roof of the Trailer Coach (TC) of Train set. These surge arrester serve to protect the insulation of the power system (or of one of its components) from undue stresses resulting from over-voltages.



Figure 14: Lightning/ Surge Arrester

5.5.9.1 Constructional Features

- The active components of the arrester are metal oxide resistors. They are arranged in a stack and hermetically protected against environmental influences by means of directly mounted silicon enclosure.
- The mechanical strength is attained by glass-fibre-reinforced polymer rods which tightly enclose and compress the resistor stack.
- Due to its hydrophobic properties, the silicon enclosure minimises electrical discharges on the enclosure surface and thus ensures particularly good operating characteristics, even under conditions of heavy pollution.
- The flanges are made of a lightweight metal alloy suitable for use outdoors and directly connected with the silicon enclosure.



The metal-oxide (MO) resistors are tightly enclosed by the fibre-reinforced plastic (FRP) rods (as if in a cage). In the event of resistor overload, an extremely unlikely case, but which cannot entirely be ruled out, the resultant arc produces no overpressure, since the resistors are not enclosed by a sealed, mechanically rigid casing.

The arc escapes immediately through the silicon enclosure, without any abrupt rupturing of the mechanical load bearing enclosing structure. At the same time the Metal Oxide resistors are held largely in place by a considerable number of FRP rods. The risk of parts flying off is therefore minimised.

In the case of over-voltages due to lightning or to switching operations, the resistors become conductive (ohm range) thereby allowing a discharge current to flow to ground and the overvoltage to be reduced to the value of the voltage drop at the arrester ("discharge voltage").

Here the discharge currents may range up to 2 kA in the case of switching surges and 1 - 10 -20 kA in the case of lightning surges.

5.5.10 Traction Transformer

In train set, Trailer Coach (TC) consists of traction transformer mounted under-slung with auxiliary converter unit. Power to Line and Traction Converter (LTC) units of both motor coaches is distributed from same traction (power) transformer.



Figure 15 Traction Transformer

The transformer is an electro technical element of the whole traction system which is in charge to propel the train. The transformer main function is to transform energy coming from the catenary to the traction and auxiliary converters.

5.5.10.1 Technical Specifications

Table 10: Traction Transformer Winding Specifications

Description	HT	Traction	Auxiliary
Quantity	1	4	2
Capacity (kVA)	2880	603	234
Voltage (V)	22500	855	343
Current (A)	128	705	682
Insulation Class	A	A	A

Table 11: Traction Transformer Voltage Rating

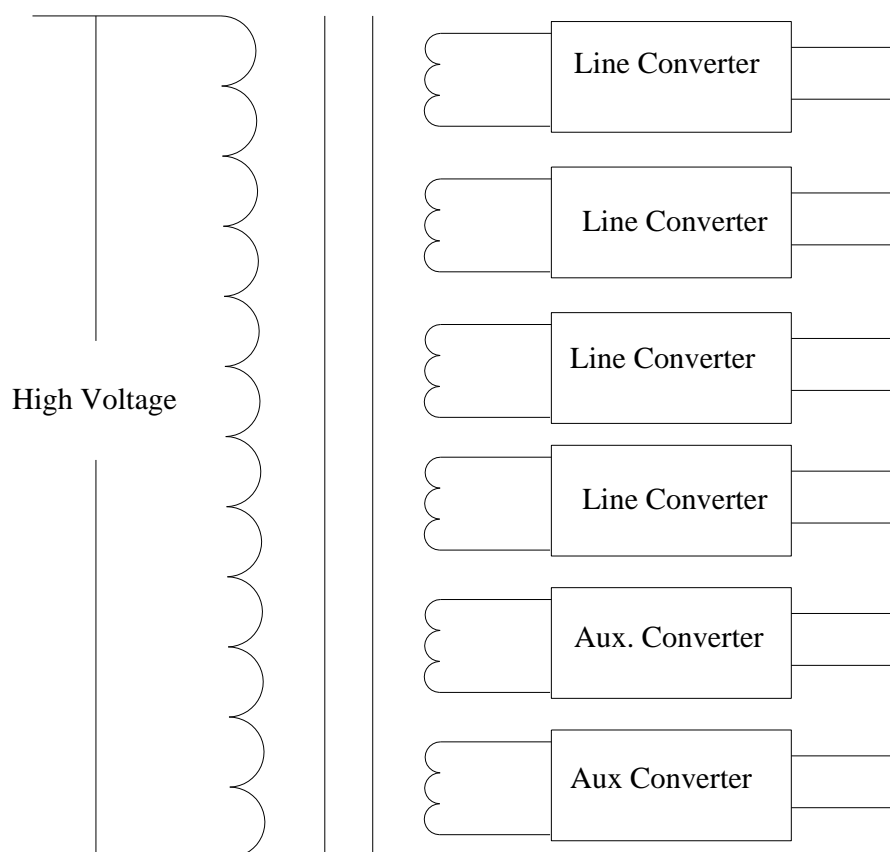
	Primary			Traction x 4			Auxiliary x 2		
	U line (kV)	Power (kVA)	Current (A)	Power (kVA)	Voltage (V)	Current (A)	Power (kVA)	Voltage (V)	Current (A)
Exceptional	16	2109	132	429	608	705	197	240	820
Continuous	19	2505	132	509	722	705	234	285	820
	22.5	2880	128	603	855	705	234	343	682
	25	2880	115	603	950	635	234	376	623
	27.5	2880	105	603	1045	577	234	413	566
Exceptional	30	2880	96	603	1140	529	234	451	519

Table 12: Traction Transformer - Dimensions and weights

Length	3200 mm
Width	2600 mm
Height	730 mm
Total weight with oil	4900 kg +/-3% kgs
Weight of oil 550 kg	550 kg
Others	
Frequency range	47 – 53 Hz

5.5.10.2 Constructional Description**Transformer**

Traction transformer is used to supply 4 traction (Line) converters and 2 auxiliary converters.

**Figure 16: Block Diagram of Traction Transformer Windings**

The overhaul transformer is composed by three main elements:

- i. Transformer itself: a steel tank containing the active part immersed in mineral oil.
- ii. Cooling system: Oil Directed Air Forced (ODAF):
 - one aluminium coolers with stone protection grids + two fans supported by steel frame
 - an hydraulic network and one axial pump for oil circulation

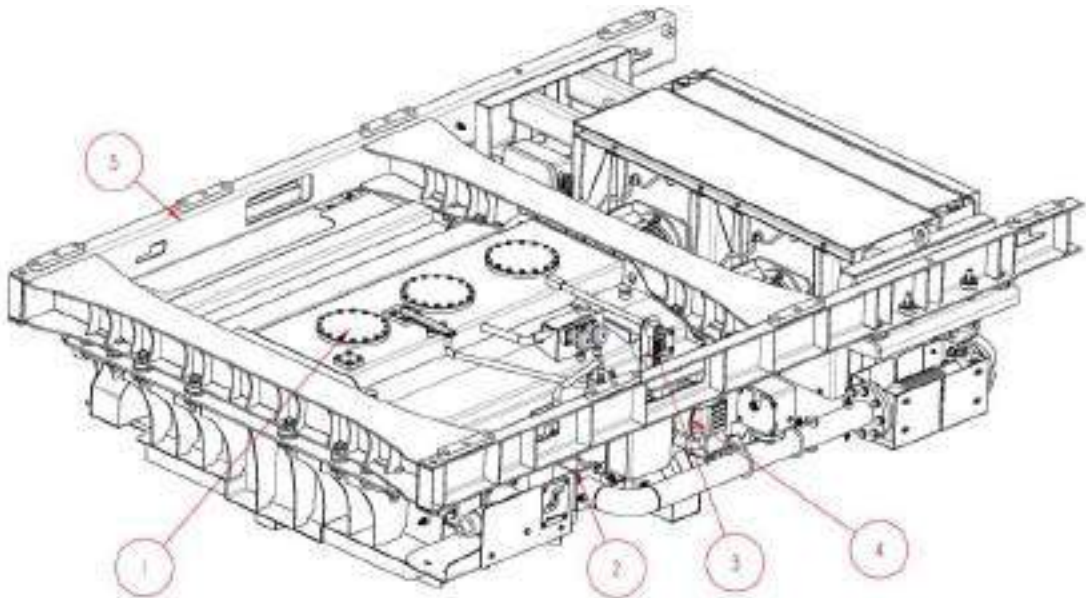
- an oil expansion tank allows oil expansion linked to warming with an air dryer.
- iii. Monitoring: several sensors (temperature, flow, oil level, etc...) linked by wires to connectors.

The interfaces are:

- Electrical interfaces: 13 low voltage bushings, 1 high voltage bushing and 1 earth terminals
- Mechanical interfaces: 6 fixing points for fixing to train coach body.
- 3 phase equipment (motor-fan) : 1 connector.
- Monitoring interfaces: 1 connector.

The main transformer is fixed to the frame using 16 dampers in order to filter vibrations generated by active part.

The cooling system is fixed to the frame using 4 dampers in order to filter vibrations generated by motors.

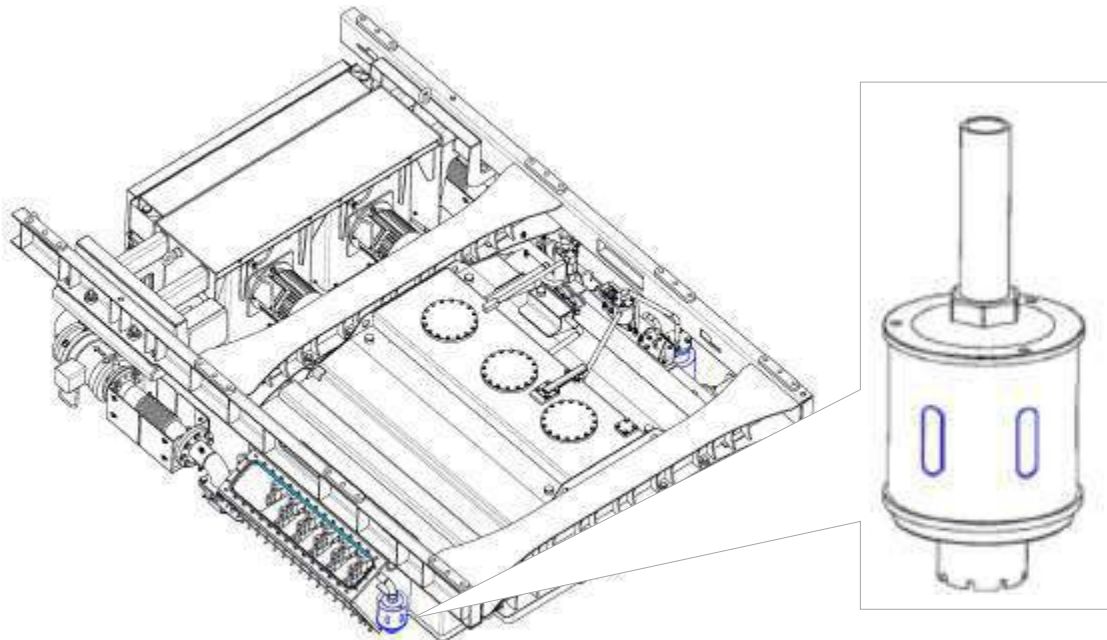


- The active part of the transformer is placed in a tank, immersed in Mineral Inhibited high grade oil IEC 60296 which ensures insulation and cooling.
- The tank has a welded cover. The oil expansion tank (1) that is part of the transformer's bell communicates directly with the tank.
- The top of the oil expansion tank is connected to the atmosphere through an air dryer (2). A second air dryer (5) is connected to the LV connector box.
- An oil level indicator (3) graduated in °C, with max and min labels, is placed on the side of the oil expansion tank for reading oil level.
- The transformer is protected from overpressure through a pressure relief device (4). This valve has an operating indicator and a contact signalling that it is opened.
- The frame has earthing terminals for electrically bonding the unit.

Air dryer

When the oil inside the transformer is cooled or heated, the volume of oil inside the transformer changes. Through the air dryers, air could enter or leave the transformer's oil expansion tank and avoid over or under pressure. This air is dehumidified by a desiccant.

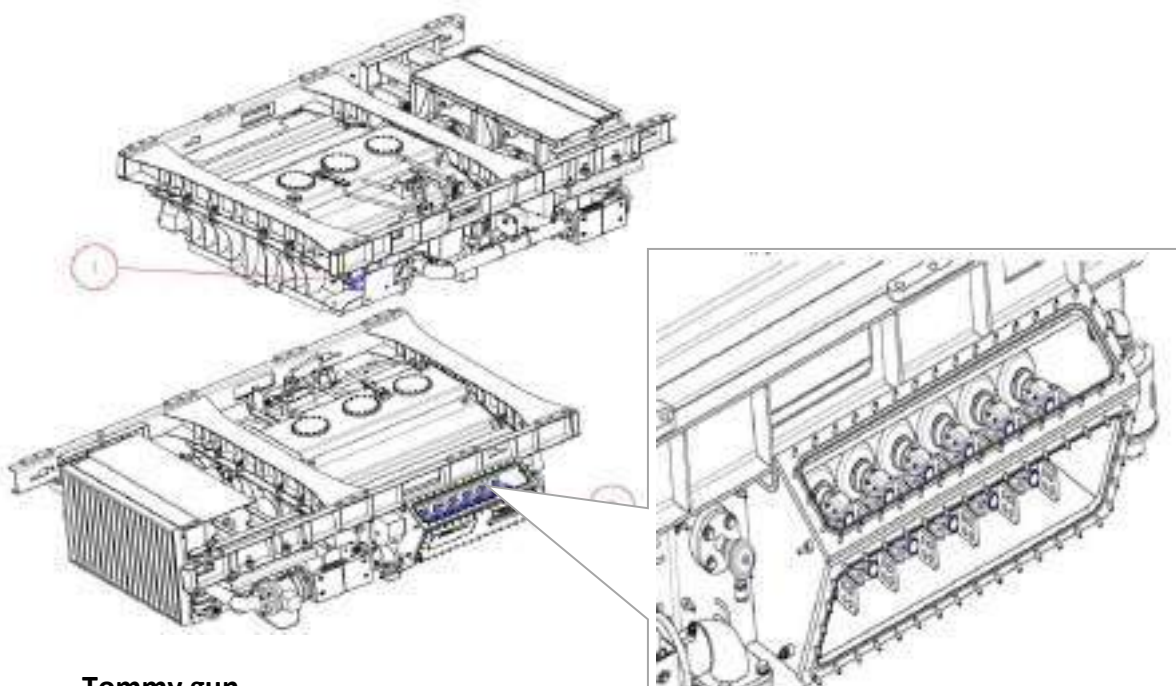
The first air dryer is connected to the oil expansion tank by the air dryer pipe. The second air dryer is connected to the LV connector box in order to avoid rust on the connectors.



Bushings

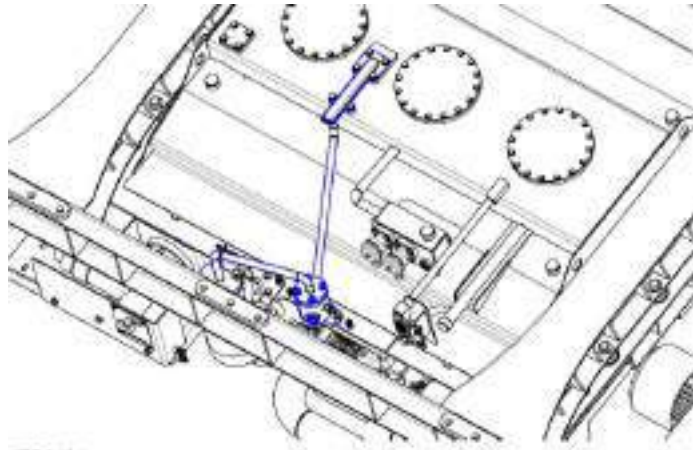
There are two types of bushings located on the transformer:

- 1 no. high voltage plug-in bushing for 36kV, 630A input (1) .
- 13 nos. identical ceramic bushings (2) : 12 low voltage outputs, 1 neutral input.



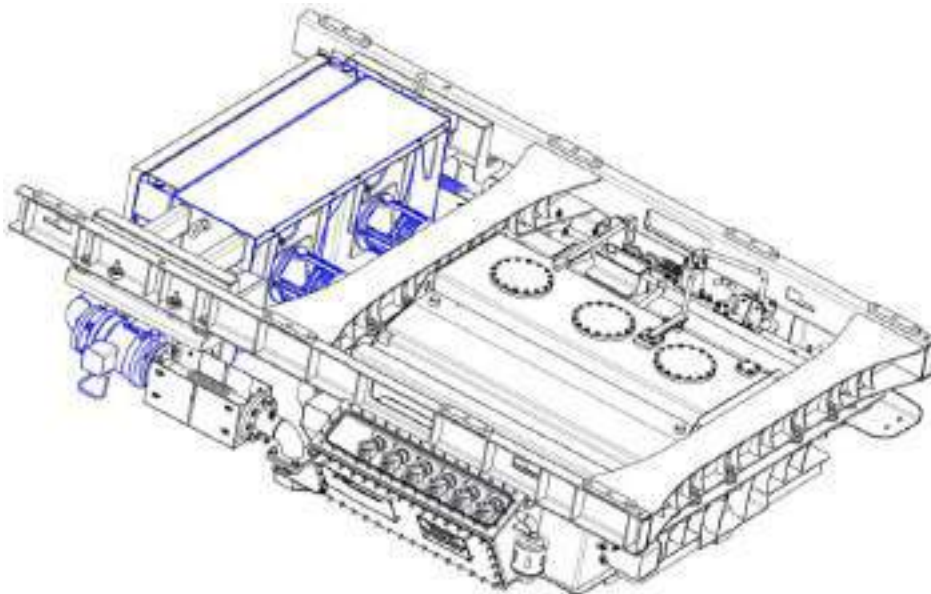
Tommy gun

A container is set on the air link between air dryer and conservator tank to avoid air dryer pollution with oil. An oil sight glass is placed on the container to check the presence of oil.



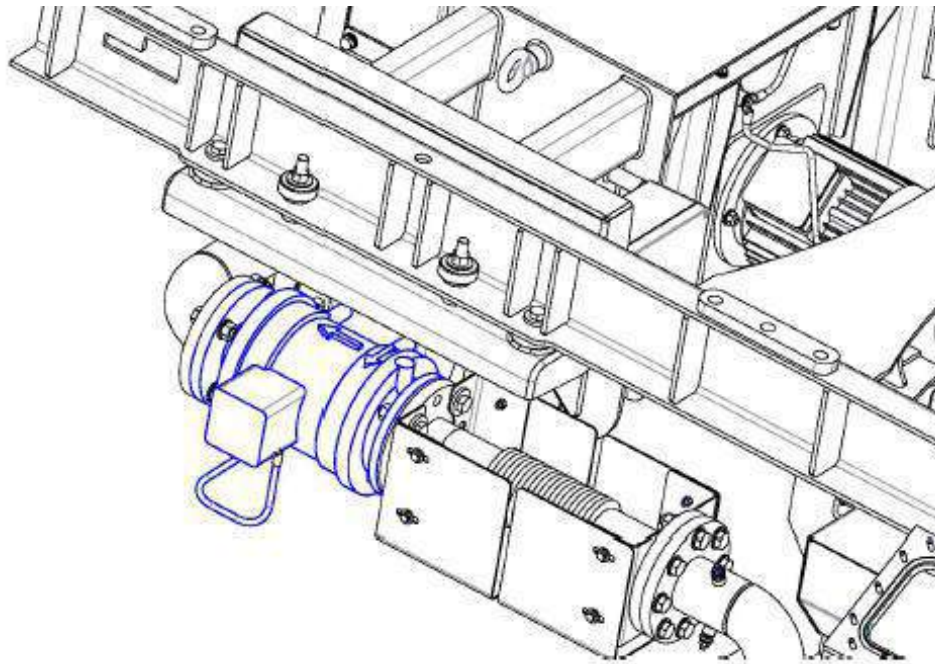
Cooling system

- The transformer assembly is cooled by means of one cooler, fed with oil by oil pump. The cooler is equipped with 2 motor fan sucking air through the radiator and blowing it on the bottom side of the train.
- The refrigeration assembly can be isolated by means of four isolating valves DN80. This makes it possible to change motor pump set, cooler and oil flow switch by limiting the draining of oil to the volume of these parts.



Motor pump set

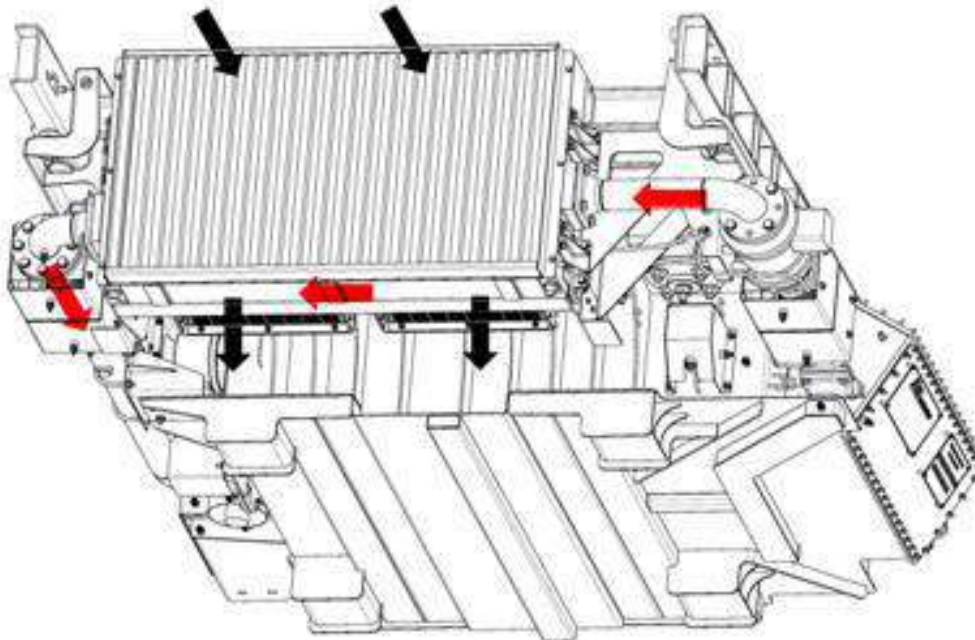
The immersion type pump which ensures the flow of the oil starts as soon as the railcar is powered up. The oil pump is supplied with 415 V three-phase 50Hz, directly connected to the train inside the terminal box by harting connector.



Coolers and motor fan sets

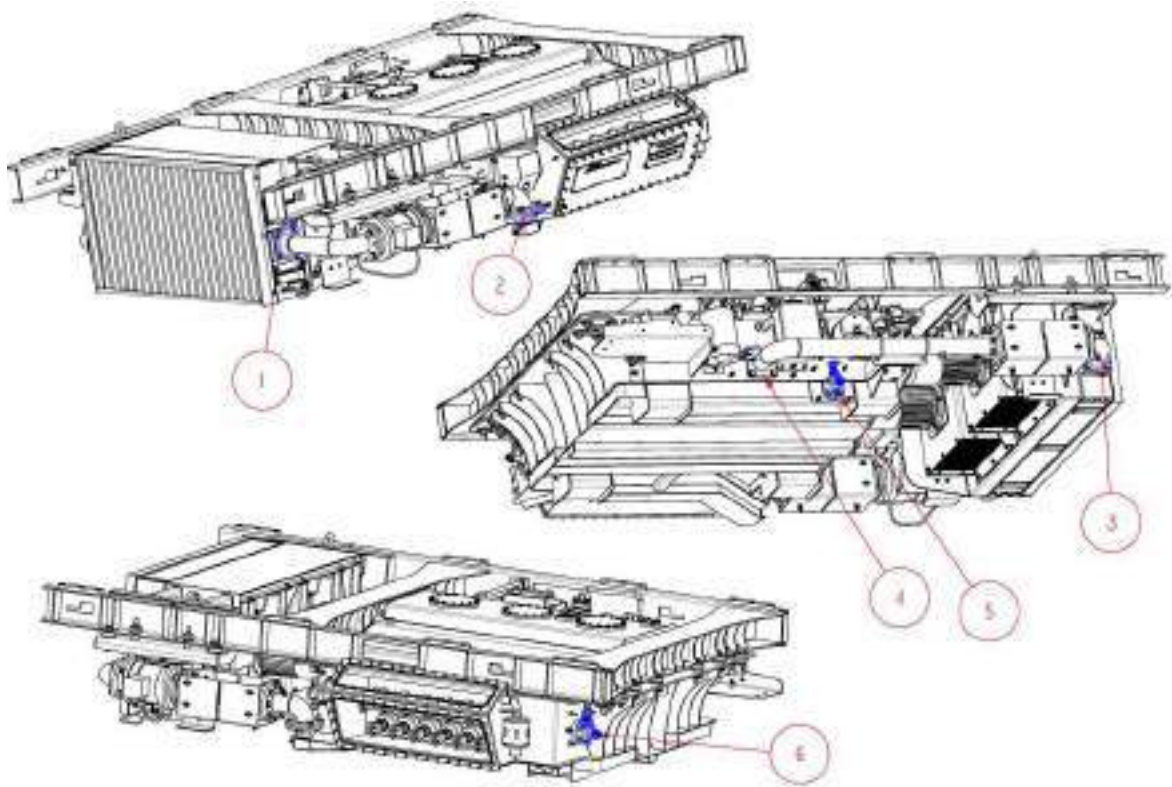
The cooler is operating as follows:

- Fresh air get from external side of the car body
- Then this air get through coolers made of aluminium and bars, and cools the oil inside
- Finally the air now heated is sucked by the motor fan and blow on bottom side.



- The cooling unit is removable from below with transformer on the train.
- The motor fan sets are supplied with 415 V three phases 50Hz, connected to the train inside the terminal box by harting connector.

Valves



- Two DN25 valves are arranged at the bottom (5) and at the opposite part of the tank (6), allowing the oil to be filtered through a treatment device.
- The valve (5) located at the tank bottom is also used to drain the transformer.
- Four isolating valves DN80 (1) ,(2) ,(3) , (4) isolate the refrigeration assembly.

5.5.10.3 TRANSFORMER MONITORING

Different information are available on the transformer, with three main functions:

Oil cooling monitoring

- 2 PT100 sensors
- oil flow switch

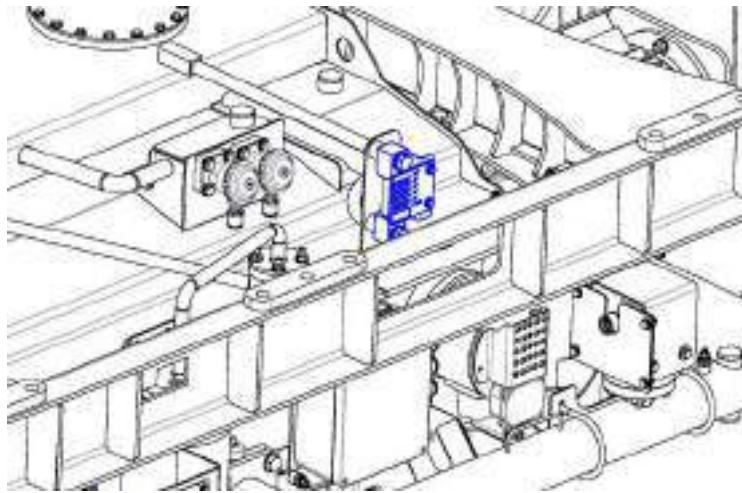
Oil level monitoring

- Visual Oil level indicator
- 2 oil level switches

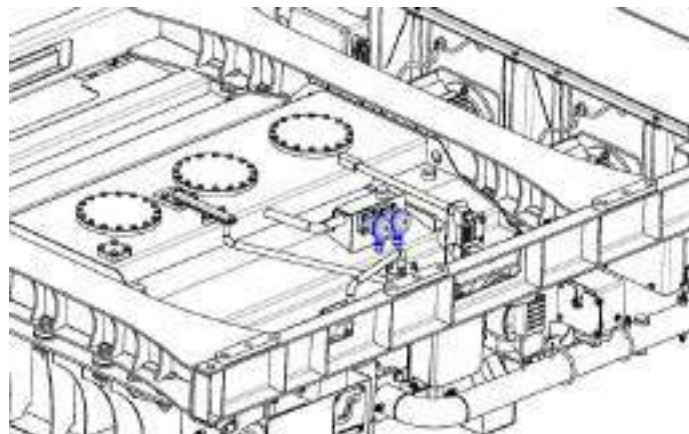
The auxiliary connections (oil flow switch, Pressure relief device, PT100 sensors, oil level switches) are grouped in a terminal box.

Oil level indicator

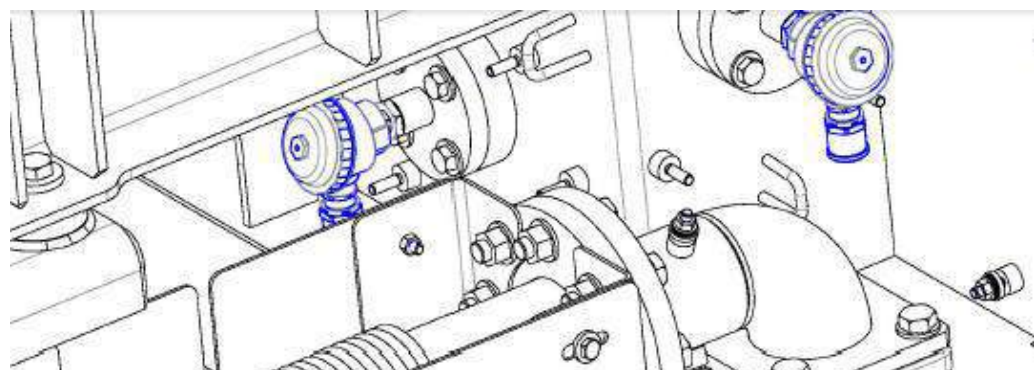
A graduate glass on the oil expansion tank indicates oil level in °C: because of oil expansion, level of the oil expansion tank is directly related to oil temperature.

**Oil level switches**

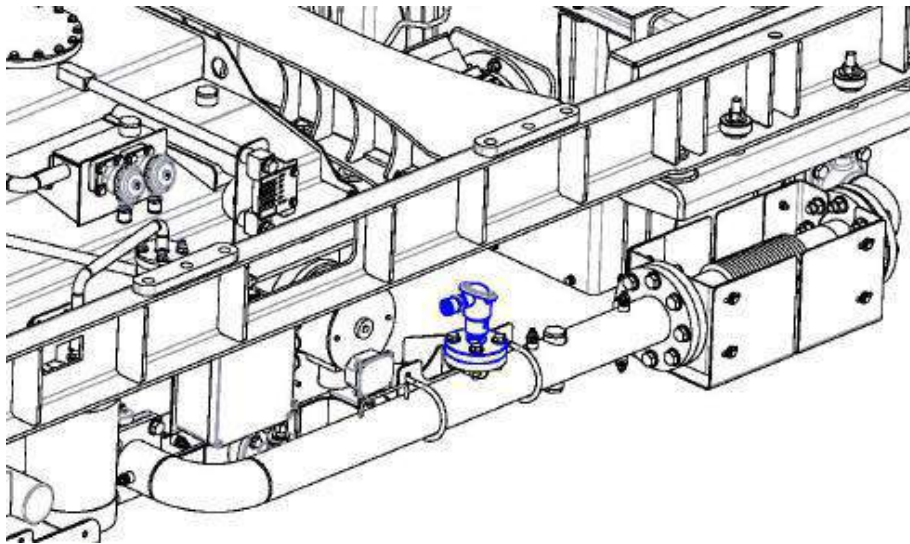
- Two oil level switches are mounted on the oil box between the oil tank and the expansion tank in order to monitor the oil level.
- The two oil level switches are mounted on two different levels. The top one indicates a low level of oil, the bottom one indicates critical level of oil.

**PT100 sensors**

Two PT100 sensors are mounted on the tank. The signals are sent to the supervision which regulate the oil temperature with the fan motor speed.

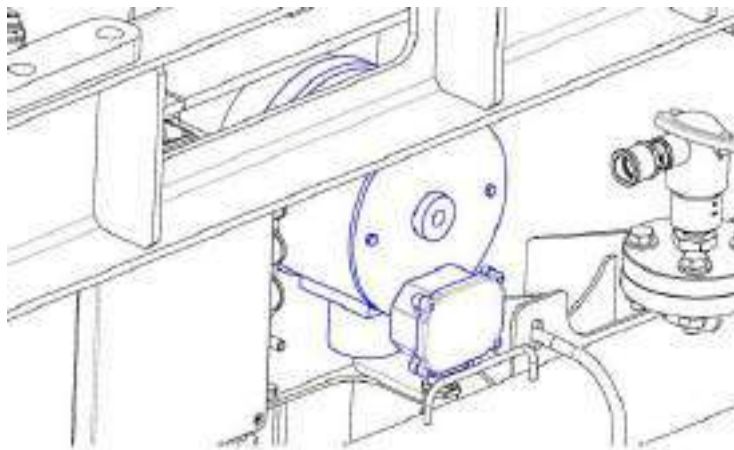
**Oil flow switch**

Oil flow switch is a paddle type. It detects the minimal oil flow. This equipment monitors oil circulation and proper functioning of the oil pump.



Pressure relief device (or Overpressure valve)

Pressure relief device, rated at one dry contact 0.7 bar, protects the transformer from accidental overpressure. A valve opening indicator (red pushbutton) is directly mounted on the pressure relief device cover.



5.5.11 Traction Motor & Gear Drive Unit

Train set coaches are equipped with modern bolster-less design bogies with **fully suspended traction motors**. Motor coach is a powered vehicle with four axles each equipped with a 3 phase asynchronous Traction Motor (TM).

Traction motors are fully suspended i.e. traction motor weight is not loaded on to the wheel directly. This reduces the un-sprung mass, resulting in better ride comfort.

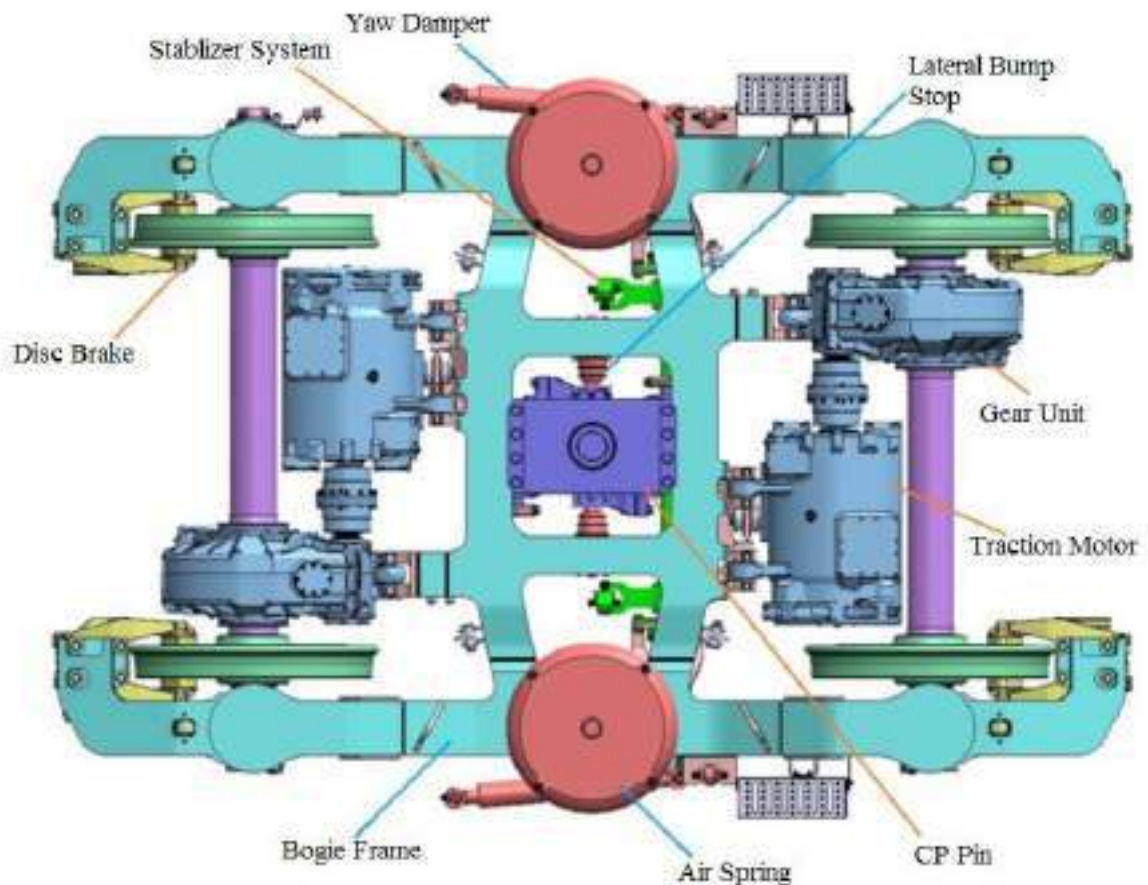


Figure 17: Train Set Bogie with Traction Motor and Gear Box Assembly

5.5.11.1 Technical Data of Traction Motor

Table 13: Technical Data of Traction Motor

S. No.	Description		Details
1.	Designation		3 phase AC Asynchronous Traction Motor
2.	Designed by		TSA
3.	Make		Medha
4.	Type designation		TME 49-35-4
5.	Weight of traction motor drive with half coupling		1000 kg \pm 3%
6.	Continuous rating	Power	265.26 kW (electrical)
7.		Shaft output	252 kW (mechanical)
8.		rpm	3338 rpm
9.		Voltage	1375 V
10.		Current	123 A
11.		Frequency	112.3 Hz
12.		Slip at full load	0.89%
13.		Power factor	0.9
14.	1 hour rating	Power	291.88 kW (electrical)
15.		Voltage	1375 V
16.		Current	136 A
17.		Frequency	112.4 Hz

18.		Slip	0.99%
19.		Shaft output	277 kW (mechanical)
20.		Power factor	0.9
21.		rpm	3337 rpm
22.	Motor efficiency at rated power		95.00%
23.	Maximum working speed of TM		4992 rpm
24.	Maximum frequency		167.5 Hz
25.	Maximum temperature index of winding insulation		237°C
26.	Type of suspension		Fully suspended motor with partly suspended gear drive
27.	Speed at 160kmph with full worn wheels (877mm dia)		4992 rpm
28.	Type of cooling		Self ventilated, air cooled
29.	Air entrance temperature		≤ 50°C
30.	Protection system		IP 20 (machine protected solid objects greater than 12 mm)
31.	Class of insulation material		Class 220
32.	Terminal box protection degree		IP 65 (machine protected against ingress of dust)
33.	Overall dimensions		1431 (L)x1157 (W) x 701 (H)
	Constructional details viz. Rotor bar and rotor end ring arrangement, overhang to terminal box connection etc.		Rotor bar and end ring joints protected by use of high strength alloy shrink ring. All overhangs suitably supported.

5.5.11.2 Constructional Details of Traction Motor

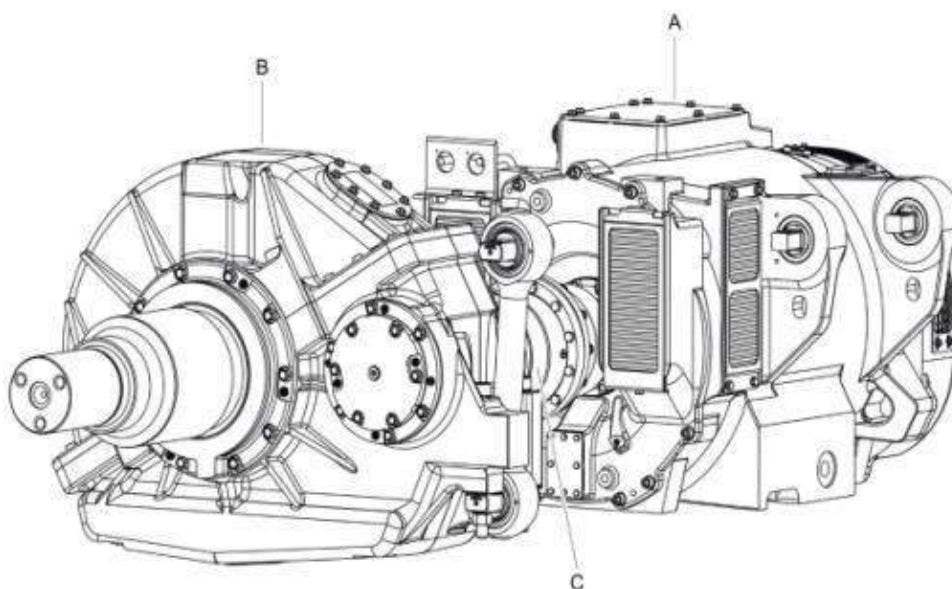


Figure 18: Main Assembly of Traction Drive Complete

- A. Traction Motor
- B. Gear Box
- C. Gear coupling

Traction motor provided in train set motor coach is a 3-phase asynchronous self-ventilated machine.

Stator

The stator consists of lamination stack, which are fitted in a cast metal housing. The stator windings are shaped copper coils, which are wound from insulated rectangular profile - banded with additional coiling insulation and into which slots equipped with a slot lining are inserted.

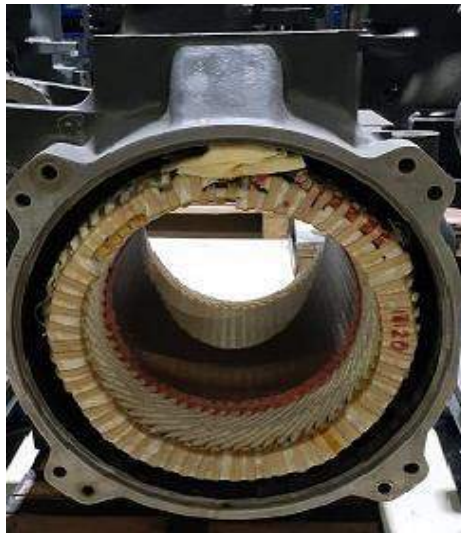


Figure 19: Stator

The connections ("circuitry") of the stator coils take place on the non drive side (NDE). The stator winding is insulated in accordance with TSA standard and conforms to insulation class 220 in accordance with IEC60349-2.

Rotor

The rotor lamination stack made of layered dynamo sheets is mounted on a solid motor shaft and clamped on both sides by rotor moulding press rings. On the non-drive side (NDE), the lamination stack is secured further with a ring shrunk onto the shaft.



Figure 20: Rotor

Short circuit bars and short circuit rings are welded on both sides. Shrink collars made up of high-strength, non-magnetic material absorb the loading from the centrifugal force load on the short circuit rings.

Motor connections

Terminal box is located on top of the motor and provided with cable glands.

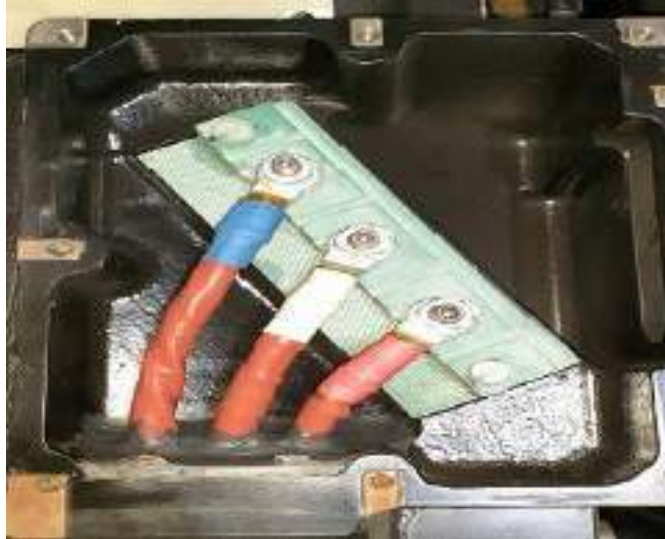


Figure 21: Motor Connection

Traction Motor bearings

The motor shaft is mounted with ceramic rolling element bearings at both DE (Driving End) & NDE (Non Driving End) in the stator housing. The details are as under.

- DE (Driving End) : Deep groove ball bearing - 6217 M/HC5C4HS0
- NDE (Non Driving End) : Cylinder roller bearing - NU1012 MR/HC5C4

Advantages of Ceramic bearing (Hybrid bearing)

- Bearings balls are made from Ceramic material
- Bearing insulated at rollers
- No deformation at higher speed
- No deformation at higher temperature
- No wear & tear of the rollers

Traction motor bearing lubrication re-greasing details

Fill the grease -

DE Bearing : 21 gms

NDE Bearing : 9 gms

Grease type : Shell Gadus S3 V2220C 2

Traction Motor Cooling

The motor is air cooled by a fan mounted at the non-drive end (NDE) of the rotor shaft, air flow is mainly routed through heat exchange channels at the external

periphery of the magnetic stack, one part is ducted inside the rotor, cooling air is filtered at the inlet (grid type).

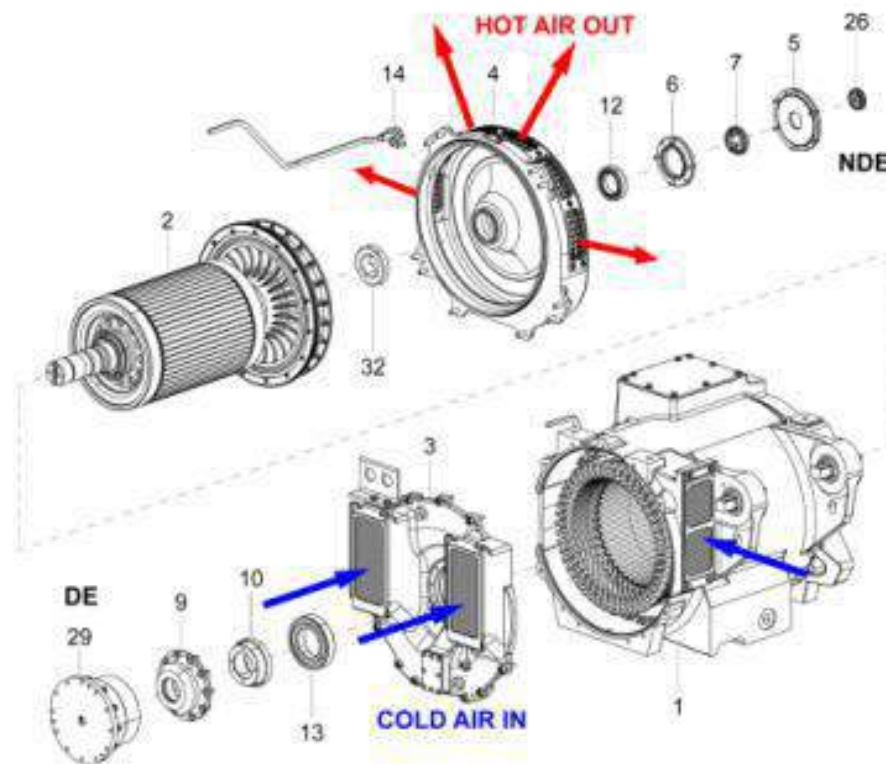


Figure 22: Air Outlet/ Inlet of Traction Motor

Speed sensor

For monitoring the speed, a speed sensor is mounted in the stator housing.

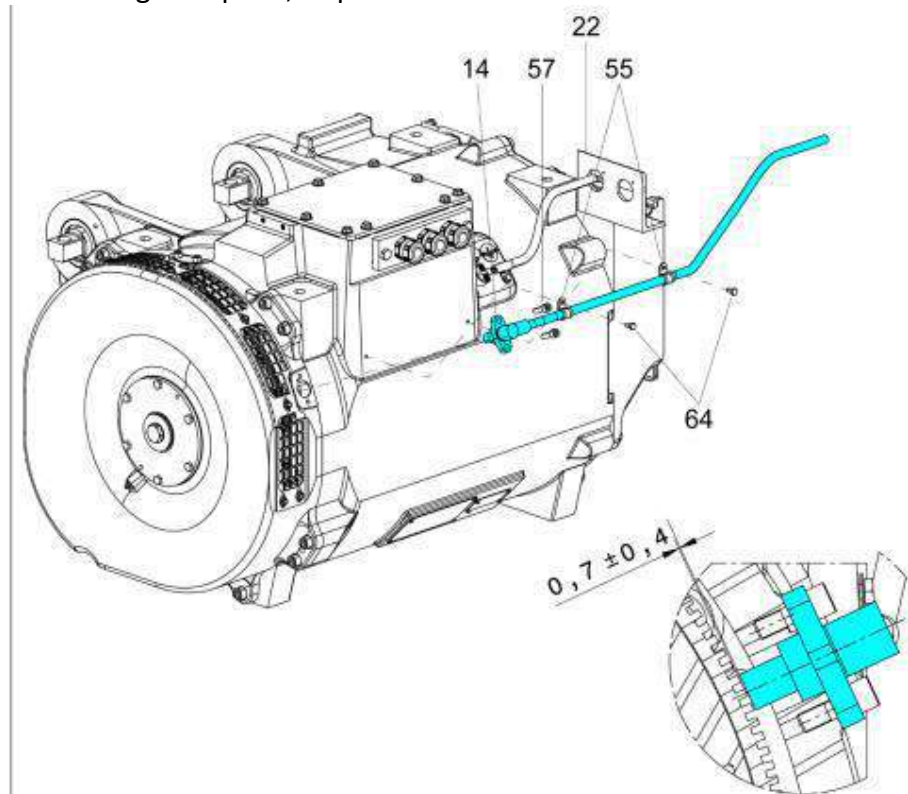


Figure 23: Speed Sensor Location in Stator

Pt100 Temperature Sensors

For monitoring the stator temperature, Pt100 temperature sensor is positioned in the stator housing.

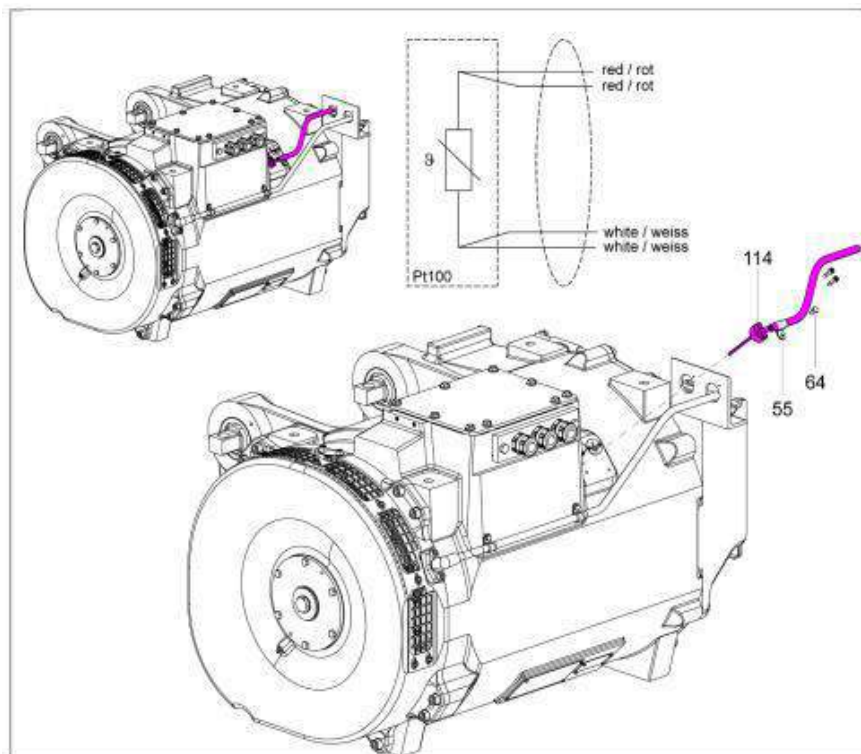


Figure 24: Temperature Sensor Location in Sensor

Traction Motor Water Flood Level

- Traction motor : Water flood level : 400 mm from Rail level
- Water draining from stator housing in rainy season by opening the drain plug (53)

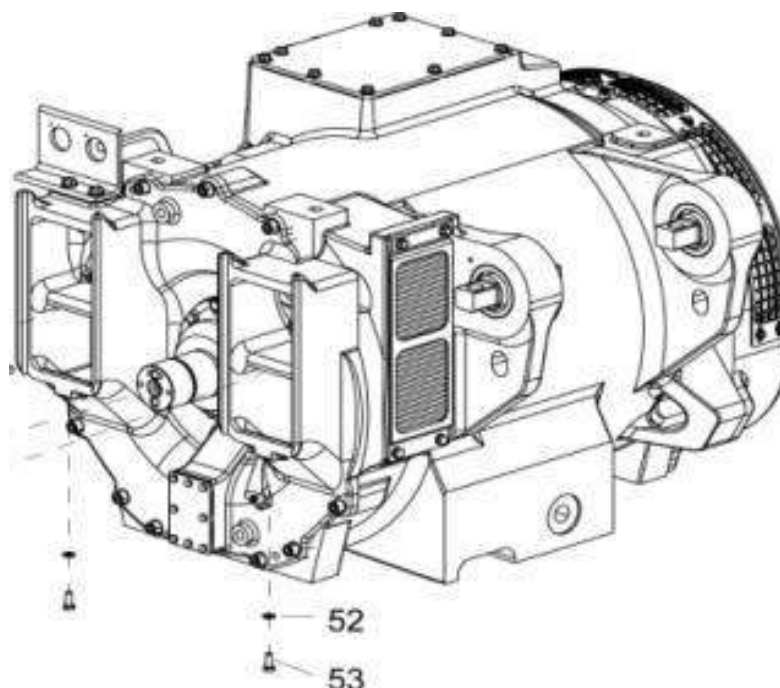


Figure 25: Flood Water Drain Plug (53)

5.5.11.3 Gear Drive

Partly suspended drive with bogie frame fixed motor and axle-mounted gear. Motor shaft and gearbox input shaft are connected by a coupling that transfers torque and compensates for displacements between motor and gearbox.

The main gear is mounted directly onto the wheel set shaft and transfers torque directly to the wheel set shaft.

The gearbox is a helical gear with oil sump splash lubrication.

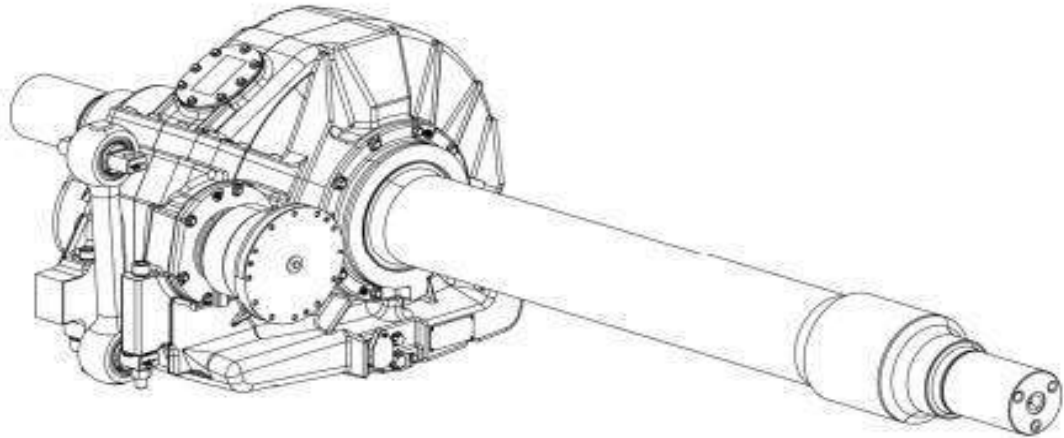


Figure 26: Drive Complete

5.5.11.4 Technical Data for Gear Drive

Table 14: Technical Data for Gear Drive

S. No.	Description	Details
1.	Designation	Partly suspended gear box assembly
2.	Type designation	GKD 1-52-372A
3.	Dimensional drawing	TSA016533
4.	Weight of gearbox unit with half coupling and without oil m _{Gearbox}	490kg
5.	No. of teeth of Main Gear	98
6.	No. of teeth of Pinion	19
7.	Gear ratio	5.157
8.	Gear system	Single stage spur gear
9.	Center distance between Pinion and Main gear	372 mm
10.	Gear Box : Oil lubrication Type / Make	Servo SynGear 75W-90LL / Indian Oil Make

5.5.11.5 Constructional Details of Gear Drive

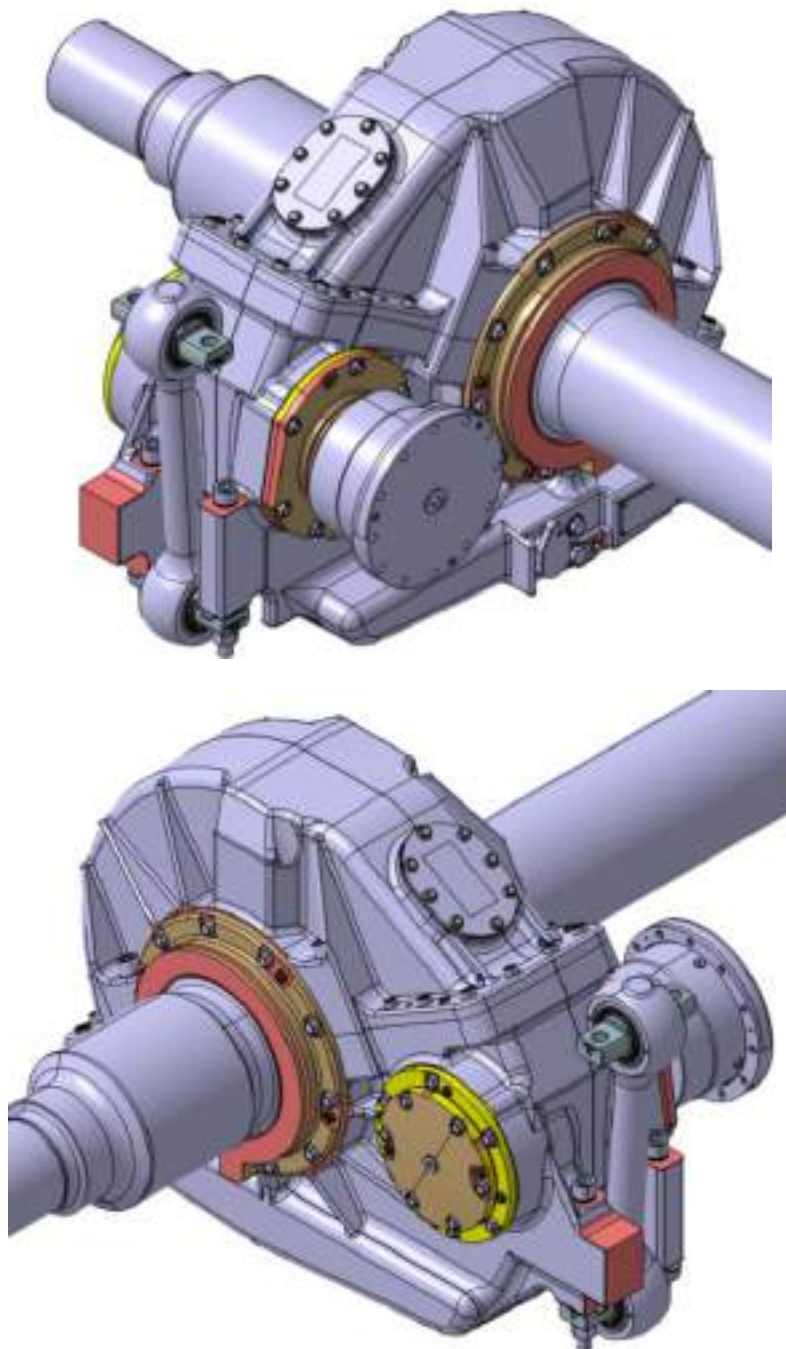


Figure 27: Gear Drive Assembly

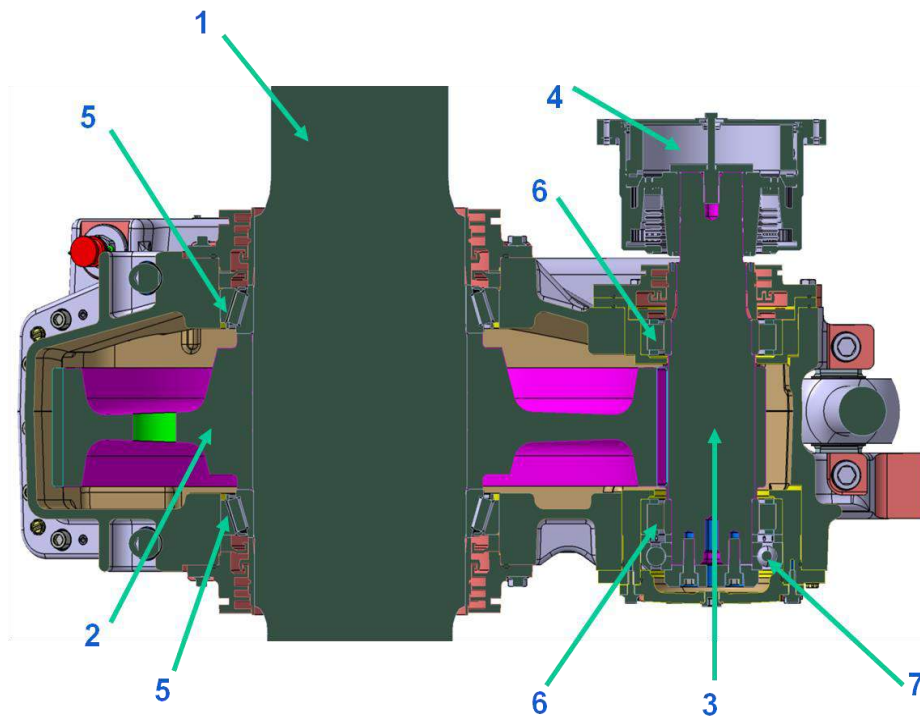


Figure 28: Gear Drive Sub-Assemblies

- | | | | |
|----|-------------------|----|-------------------------------------|
| 1. | Axle | 5. | Taper roller bearing – 2 nos. |
| 2. | Main Gear | 6. | Cylindrical roller bearing – 2 nos. |
| 3. | Pinion | 7. | Four Point contact bearing |
| 4. | Flexible coupling | | |

Gear Box Description

The gearbox is a helical gear with oil sump splash lubrication.

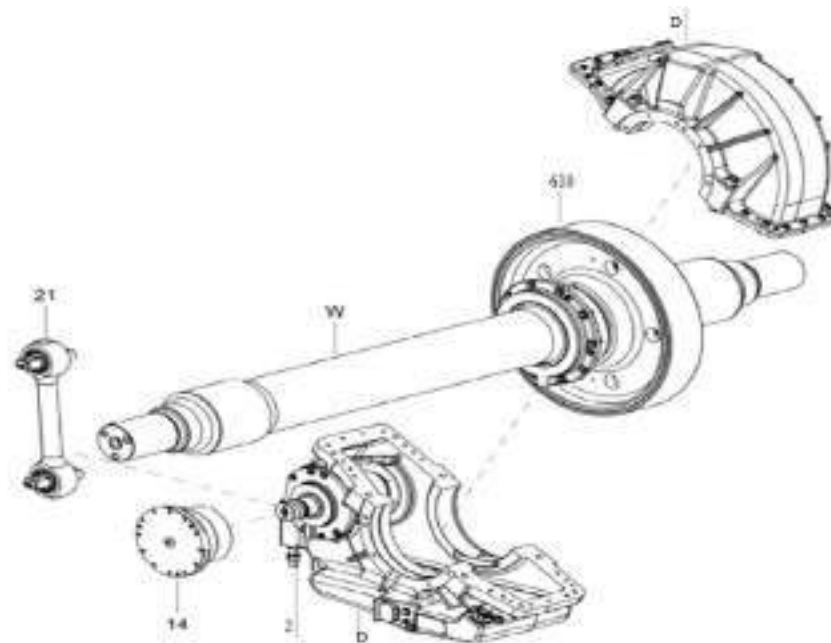


Figure 29: Main Component of Gear Box

- | | | | |
|---|----------------------|-----|-------------------------|
| D | : Gear box assembled | 21 | : Reaction Rod complete |
| 2 | : Pinion | 610 | : Main Gear |

14 : Coupling Half gear box side W : Wheel set Shaft

Motor & Gear half Coupling

A curved teeth coupling connects motor with gearbox. The coupling is torsional rigid, the halves are self-centering by the teething. The coupling consists of two halves whose flanges are bolted together.



Figure 30: Motor Coupling

The coupling is lubricated by oil and is hermetic sealed to the outside by two steel bellows, so leakage can be suspended. For the regular oil change both coupling halves are equipped with drain plugs, this can be performed on the installed coupling without disassembling from the shafts.

The coupling halves are mounted onto the shafts by tapered press fits, including oil injections for mounting and dismounting.

The coupling transfers torque and compensates radial, axial and angular misalignments between motor and gearbox.

At the general overhaul the coupling has to be checked visually for checking the ability for further use in operation.

A slipping bush is installed at the gearbox side to protect the gearbox of too high shock torques that can be generated in the motor in case of a converter short circuit.

The coupling is insulated, this ensures that the gearbox bearings are not affected by discharging currents of the rotor.

Connection Gearbox to Wheel Set

The main gear is directly mounted onto the wheel set shaft by a cylindrical shrink fit (the main gear is heated up for the joining operation), including oil injections for dismounting.

Gear box Housing

The gearbox housing is casted. The gearbox housing is designed to high stiffness and low noise radiation and protects oil level indicators from direct hits by rocks from the track.



Figure 31: Gear Box Housing

Gear box Support

The gearbox is supported by a reaction rod on the bogie frame. The reaction rod incorporates two spherulastic bushings. During operation, the elastomers will wear and must be checked regularly and exchanged when the end of the life time is reached.

Bearings

The input shaft is supported in the gearbox housing by two cylindrical roller bearings and one four- point contact bearing for the axial forces. These bearings have single piece solid brass cages.

The output shaft is supported by two tapered roller bearings. For the tapered roller bearings pressed steel cages are used. All bearings are oil lubricated.

Table 15: Bearings Details of Gear Box

Bearing Data			SKF Type	FAG Type	Replacement interval in km
Input shaft	motor side	Cylindrical roller bearing	NU 2217 ECML/C4	NU 2217 E-MPA/R120-140	30,00,000
	wheel side	Cylindrical roller bearing	NU 2217 ECML/C4	NU 2217 E-MPA/R120-140	30,00,000
	wheel side	Four point ball bearing	QJ 217 N2MA/C4H	QJ 217-N2-MPA-C4	30,00,000
Output shaft	motor side	Tapered roller bearing	BT1-0054/VE679	F-801207.01	30,00,000
	wheel side	Tapered roller bearing	BT1-0054/VE679	F-801207.01	30,00,000

Lubrication and cooling

- The gears are lubricated by oil splash lubrication. The gearbox is cooled by convection.
- The design of the bearing area (oil stow provisions) ensures that a minimum amount of oil remains in the bearing. A smooth start-up of the gearbox is allowed, especially at low speeds and low environmental temperatures.
- The gearbox includes an oil filling hole, an overfill protection, an oil sight glass (changeable from outside) and a magnetic drain plug, which collects metallic wear floating in the oil.
- The oil level can be checked quickly and reliably through an oil sight glass, marked with minimum and maximum. The oil lubricant for gear drive is Indian Oil Servo Syn Gear 75W-90 LL

Sealing

- Contact-free labyrinths are used to seal the shafts. The gearbox housing and covers are sealed with liquid sealing substances. O-rings are used for sealing the bearing cartridges, bearing covers and labyrinth covers.
- During cleaning of the vehicles pay attention, that high-pressure water is not directed into the labyrinth gaps, or protects them with covers.

5.5.12 Jumper Couplers

Jumper coupler (Power coupler) is used for transmission of power supply from one coach to the other coach. The Unit is mounted directly to under-frame of MC and TC coaches. Power coupler assembly consists of three sub assemblies:

- Junction box
- Harting connector plate
- Cable holding plate

Overview of the Location of Jumper coupler in Loco



Figure 32: Overview of the Location of Jumper coupler in Loco

Mounting location of power coupler assembly on under-frame-motor coach and Trailer coach is shown in below figure

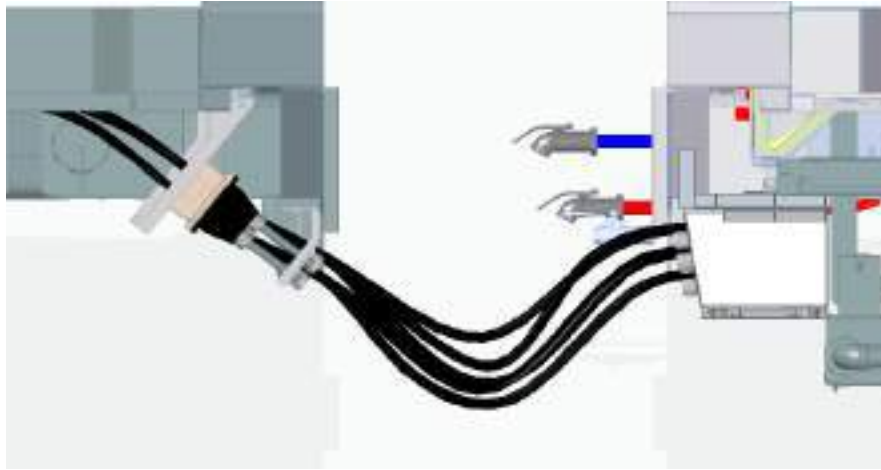


Figure 33: Mounting location of power coupler assembly on under-frame-motor coach

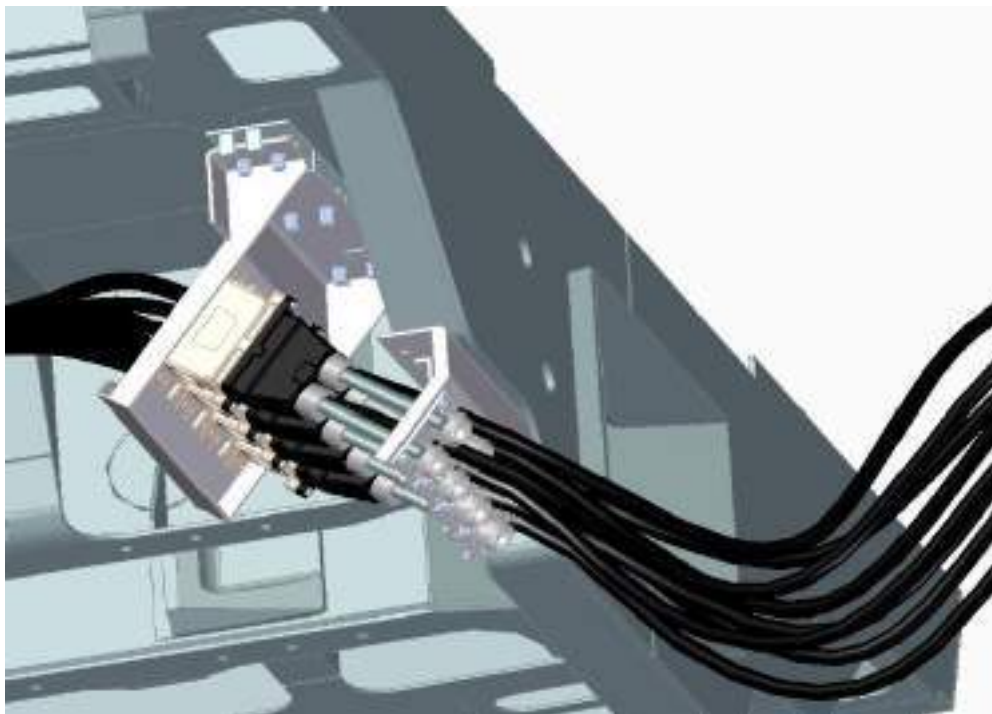


Figure 34: Mounting location of power coupler assembly on under-frame in Trailer coach

5.5.13 Pantry/ Isolation Transformer

20 kVA, 415V/230V/110V AC, 3 phase, dry type and air cooled power distribution transformer for the Pantry Car, Toilets, Infotainment, Charging Sockets load. It has 15.0 kVA-230VAC (3 x single phase winding)+ 4.1kVA-110V AC (3 x single phase winding).

Overview & Location



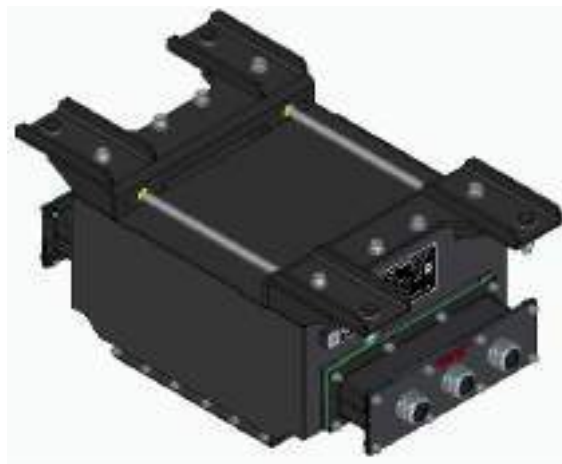


Figure 35: Isometric View of Isolation Transformer

5.5.14 Master Controller

The Master Controller model S334 H32 makes SCHALTBAU is mounted to the table plate of the Driver's console and protected from contamination and free from distortion. Dimensions and shape is given below.



Figure 36: Master Controller

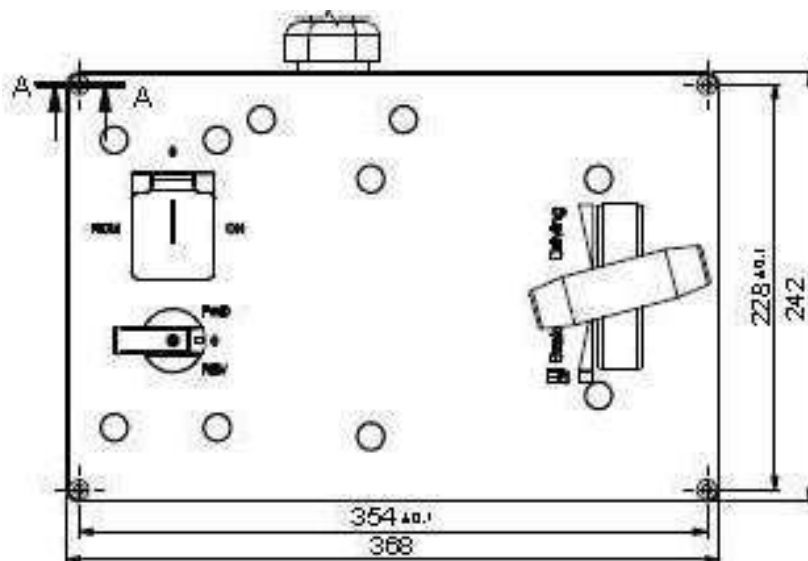
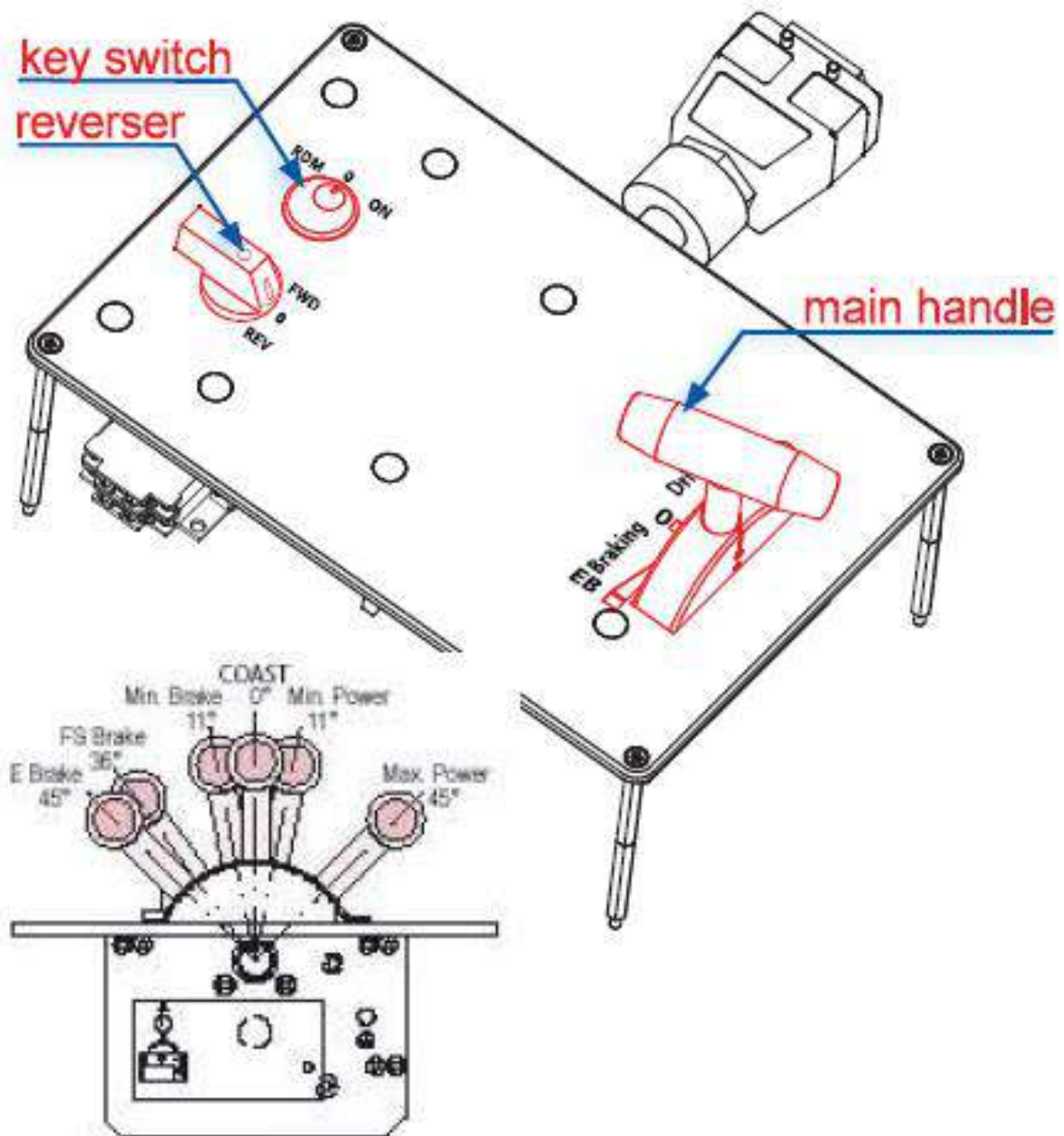


Figure 37: Dimensions of Master Controller

The layout of the Master Controller is symmetrical and visually in figure. The operating elements were arranged in such a way that an ergonomic flow of operation is guaranteed. The key switch, the reverser handle and the main handle are integrated into a mechanical locking system. The switching elements are wired which means that the operator still needs to connect the device as a vehicle component after assembly.



5.5.14.1 Technical Data

Table 16: Technical data of Master Controller

Operating Voltage	110 V/ 24 V
Insulation Test Voltage	According to VDE 0115 Control Switch – housing 1.0kV AC
Temperature range :	-30 degree C to +70 degree C
Protection class	IP 00

Weight	Approx. 15 kgs. Including plug and conductors
Switching elements	12 pcs. Snap-action switches S847b

5.5.15 Driver Desk

Driver Desk is provided in driver cab for user interface. All equipment such as switches, lamps, master controller, DDU, PIS interface which are required for driver interface are mounted on driver desk. Layout of equipment are given in below sections. Driver's cab is for motor man and guard. The left-hand side of the driver's cab is the workstation for the motor man. The operation switches, lamps, gauges displays which are used motor man during driving are provided in front of motor man. The right-hand side is designed for the guard. The easy understanding the driver desk is further divided into sections A,B & C. further C is divided into 3 sub sections C1, C2 & C3.

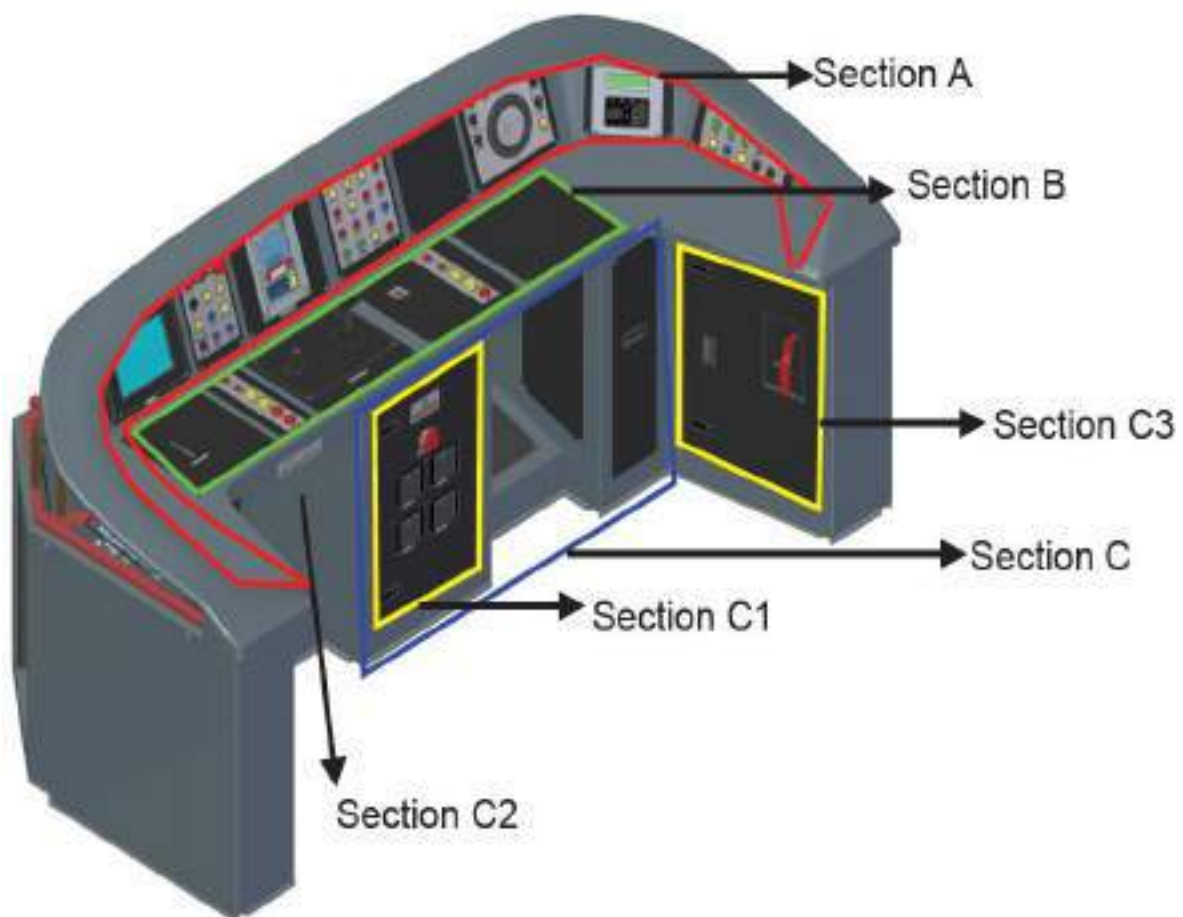
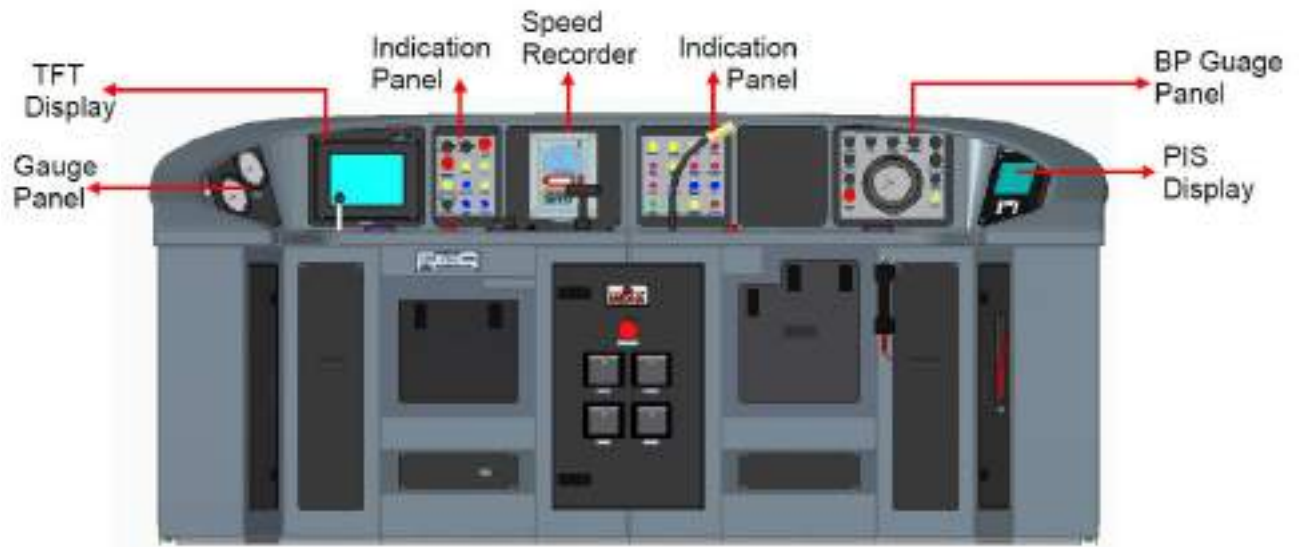


Figure 38 : Driver Desk (Section-A)

5.5.15.1 Section A is divided in 10 panels

1. Cabin Control Switches
2. MR-BP Duplex Gauge and BC Gauge
3. Main Display Panel
4. Driving Control Switches
5. Speed Recorder
6. Indications for Train Functional Parameters

7. TPWS Display Unit (Dummy Panel)
8. Cabin Control Switches for Assistant Driver and Gauges
9. MMI unit of PIS (Operation by Assistant Driver)
10. Doors Control Switches



Cabin Control Switches



Figure 39: Cabin Control Switches

MR-BP Duplex Gauge and BC Gauge

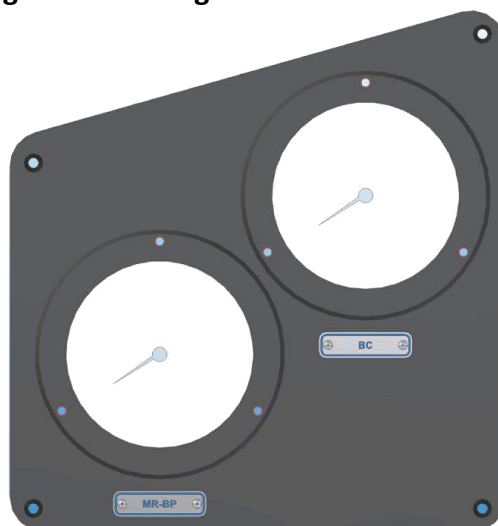


Figure 40: MR-BP Duplex Gauge and BC Gauge

Speed Recorder



Figure 43: Speed Recorder

Indications for Train Functional Parameters



Figure 44: Indications for Train Functional Parameters

Cabin Control Switches for Assistant Driver and Gauges



Figure 45: Cabin Control Switches for Assistant Driver and Gauges

MMI unit of PIS (Operation by Assistant Driver)



Figure 46: MMI unit of PIS (Operation by Assistant Driver)

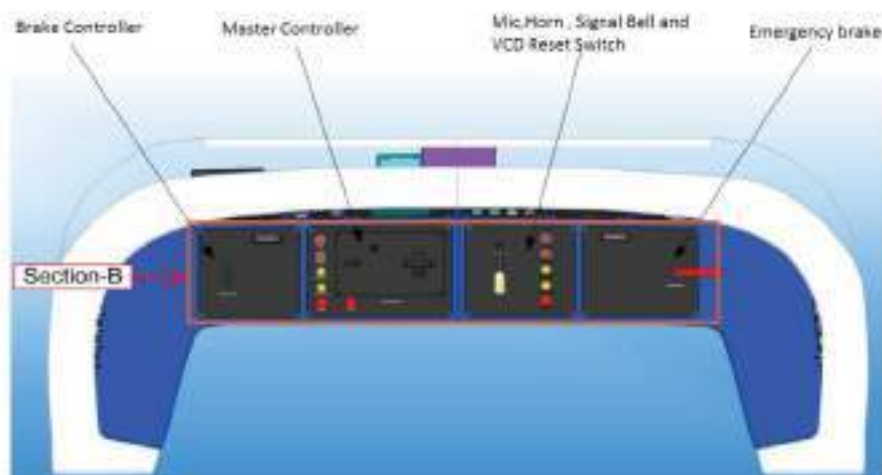
Doors control switches



Figure 47: Doors control switches

Driver Desk (Section-B)

Driver Desk (Section-B)



Brake Controller



Figure 48: Brake Controller

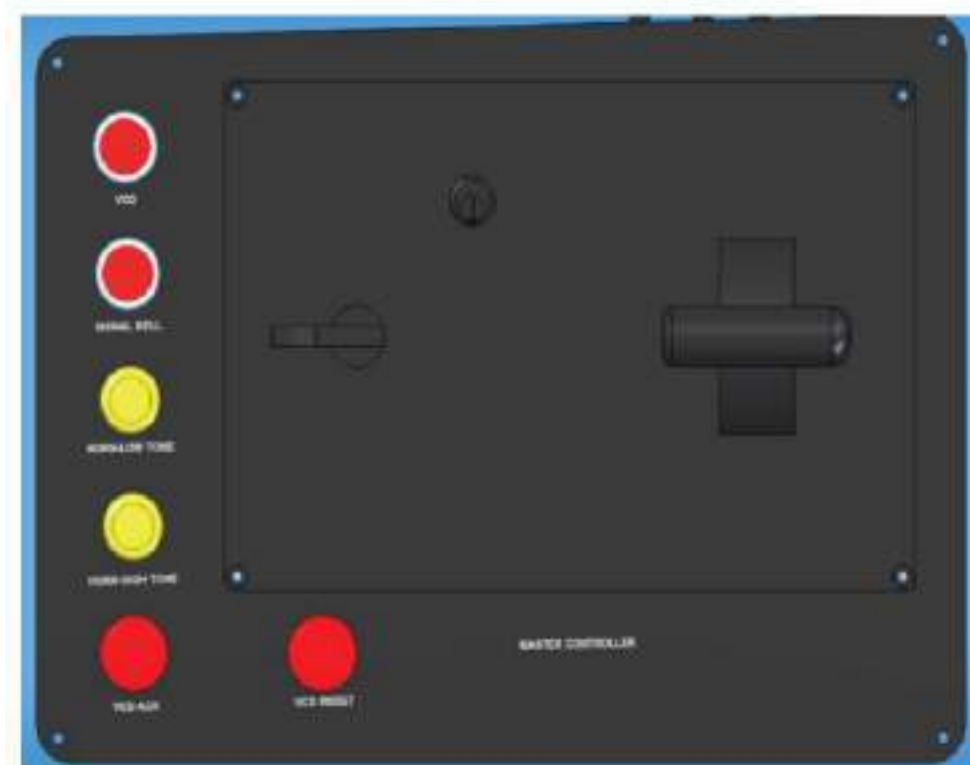
Master Controller, Horn, Signal bell and VCD Reset Switch

Figure 49: Master Controller, Horn, Signal bell and VCD Reset Switch

Mic, Horn , Signal Bell and VCD Reset Switch

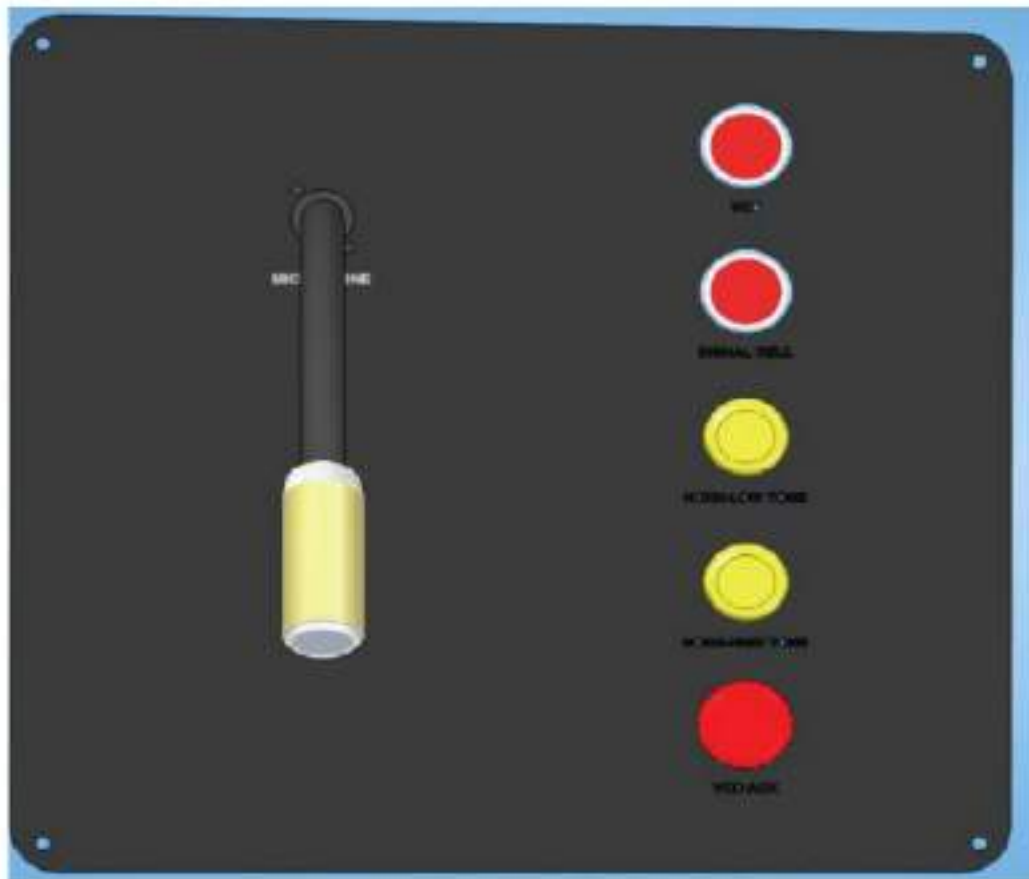


Figure 50: Mic, Horn , Signal Bell and VCD Reset Switch

Emergency Brake Handle



Figure 51: Emergency Brake Handle

Under Driver Desk Front View (Section-C)

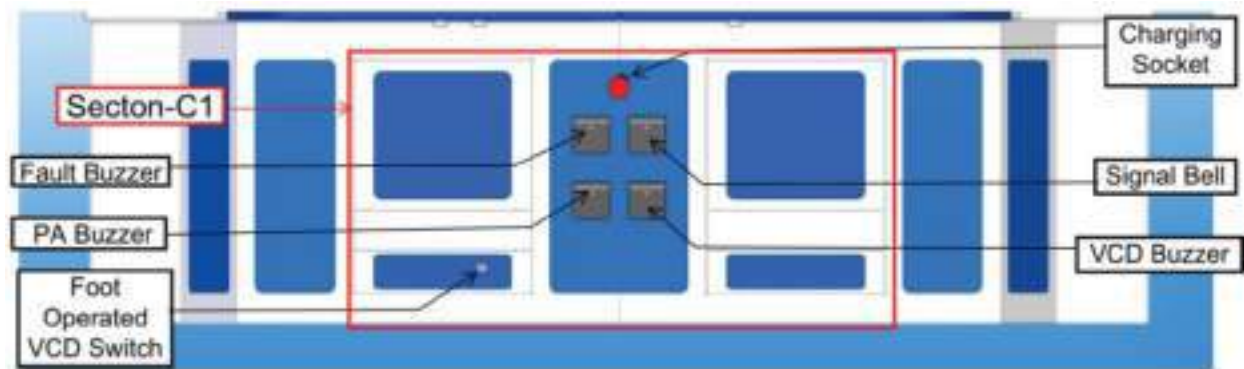


Figure 52: Front Bottom side components of Driver Desk (Section-C1)

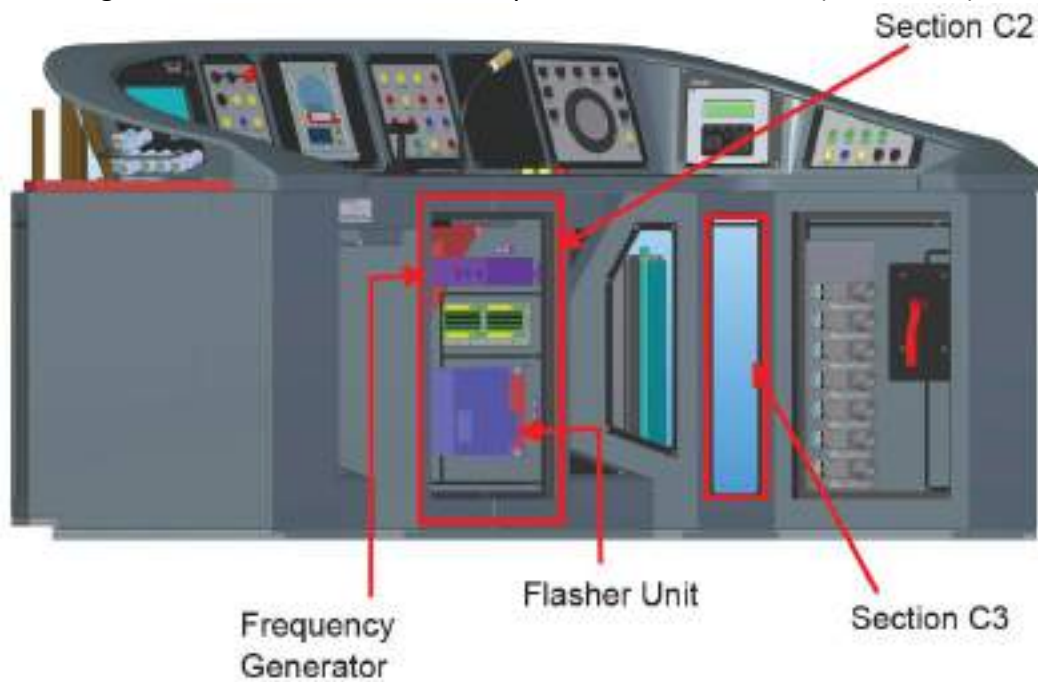


Figure 53: Front Bottom Internal side components of Driver Desk (Section-C2)

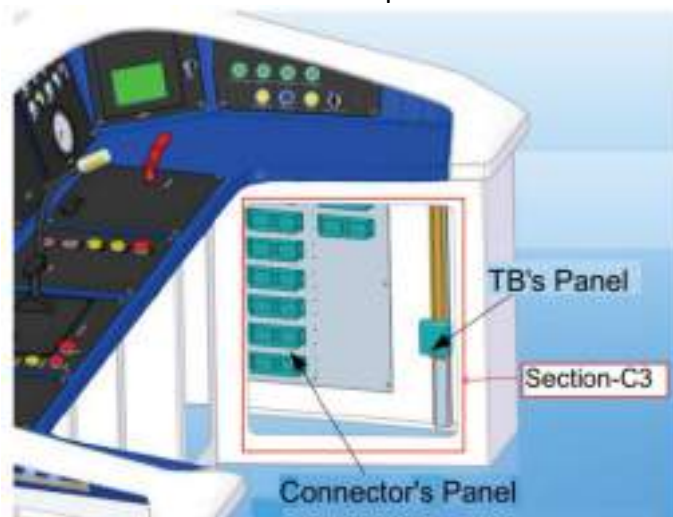


Figure 54: Bottom Left side components of Drivers desk (Section-C3)

5.5.15.2 Driver Display Unit (DDU)

TCMS DDU provides information for the TCMS system to support Loco pilot in operating rake while normal operation, as well as in case of malfunction of a subsystem. DDU supports the maintenance staff in setting basic system parameters and fault finding. In case of failure of TCMS DDU, train can still be operated. There is one DDU installed in each DTC cab. DDU communicates with TCMS and performs the following basic functions:

- Provide an interface to control train functions
- Display operational status of train functions
- Display diagnostic events

Screen layout consists of 7 sections which are described below:



Section 1 - Head line area

Head Line area gives the information about train number configured, screen heading, date and time fields

Section 2 – Soft key buttons area

The soft key button area contains 10 touch sensitive buttons for different menu entries.

Section 3 – Main Screen area

The main screen area shows the actual content of the selected screen. If required, further touch sensitive buttons are shown in the main screen area.

Section 4 - High Priority Message field

Active diagnostic events which require acknowledgement by motor man are present in high priority message field area. For each event, the source of the event (basic unit number) and its event text are displayed along with an acknowledge button. If no such event is present, the text field and acknowledge button are not displayed. The events are presented in the order of their time of occurrence, across all event sources. When the acknowledge button is pressed, the respective event is

acknowledged and disappears from this area. Clicking on the event is available at events list.

Section 5 - Scrolling Events area

All pending active events are presented in scrolling events area in a scrolling pattern. For each event, the source of the event (basic unit, module details) and its event texts are displayed. If no such event is present, the text field is not displayed. Motor man can manually scroll up and down the list with the provided scroll buttons.

Section 6 - Pop up Messages area

Pop up messages area is used to show informative (Popup) messages to motor man depending on the operational status of the train. If no popup message is pending, the area shall be blank.

Section 7 – V max area

V max area indicates the maximum available/allowed speed of the train. If traction interlock condition is detected by CCC, then 'Zero Force' appears in this area.

5.5.16 ECC and CRW Unit

Each Driving Trailer coach consists one CRW & GCRW. CRW is located behind the loco pilot, who operates circuit breakers and switches of CRW panel. The weight of CRW panel is 490 Kgs approximately. MC, TC, and NDTC contain one ECC panel in each coach.

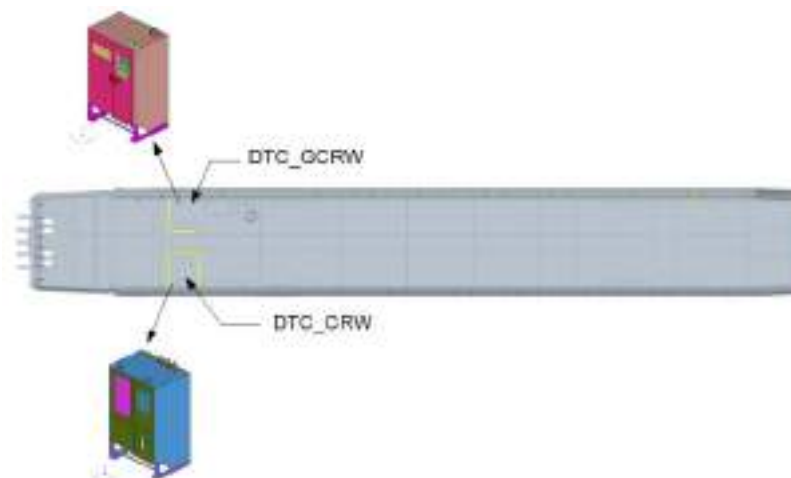


Figure 55: DTC CRW and GCRW Location

5.5.16.1 DTC CRW

One electrical cubicle is provided at rear side of driver cab. It houses all electrical and electronics components required for rake level control. It houses CCU'S, LRMS, TPWS, ECN Switches, MCB's, Relays & contactors for various application.

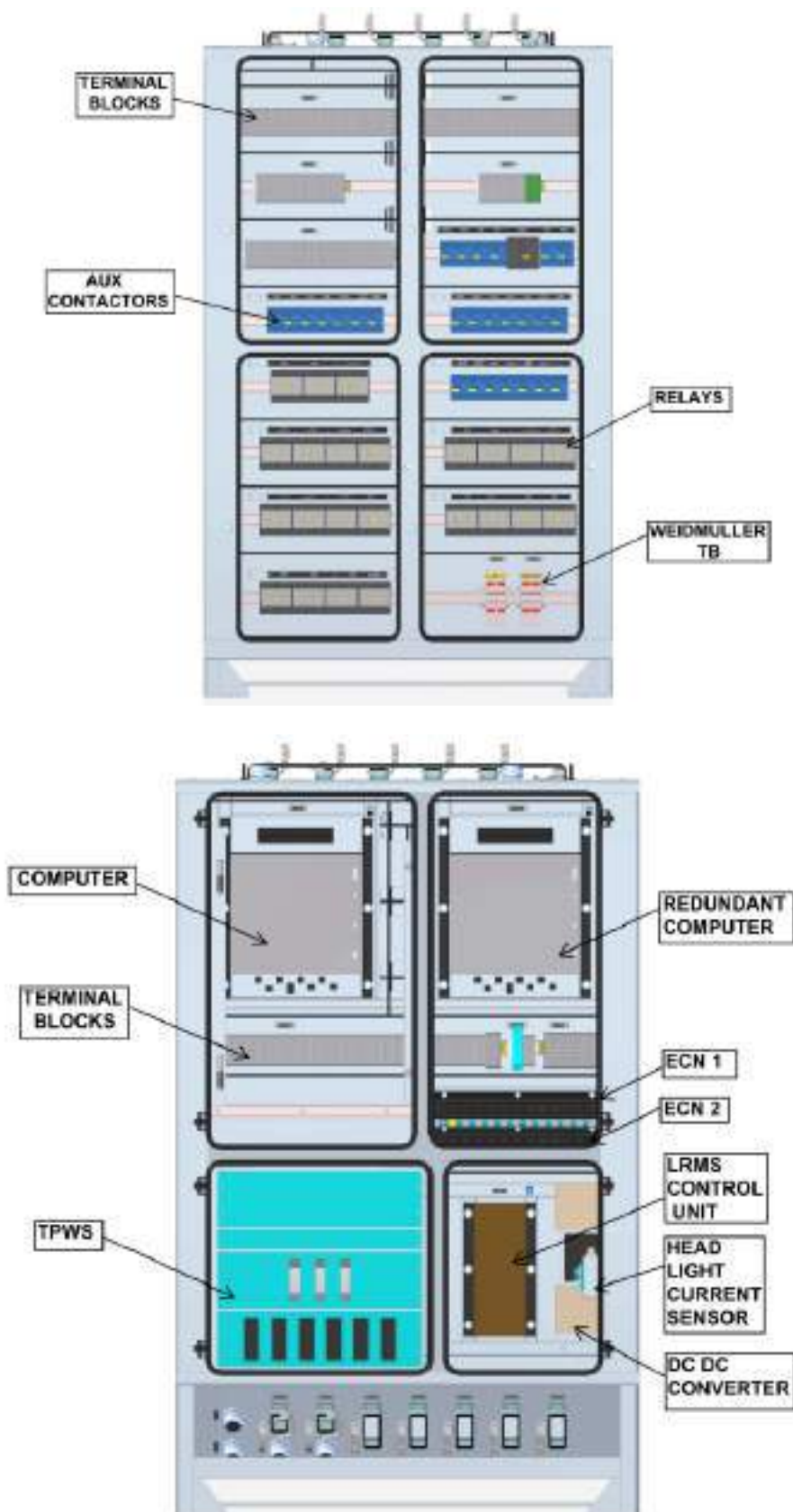
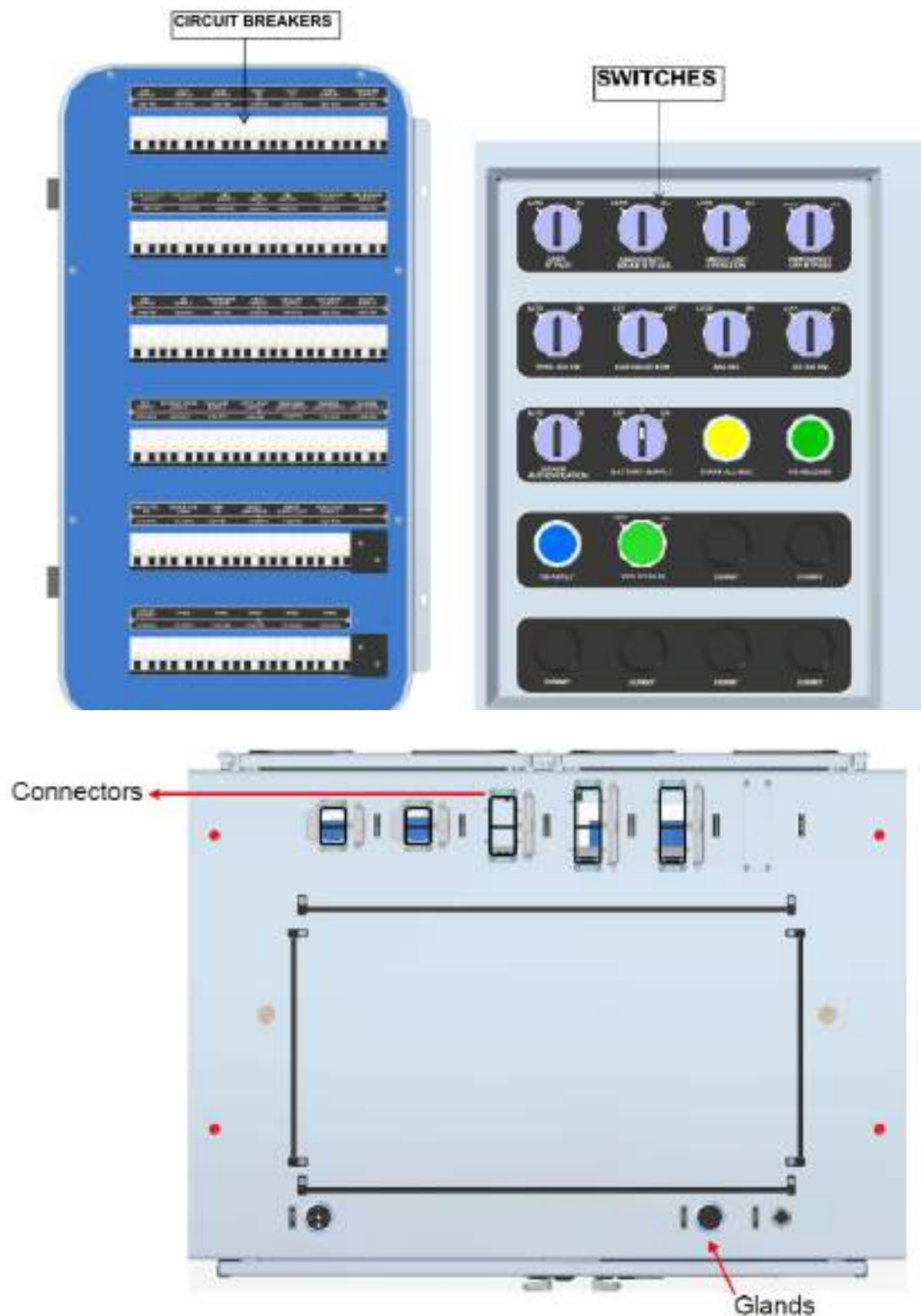


Figure 56: CRW Front and Rear View



5.5.16.2 DTC GCRW

One Electrical Cubicle is provided at guard rear side of DTC cab. It houses all electrical & electronics components required for rake level control. It houses PCU'S, EBCU's, CCTV NVRs, CCTV Ethernet Switches MCB's, Relays & contactors for various application. Equipment layouts are shown in below section.

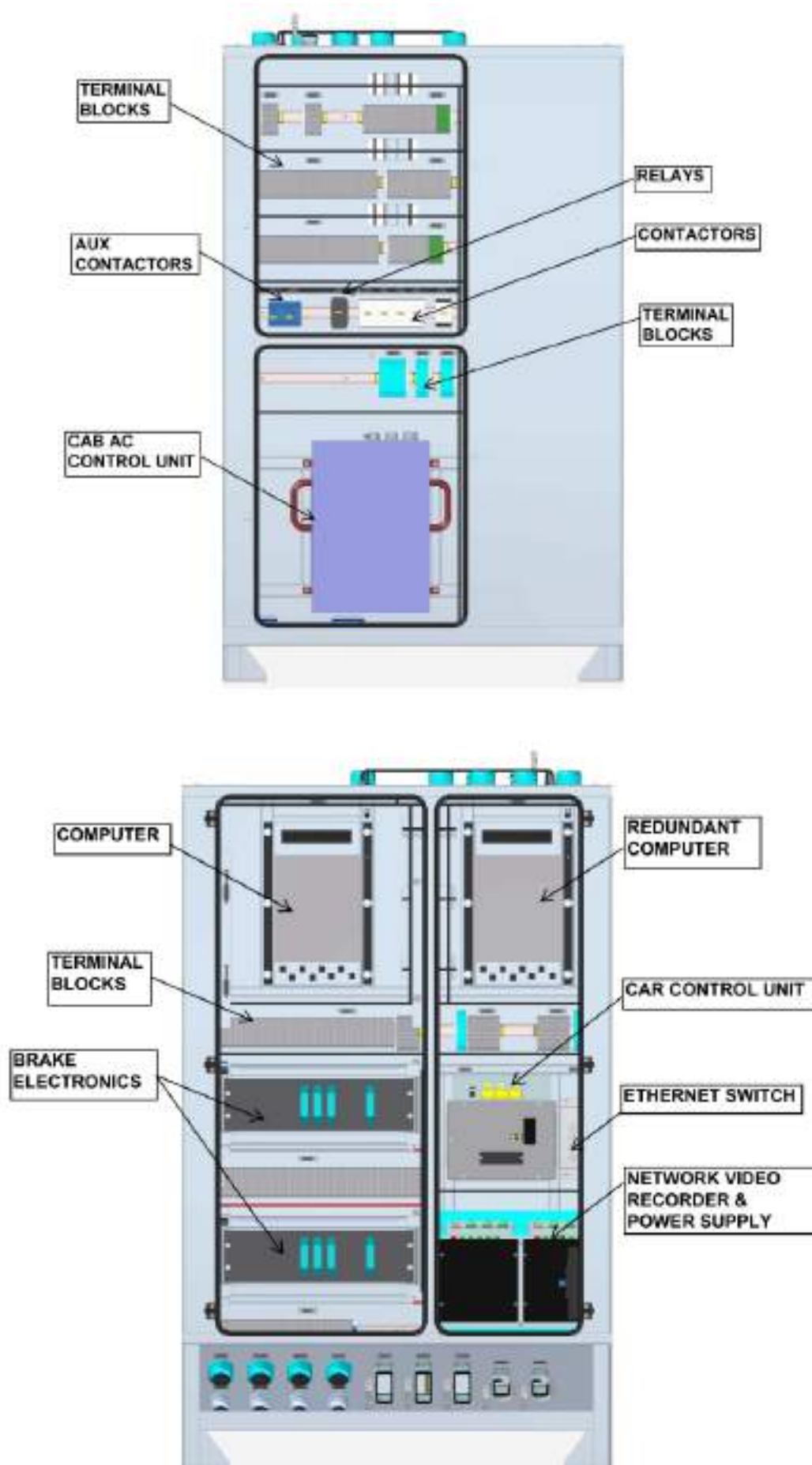
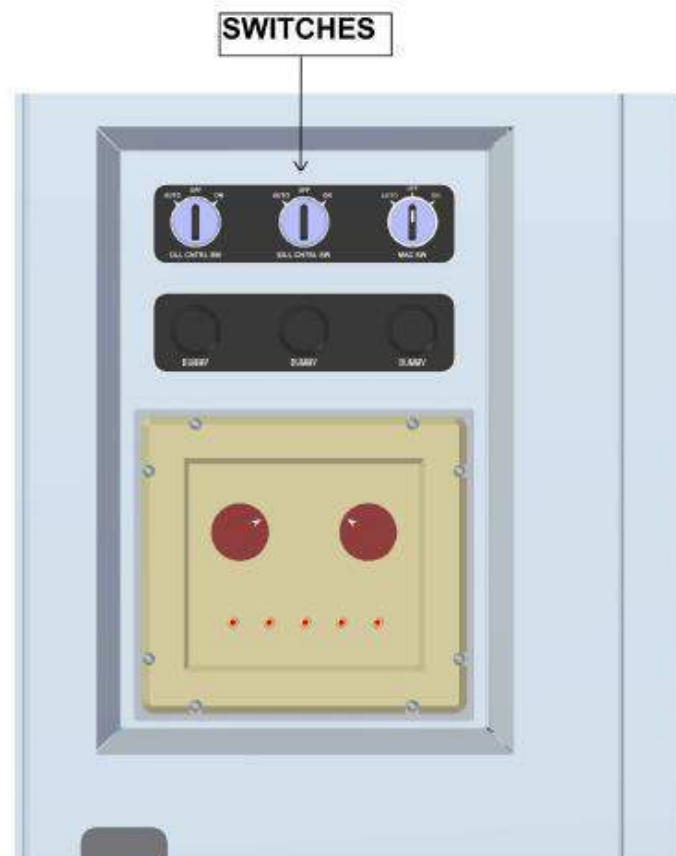
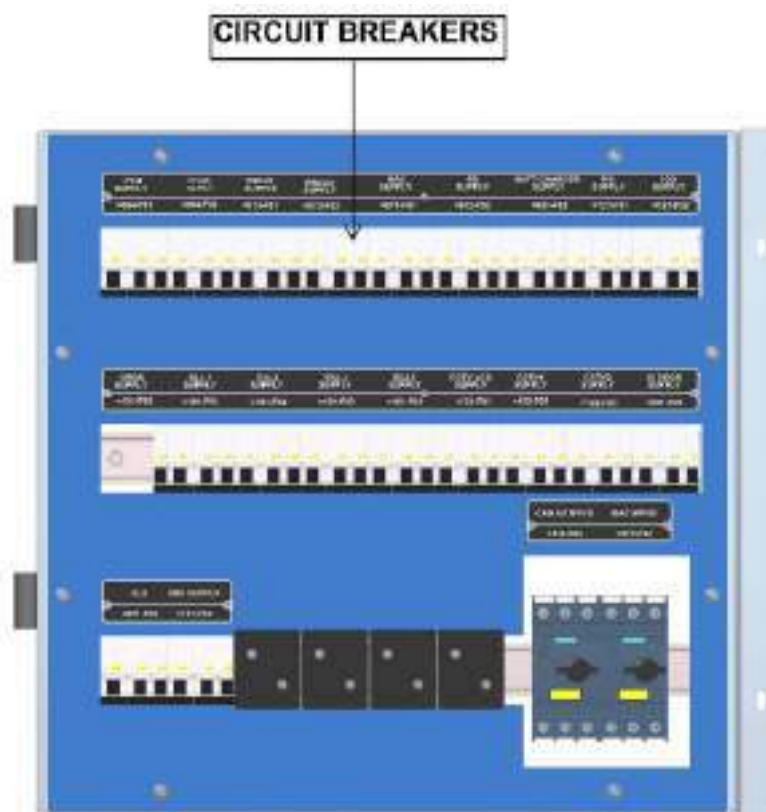


Figure 57: GCRW Front and Rear View



5.5.16.3 MC ECC, TC ECC & NDTC ECC

One Electrical Cubical is provided at driving end of MC, TC, NDTC cab. It houses all electrical & electronics components required for rake level control. It houses

MCUS, EBCUS, MCB, Relays & contactor for various application. Equipment layouts are shown in below section. The location for ECC is same in MC, TC, NDTC.

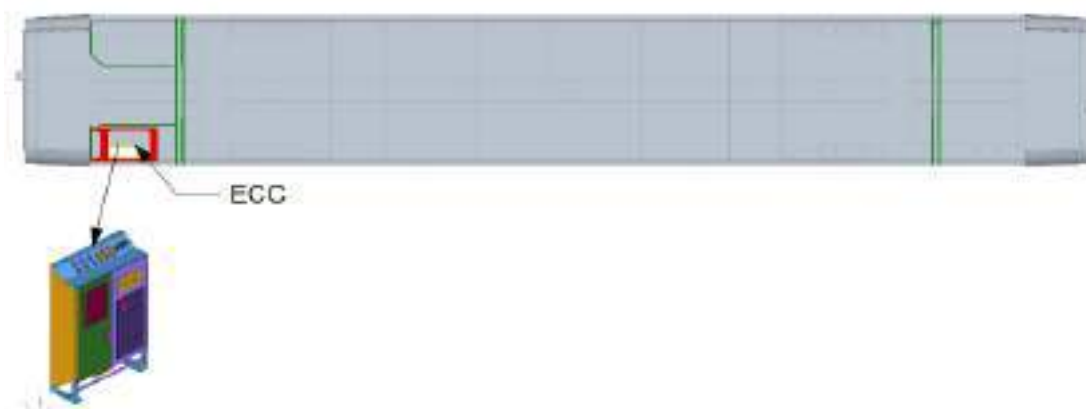
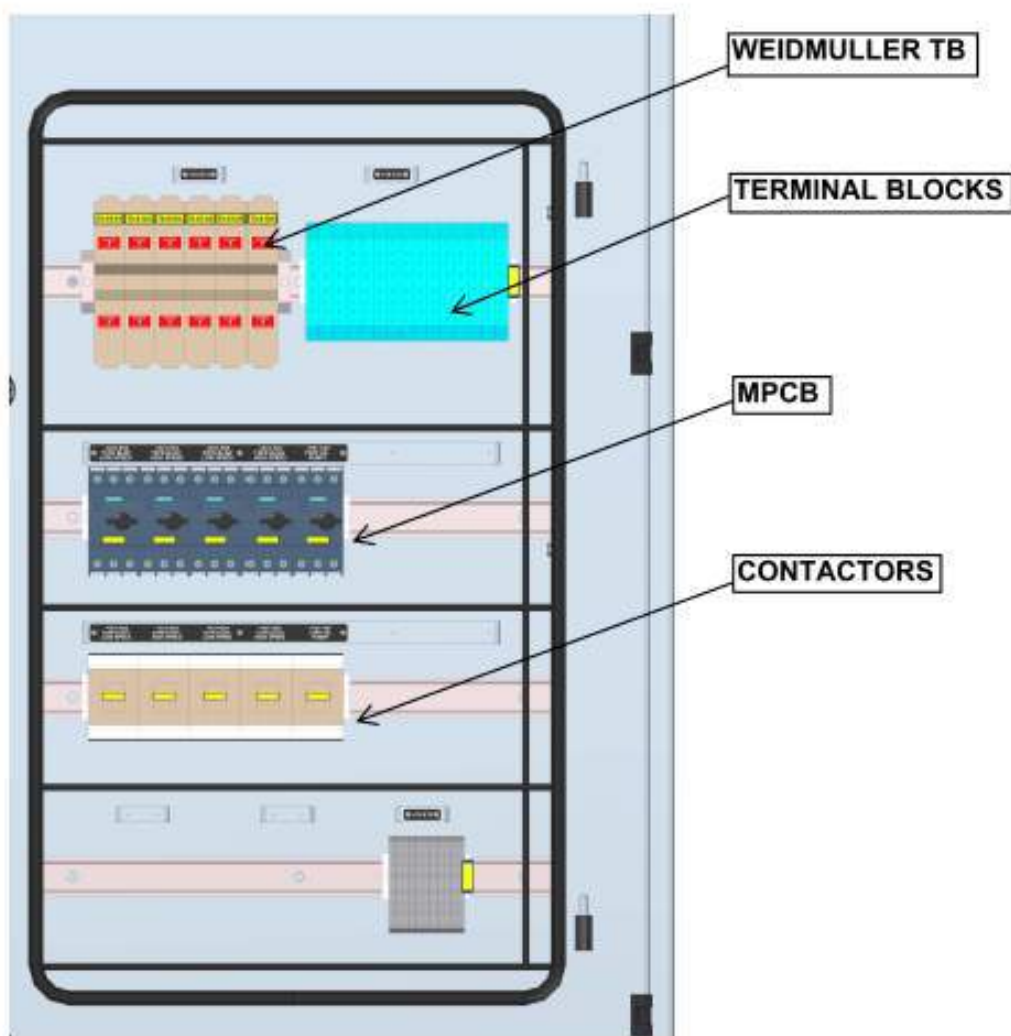


Figure 58: Location of ECC in MC, TC, NDTC



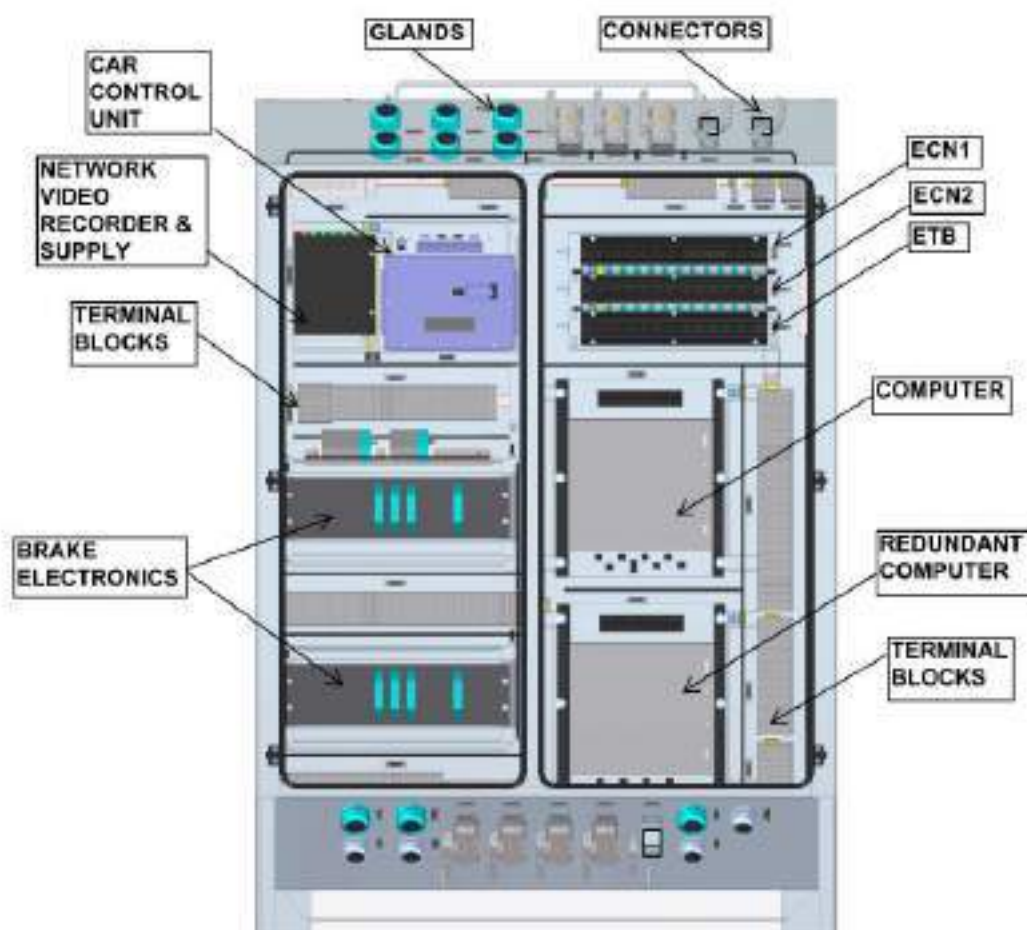
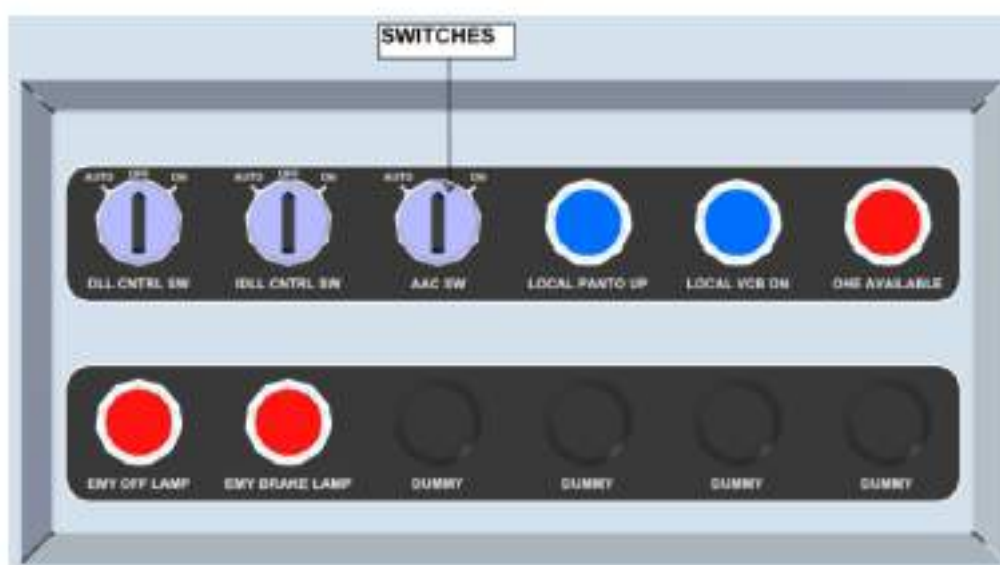
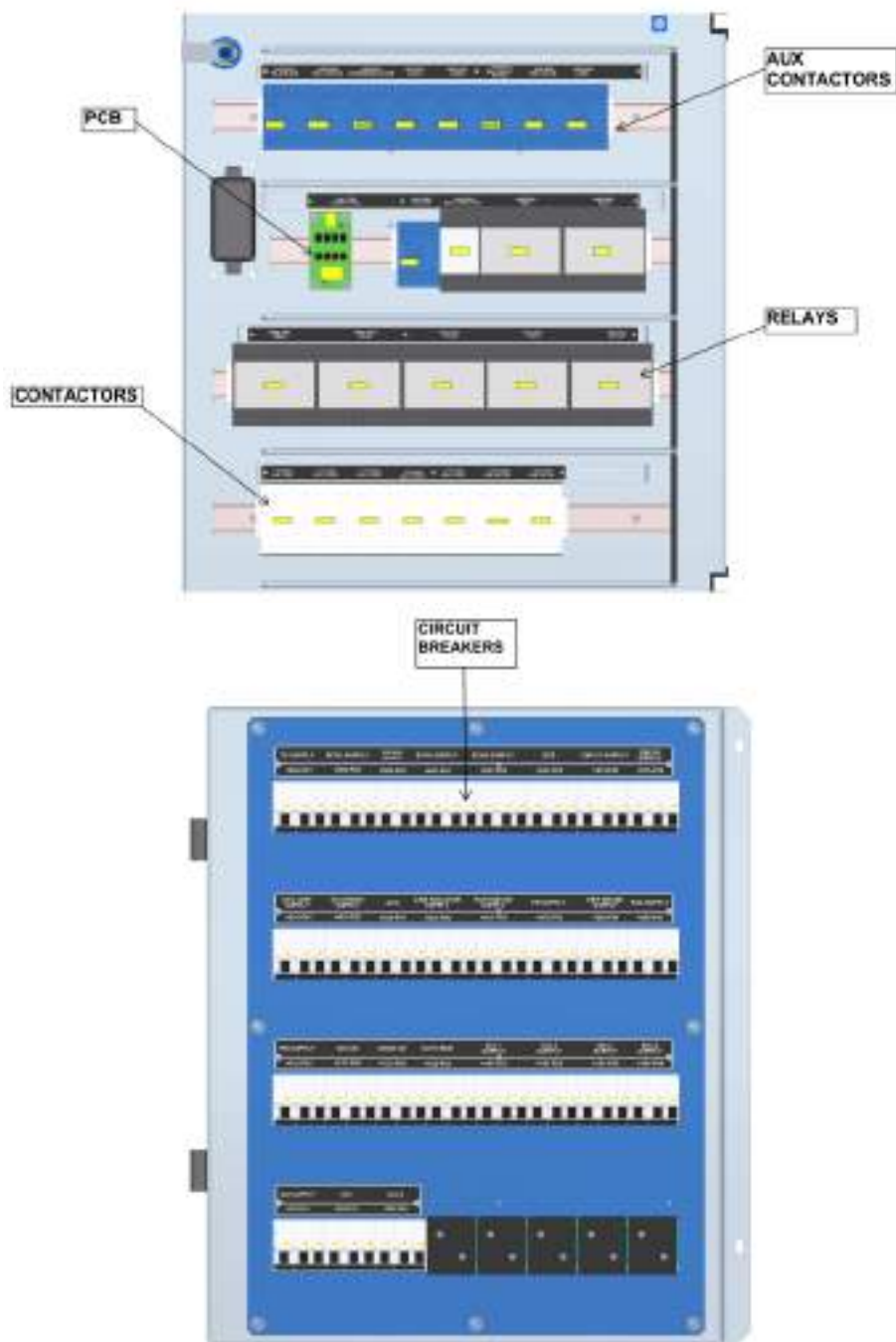


Figure 59: ECC Front and Rear View





5.5.17 Light (Headlight & Marker Flasher)

5.5.17.1 Head Light

Twin LED type headlights are provided at both the DTC. Head light illuminates front track ahead at night time or even at daytime when train passes through dark places e.g. tunnels etc.. It facilitates for train pilot to have good visibility to look for any obstruction or any abnormality on track. Accordingly driver can take necessary action for ensuring safe and efficient operation of the train.

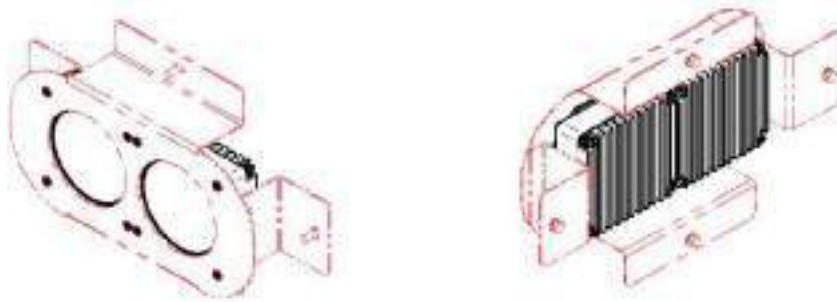


Figure 60: Head Light

5.5.17.2 Flasher Light

LED type Flasher lights are provided at both the DTC. The control box of flasher light is provided in driver's cab. The provision of flasher light has great significance from both the safety and operating point of view. It attracts the attention of driver of approaching train on the adjacent track and indicates him to be cautious and stop train in the event of any unsafe track conditions.



Figure 61: Flasher Light

5.5.17.3 Marker Light/Tail Lamp

LED type Marker/tail lights are provided at both the DTC.



Figure 62: Marker Light

5.5.18 Electrical Driven Wiper

Wiper assemblies are provided on front look out glass (wind screen) of Driver Trailer Coach (DTC) in train set to clean the glass during rainy season and also wet clean the dust with washer system.



Figure 63: Wipers

5.5.18.1 Wiper Linkage Assembly

The **wiper motor** is mounted on a fabricated steel bracket which is polyester powder coated black to prevent corrosion. The motor is connected electrically by means of a multi-pin connector.

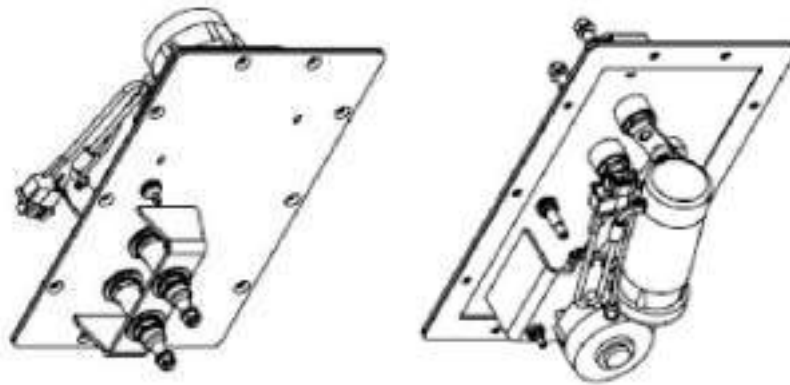


Figure 64: Wiper Motor

The **drive crank** is secured to the wiper motor shaft and connected through a double bearing or a tie-bar/bearing assembly, to the main spindle lever assy. These components transfer the motor shaft rotation to the wiper arm assy.

The **drive mechanism** transfers the rotary output from the motor to a reciprocating motion of the spindles. This mechanism is zinc plated and is sized to give the correct angle of arc for the windscreen wiper arm being driven.

A main spindle and idler spindle are used on pantograph units. These pass through the bulkhead, connecting the drive mechanism to the wiper arm. These are manufactured from stainless steel, to prevent corrosion.

5.5.18.2 Wiper Arm Assembly

The wiper arm is manufactured from stainless steel with brass castings and is polyester powder coated to prevent corrosion and to be of good appearance.

One wiper arm assembly is used on each unit. The wiper arm assembly mounts directly onto the spindles protruding through the cab structure. The wiper arm is secured to the spindles with a series of nuts and washers.



Figure 65: Wiper Arm Assembly

5.5.18.3 Wiper Blade

The blade is secured to the arm assembly using the blade clip arrangement on the arm with a blade retaining screw and Nylock nut.

5.5.18.4 Wash Tank/Pump Assembly

The 9.6L water tank is fabricated from stainless steel. Mounting is achieved by bolting via four slotted brackets on the side of the tank. The wash pump is mounted on the inside of the wash tank, it is powered by a 24v DC supply, and when energised, the pump supplies washer fluid to the wash jet mounted on the wiper arm, through suitable tubing.

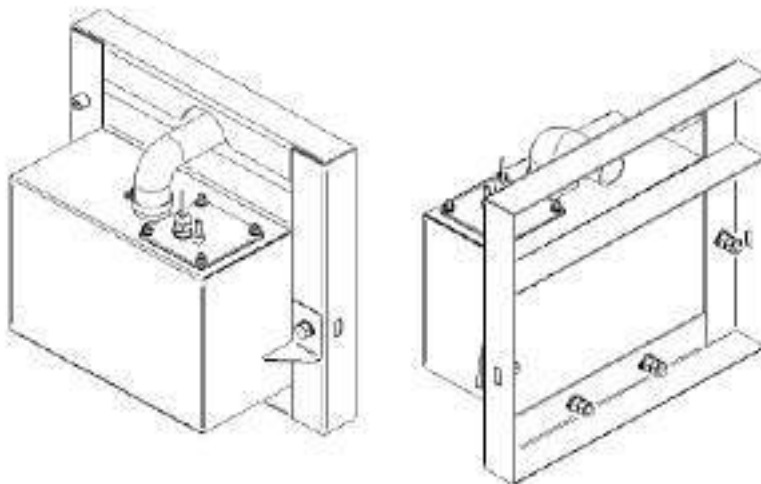


Figure 66: Wash Tank/Pump Assembly

Filler spout with wash hose

The external filler spout is fabricated from stainless steel, and polyester powder coated black mounting brackets. Mounting is achieved by bolting via 4 holes on the two welded brackets.

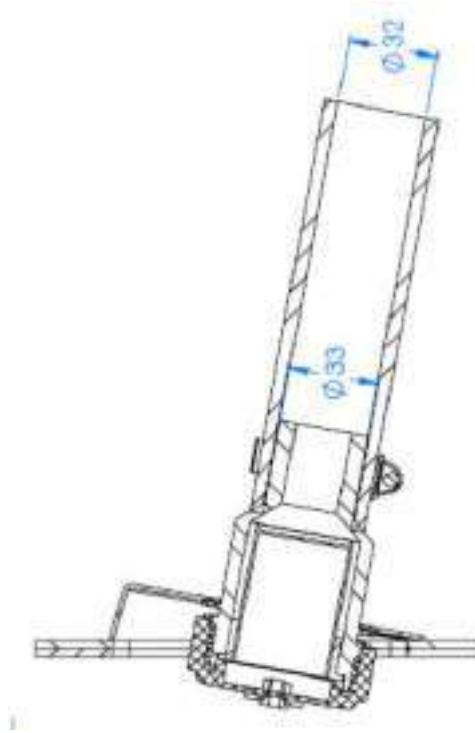


Figure 67: Filler Spout

Off/Intermittent/Slow/Fast & Push Wash Switch

4 position, 90° switching angle, – Off; Intermittent; Slow; Fast & Push to Wash

Control Unit

The control box is fabricated from stainless steel, and polyester powder coated black to be of good appearance. Mounting is achieved by bolting via flanges welded to the sides of the box. Electrically connected by means of a multi-pin connector via a harness to the two motors, switch, pump and train interface.

5.5.19 PT & CT**Current Transformer (CT)**

Split core ring type current transformer is provided on roof of TC at HT side. Primary is composed by two semi cores:

- Fixed Part: the part without secondary terminal
- Mobile Part: the part with secondary terminal box

Primary cable is positioned and centralized in the semi circumference of fixed part. It senses the primary current.



Figure 68: CT on Roof of TC

Potential Transformer

Potential Transformer is a transducer provided at the roof of TC and it senses the OHE Voltage.





Figure 69: Potential Transformer

5.5.19.1 Technical Details of PT

Table 17: Technical Details of Potential Transformer

Installation	outdoor
Insulation	silicone resin
Insulation level	36/70/170 kV
Frequency	16 2/3, 50 and 60 Hz
Primary voltage	25 kVac
Voltage Factor	1.5 Un / 30 s
Total weight	60 kg approx.

5.5.20 Earth Return Current Unit (ERCU)

The ERCU "AB 436 P" is an axial operating sliding contact for the return of operating currents and for earthing of the vehicle. Electrically insulated for the protection of the roller ends the ERCU closes the electrical circuit to the rotating wheel set shaft. The grounding cable carries the reverse current from the coach body pivoted bogie via a sliding contact to the wheel set shaft, from where it can flow into the rail via the wheel. The critical point in the reverse current flow is the roller bearing or the wheel set roller bearing is bypassed in a controlled manner.

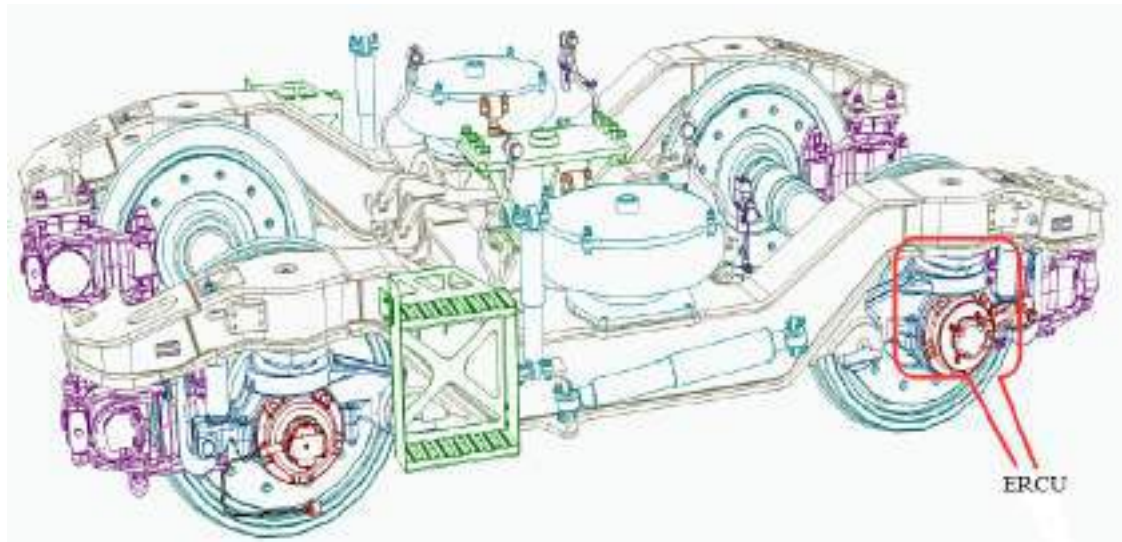


Figure 70: ERCU on Boogie

The ERCU is attached on the wheel set. The brush holder is insulated to the wheel set end cover. A contact disc which is used as contact surface is mounted on the pressure cap of the wheel set. The ERCU has a connection point on the brush holder for the grounding line.

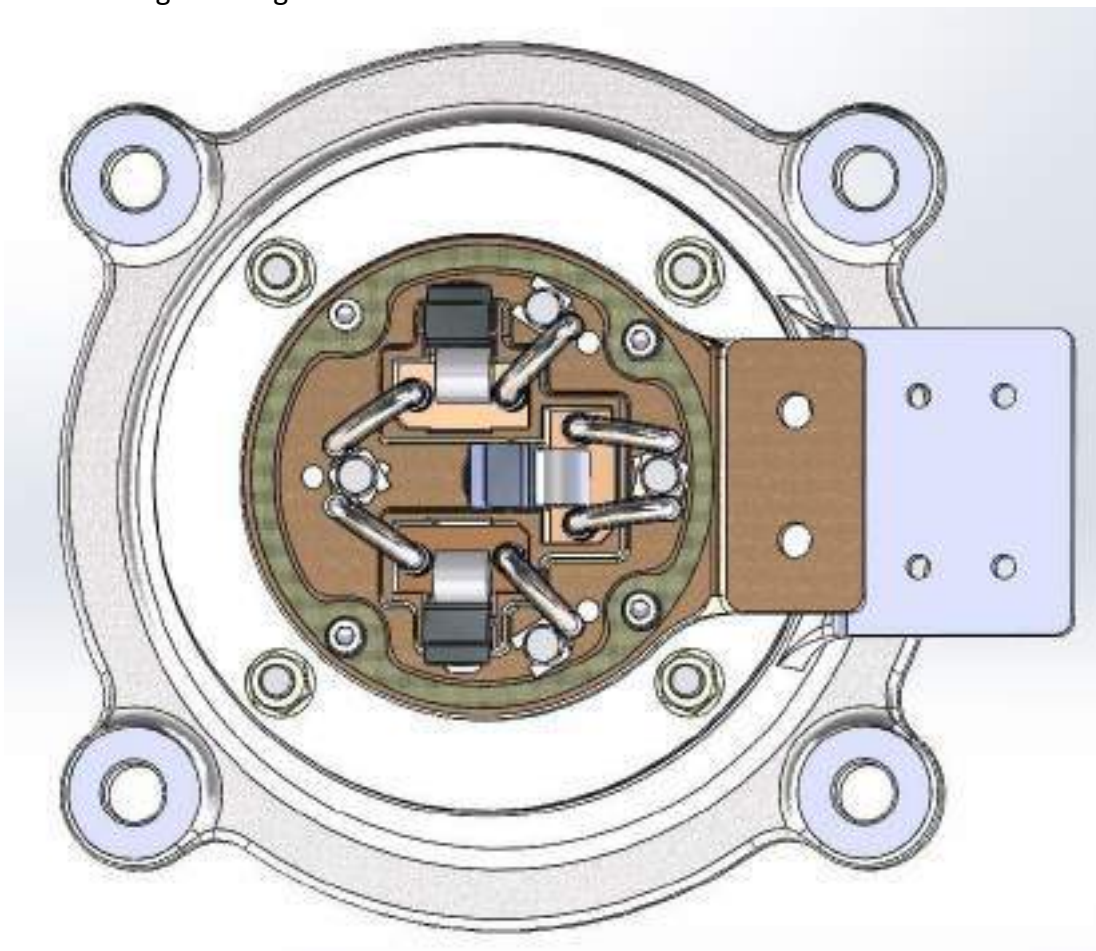


Figure 71: Earth Return Current Unit (ERCU)

5.5.20.1 Technical data

Table 18: Technical Details of Earth Return Current Unit (ERCU)

Dimension Details	
Type	AB 436 P
Drawing no	436.7240-0
Product no	7802455
Dimension	400x195 mm
Installation height	58,5 mm
Weight	5.9 ± 5% kg
Technical Data	
Effective current	600 A
Maximum current	900 A at 5 min
Number of carbon brushes	3 pc
Total contact surface	24 cm ²
Contact resistance	< 20 mW at I=50 A
Protection class	IP 65 (DIN EN 60529)

5.5.21 Battery (VRLA Battery)

VRLA batteries (110V/300AH) conforming to RDSO specification No.: RDSO/PE/SPEC/AC/0009-2014 (REV-2) is being used in Train-18 for standby power supply systems. Total 48 nos



Figure 72: Battery

5.5.21.1 Major Advantages of VRLA Batteries

- Supplied in factory filled, charged and ready to use condition.
- No topping up is required. (No Acid handling)
- Spill proof and leak proof.
- No corrosive fumes are emitted, hence user friendly.
- Safe and Explosion proof.
- Easy to install & Environment friendly.

5.5.21.2 Charging of Batteries

Never keep the batteries in discharged condition. All the batteries should be recharged within 24 hrs. followed by a discharge. In this application, the battery set may be given a terminal charge/boost charge at 2.35 VPC based on the battery conditions as explained below

The terminal charging should be given using constant voltage current limited charged having the following minimum features:

Voltage Regulation	Less than 2%
Voltage ripple	Less than 3% rms
Current ripple	Less than 10% rms
Charging current	Max.20% of Ah rating current limit to be set between 10 to 20% based on the time for recharge.
Over voltage protection	Charger trip at 2.35 V/ cell
Under voltage protection	Battery disconnection at designed End cell voltage. Otherwise to control manually.

Boost charging is not recommended more than 12 hrs.

5.5.21.3 Charge Method

Constant voltage charging is the method for giving a terminal / equalizing charge. Determine the maximum voltage that can be set in the charger. This voltage, divided by the number of cells connected in series, will establish the maximum volts per cell that may be used to perform the terminal charge in the shortest period of time. Refer the below Table-1 for voltage and recommended time periods. Current can be set to 20% of the battery capacity.

Table 19: Battery Charge Time According to Module Volts

Module Volts	Charge time
2.25	30Hrs.
2.30	12HRs
2.35	8Hrs

NOTE: Time period listed in Table-1 are for ambient temperatures from 15°C to 40°C for Temperatures less than 15°C double the number of hours.

Test Discharge

The batteries are shipped at 90% of the rated capacity; the same will be delivered 100% capacity after 5-6 charge / discharge cycles @ C10 capacity or 6 months in float service. However, the boost charge is mandatory for minimum of 24 hours prior to conduct capacity test.

Pilot Cell

A pilot cell is selected in the series string to reflect the general condition of all cells in the battery. The cell selected should be the lowest cell voltage in the series string

following the initial charge. Refer section- 8.1 for FRESHENING CHARGE. Reading and recording pilot cell voltage monthly serves as an indicator of battery condition between the previous reading and the present reading.

Tap Connections

Tap connections should not be used on battery. This can cause over charging of the unused cells and under charging of those cells supplying the load, thus reducing battery life.

If these instructions are not adhered to and any damage is caused to the cells as result of tap connections, the guarantee issued at the time of supply of the battery will be treated as null and void.

5.5.22 Mini Pantry Equipment

Each coach of Train 18 have a mini-pantry with heating chambers for food and refrigerating units for beverages. The Pantry equipment for heating and chilling food and beverages are better quality, making for uniformly warmer and colder beverages for passengers. Pantry equipment like hot case, refrigerating unit, water boiler, washing module sink etc. Pantry equipment are manufactured with stainless steel for a long life. Safety devices are available in equipment like Refrigerating unit, Hot Case & Water Boiler.

5.5.22.1 Technical Specification:

Hot Case Unit

2 nos. Hot Cases are provided in each DTC coach and 3 nos. in each coach of Executive chair car & Chair car Coaches.

Table 20: Technical Specification of Hot Case

Heating capacity	.95 KW each., 2 no.
Electrical Power Unit	230 V AC 1~50Hz
Pan capacity	
Volume	47.5 Ltr.
Maximum Full Size	6 Pan size 530 x325x65 mm
Half Size Pan	11 Pan Size 457 x 330 x 25 mm
Dimensions:	
Height	809 mm
Width	483 mm
Depth	675 mm
Weight	50 kg. each
No. of Trays:	6 Trays (530x325x65 mm) 11 Trays (457X330X25MM)
Safety Device Specification	
Thermostat	Solid state Electronic control with temperature setting 16 °C to 93 °C with LED display and with 6

	setting Timer
--	---------------

Refrigerating Unit

Table 21: Technical Specification of Refrigerating Unit

Operating voltage	230 V AC 1~50Hz
Wattage	600 Watt
Refrigerant	R134a
Dimensions	
Height	1000 mm
Width	1250 mm
Depth	585 mm with door
Weight	150 kg
Thermostat	2 °C -12 °C for bottle cooler area
	-8 °C to -18 °C for Deep Freezer area

Water Boiler:

Table 22: Technical Specification of Water Boiler

Operating Voltage	230V ± 10%, 50Hz ±3%
Heating element	2Nos (1500 W+1300watt)
Dimensions	
Height	640mm
Diameter	318 mm
Weight	5.5 Kg
Thermostat (OHP)	30°C to 100°C

5.5.22.2 Equipment Constructional Detail

Hot Case

- Stainless Steel construction.
- Corrosion Resist Stainless Steel Interior / Exterior body.
- Solid doors, hinged on right
- Compact Design to Save Space.
- Chrome Plated Side Racks.
- Simple On / Off Control System.
- Digital Temperature Controller.
- Good Heating Application Maintain Ideal serving Temperature throughout the Cabinet.
- Adjustable thermostat
- Quick Heat Recovery Time.
- Quick Temperature Drop Time.
- Easy to Read LED Display.
- Temperature Range 16° to 93° .
- Heat Indicator Light, Temperature Display

- Button.
- Chrome Plated Handle.
- Side Racks Have 35mm Eleven Pan Space.
- Chrome Plate Wire Shelves 2 Nos.
- For easy mobility Heavy duty caster wheel 2 rigid and 2 swivel with brake
- Door with magnetic latch
- Deluxe control option.
- Deluxe control is available with six multiple timers for each compartment to facilitate first in first out concept.



Figure 73: Hot Case

Refrigerating Unit:

- Stainless Steel Cabinet
- Automatic Defrost System.
- Night Mode Set back option
- Temperature Range 2°C to 12°C for Bottle Cooler
- Temperature Range -8°C to -18 °C for Deep Freezer
- No. of Shelves 4 Nos.
- Refrigerant Gas R134a.
- Power – 600 W / 230V
- Dimension – W 1250X D 585 X h 1000 MM
- Weight: - 150 KGS.



Figure 74: Refrigerating Unit

Water Boiler:

- Tank and lid is made of stainless steel.
- Filling level indicator.
- Double wall anti bum.
- Capacity 30 Liters.
- Adjustable thermostat 30° to 100° .
- Anti-drip system.
- Safety thermostat with reset button.



Figure 75: Water Boiler

Washing Module Sink:

Washing module with sink is fabricated from 1.0 mm thick stainless steel sheet. It will be fitted right bottom corner of the modular pantry compartment .A stainless steel work surface with a surrounding raised edge and a drawn type sink is provided. The sink will be positioned in the centre suitably covered by a sink panel.

Drawing Index

CHAPTER - 6

Contents

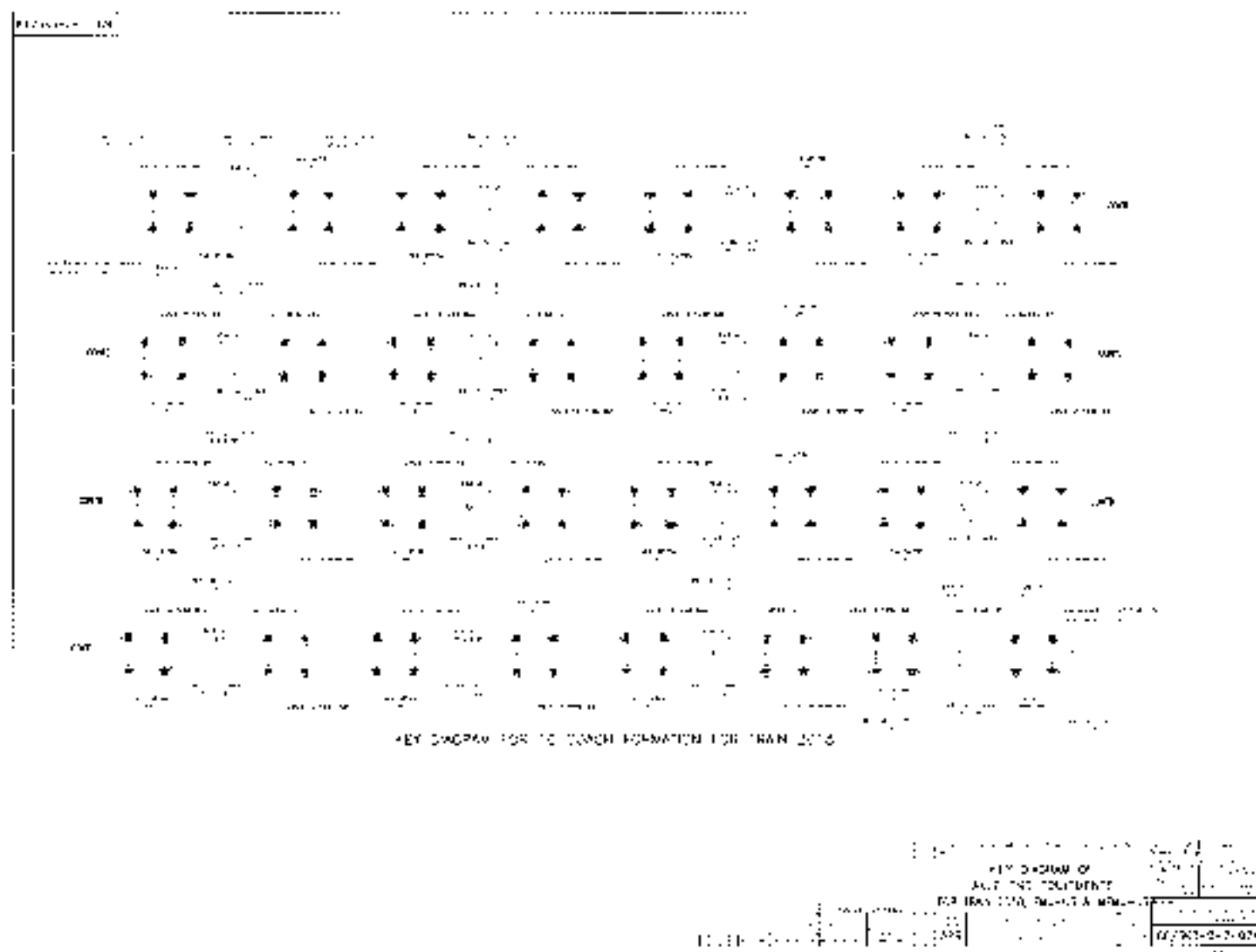
6.	Drawing Index:	3
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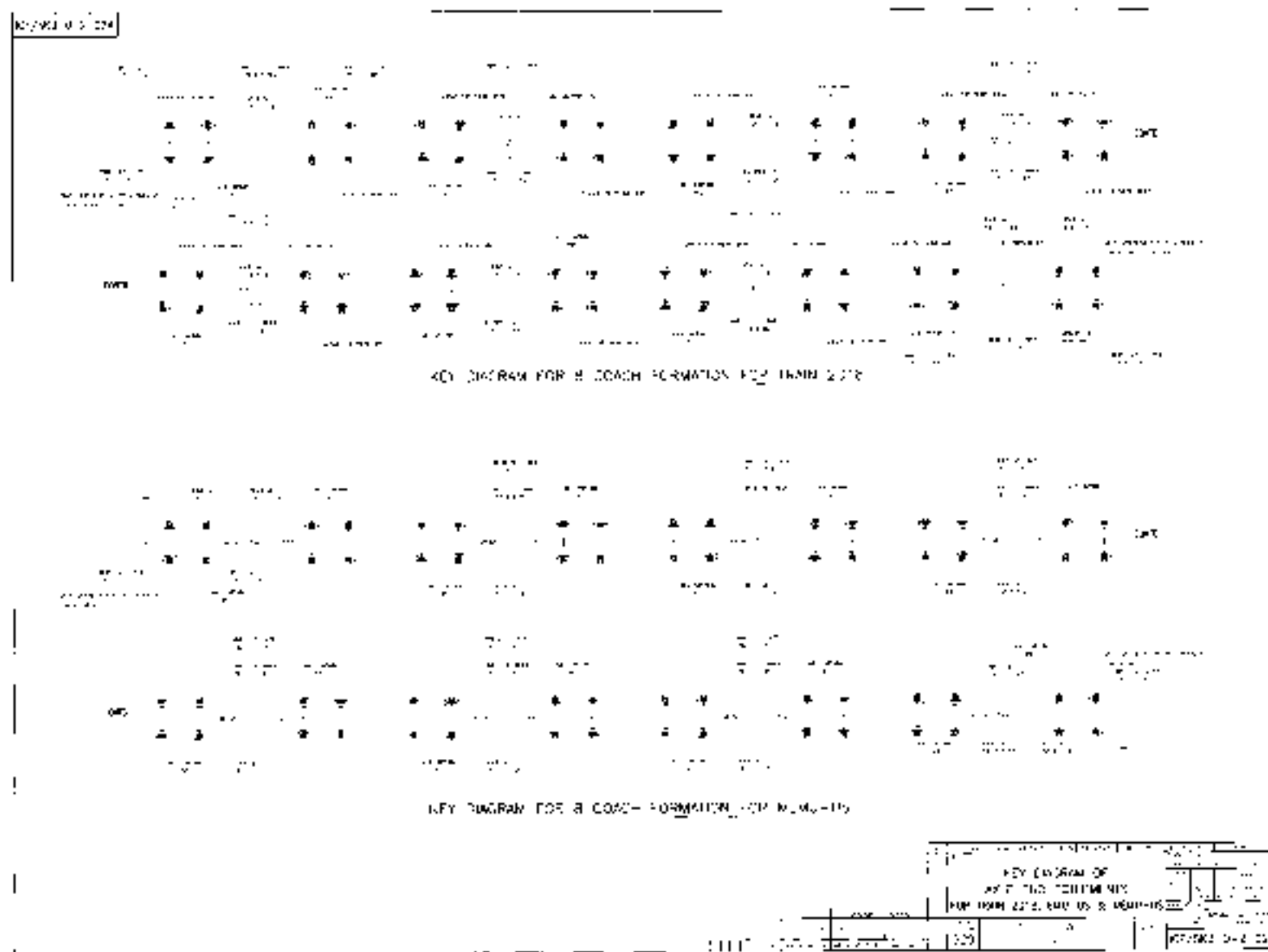
6. Drawing Index:

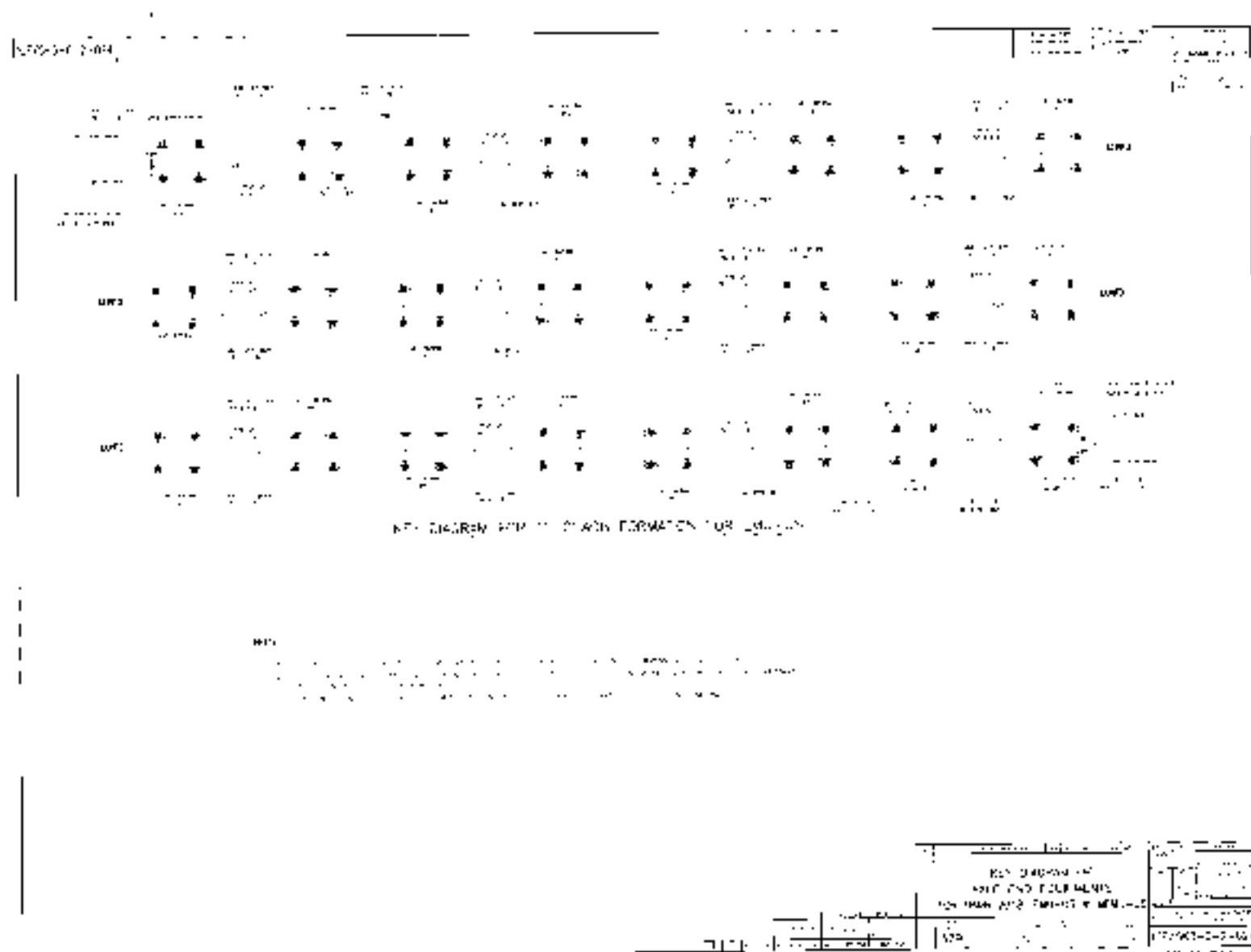
- Drawing related to Bogie
- Drawing related to Wheel & Axle
- Drawing related to Braking System
- Drawing related to Gangway
- Drawing related to Semi Permanent Coupler (CPC)
- Drawing related to Electrical Schematic
- Drawing related to Water System

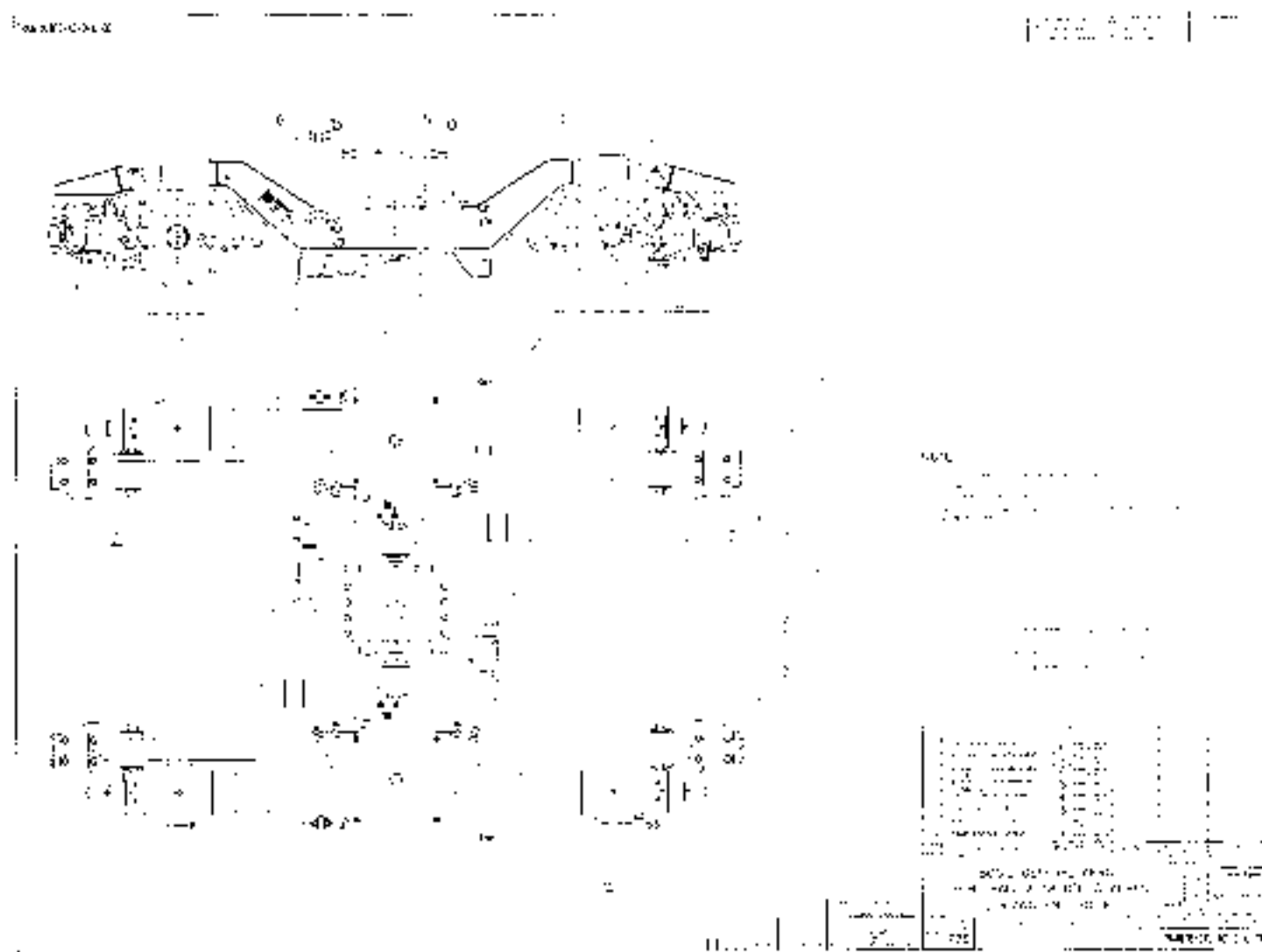
6.1 Bogie

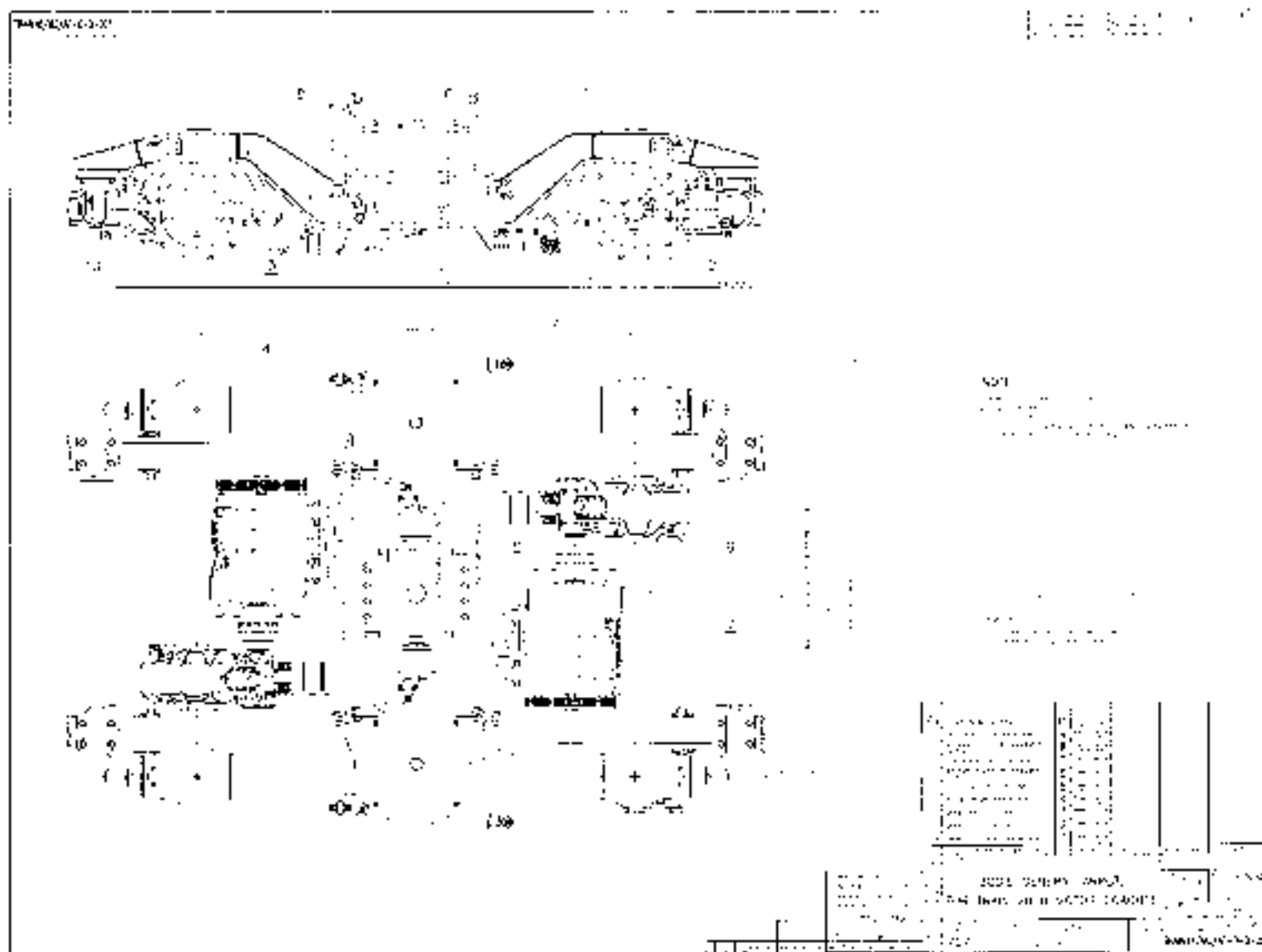
Designation	Drawing
Key diagram for axle end equipment	ICF/SK3-0-2-024
Bogie general arrangement	Train18/DTC/AC-0-0-001
Bogie general arrangement	Train18/DTC/AC-0-0-002
Bogie general arrangement	Train18/MC/AC-0-0-001
Reaction Rod fixing arrangement	Train18/MC/AC-0-0-002
Traction Motor fixing arrangement	Train18/MC/AC-0-0-003
Primary Suspension arrangement	Train18/MC/AC-0-0-003
Wheel & Axle Set	Train18/MC/AC-0-2-001
Roller Bearing arrangement (Outer wheel-set)	72702002
Roller Bearing arrangement (Inner wheel-set)	72702003
Bogie Frame complete (sheet-1)	72703001
Bogie Frame complete (sheet-2)	72703001
Secondary Suspension(sheet-1)	72705001
Secondary Suspension(sheet-2)	72705001
Stabiliser assembly	72705003
Secondary Suspension(sheet-1)	72705004
Secondary Suspension arrgt. with adjustment	Train18/MC/AC-0-5-009
Disc brake fixing arrangement	Train18/MC/AC-3-2-001
Suspension diagrammatic arrgt. (sheet-1)	Train18/MC/AC-9-0-006
Suspension diagrammatic arrgt. (sheet-2)	Train18/MC/AC-9-0-006
Bogie general arrgt.	Train18/TC/AC-0-0-001
Wheel & Axle Set	Train18/TC/AC-0-2-001
Roller Bearing arrgt.(wheel-set with Tacho for DTC)	72802003
Roller Bearing arrgt.(Inner wheel-set)	72802004
Roller Bearing arrgt.(Outer wheel-set)	72802005

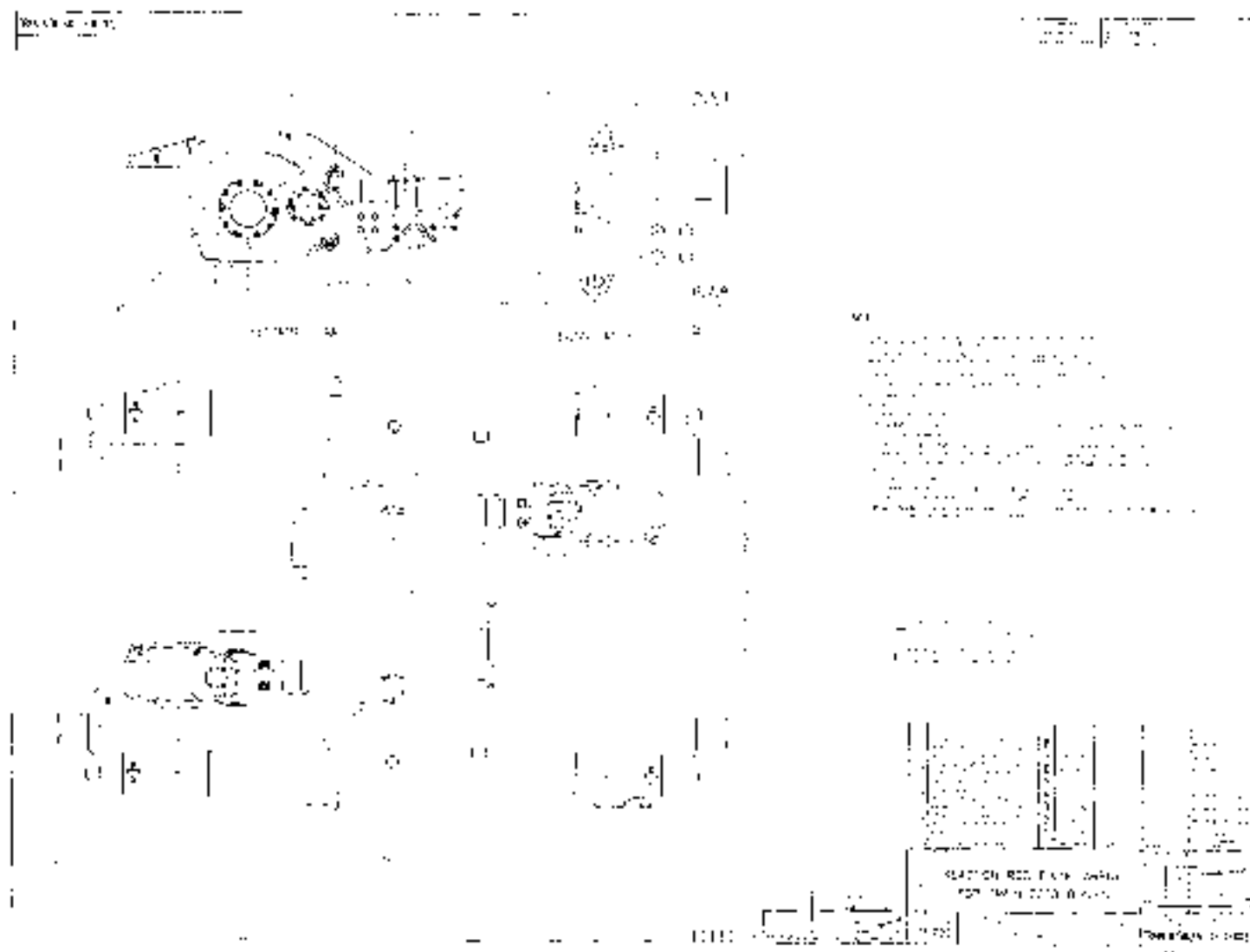


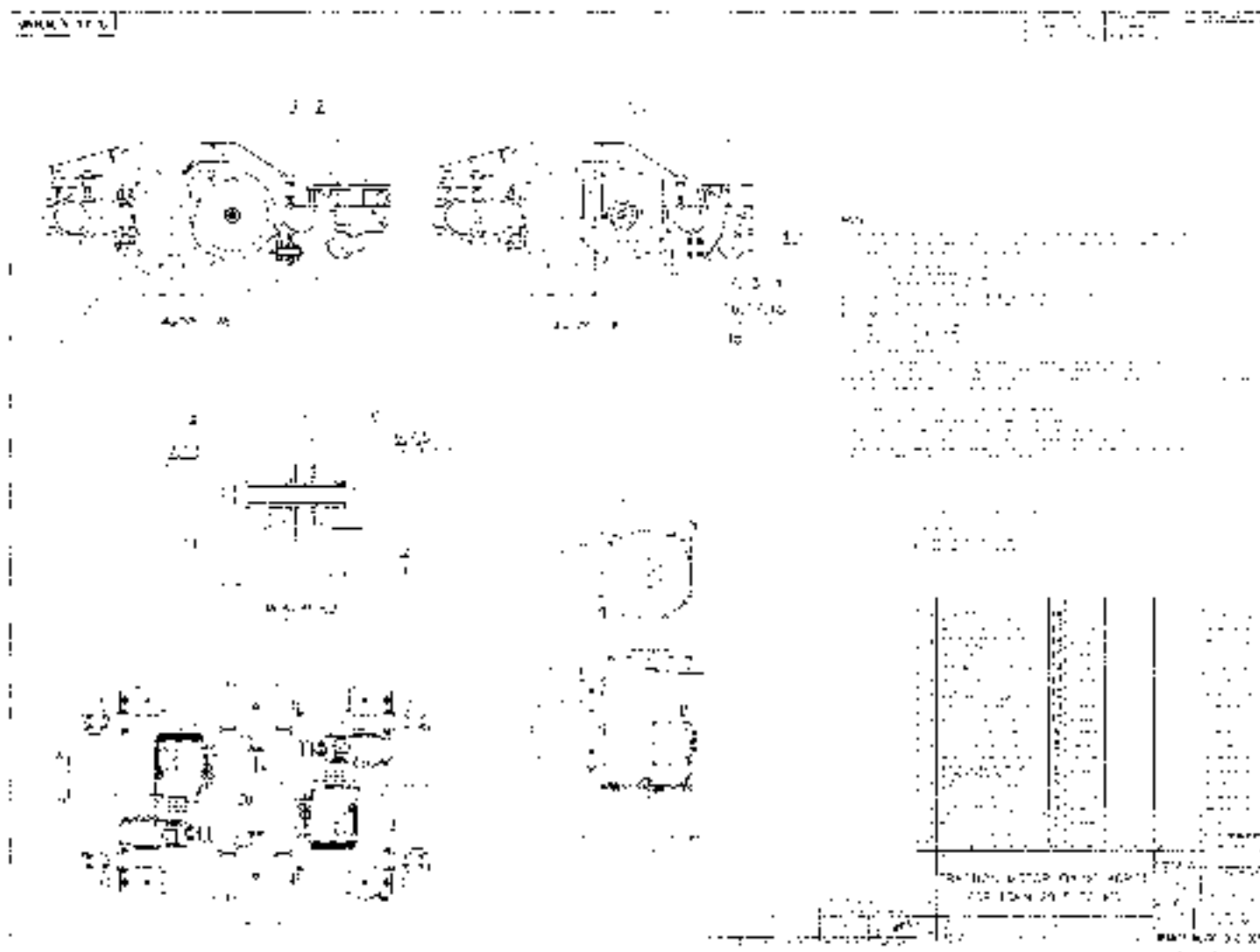


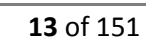


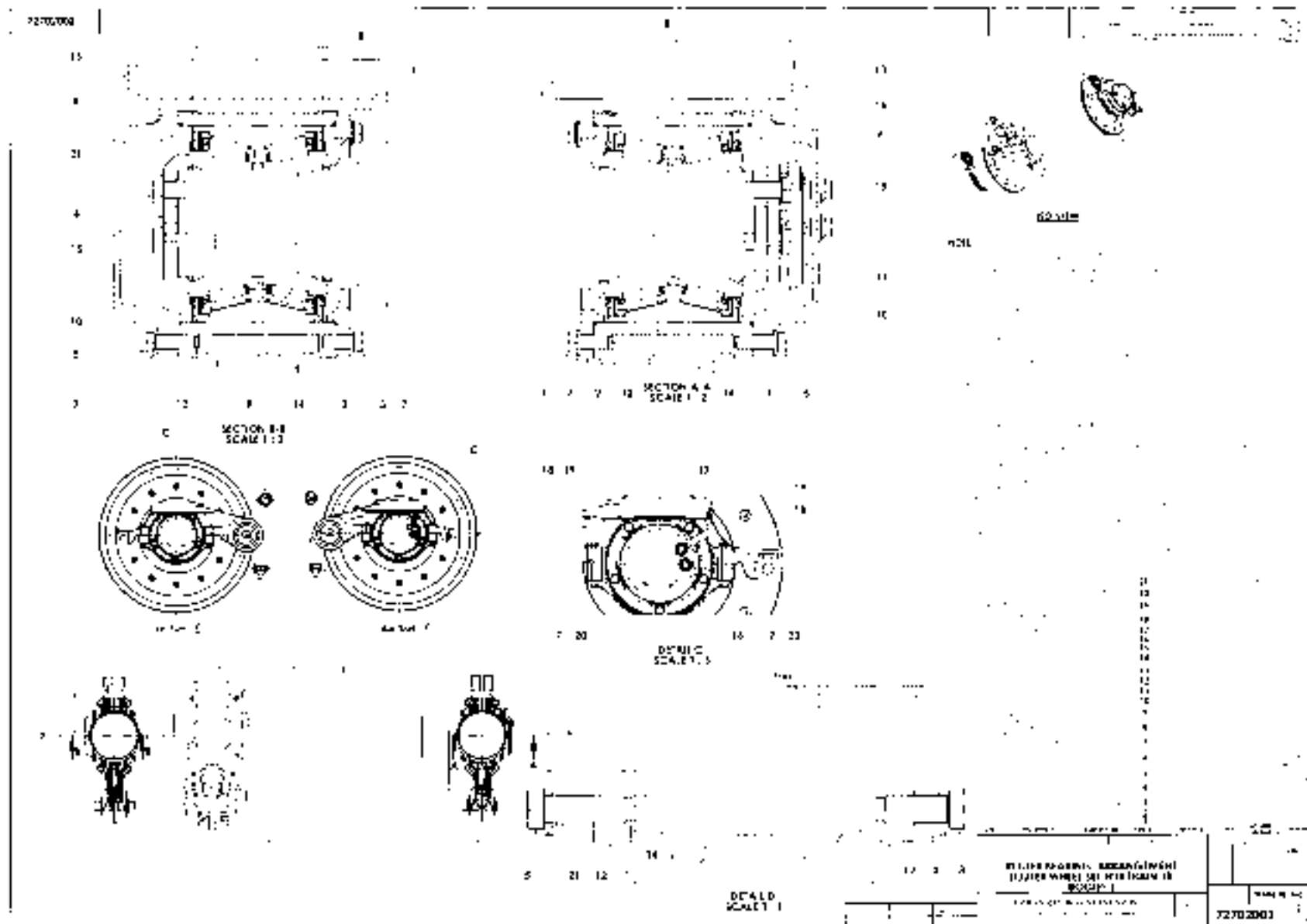


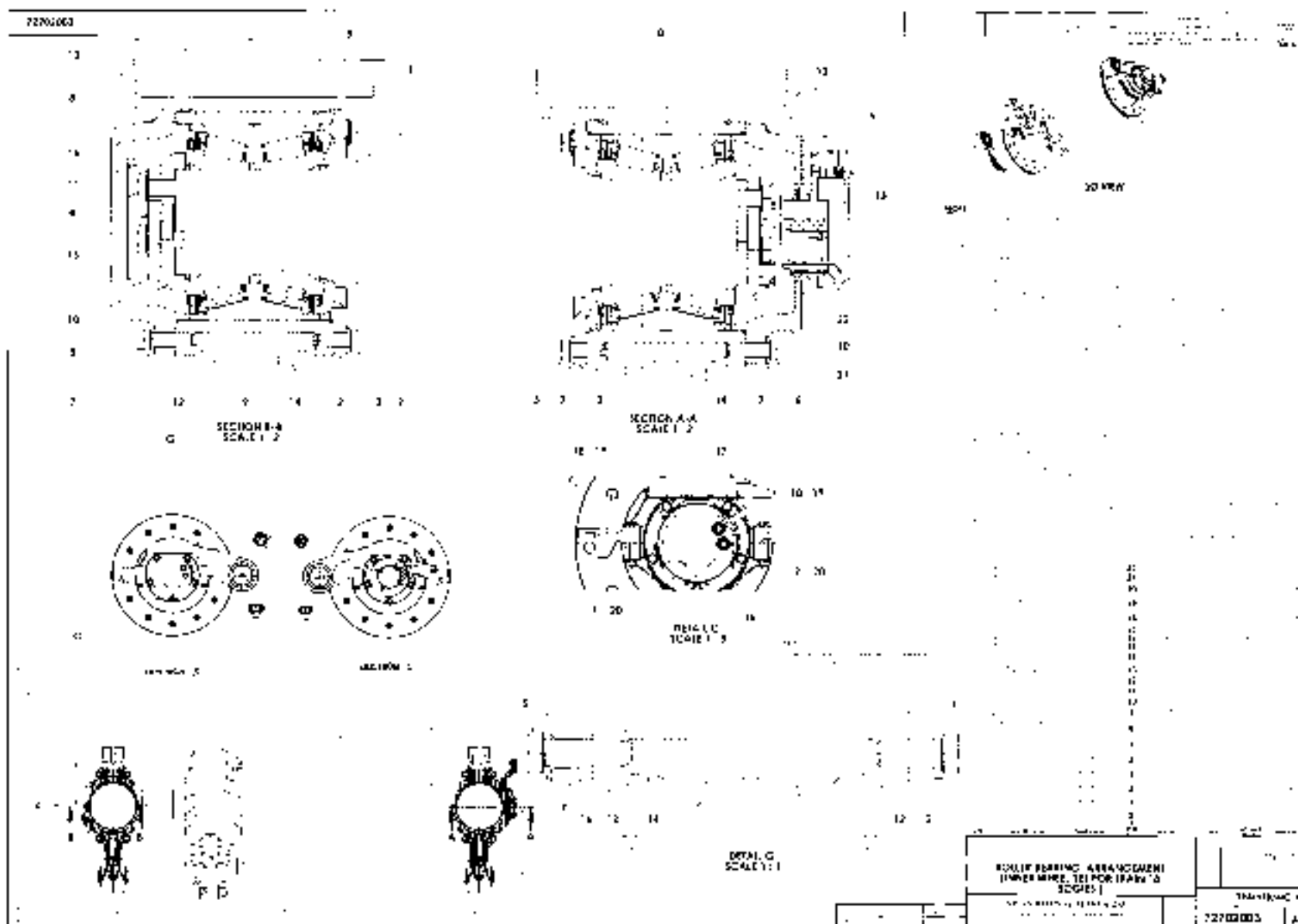


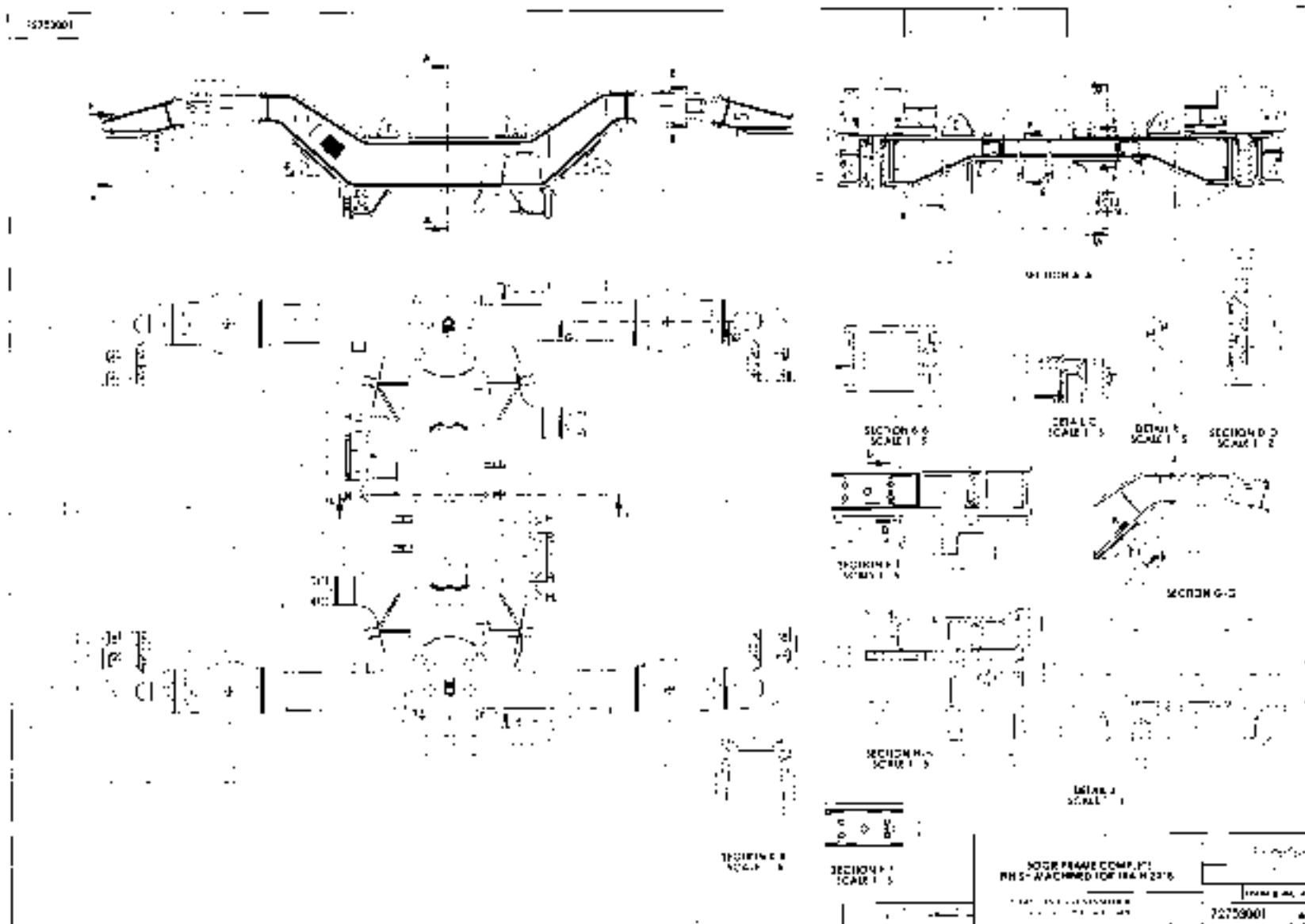


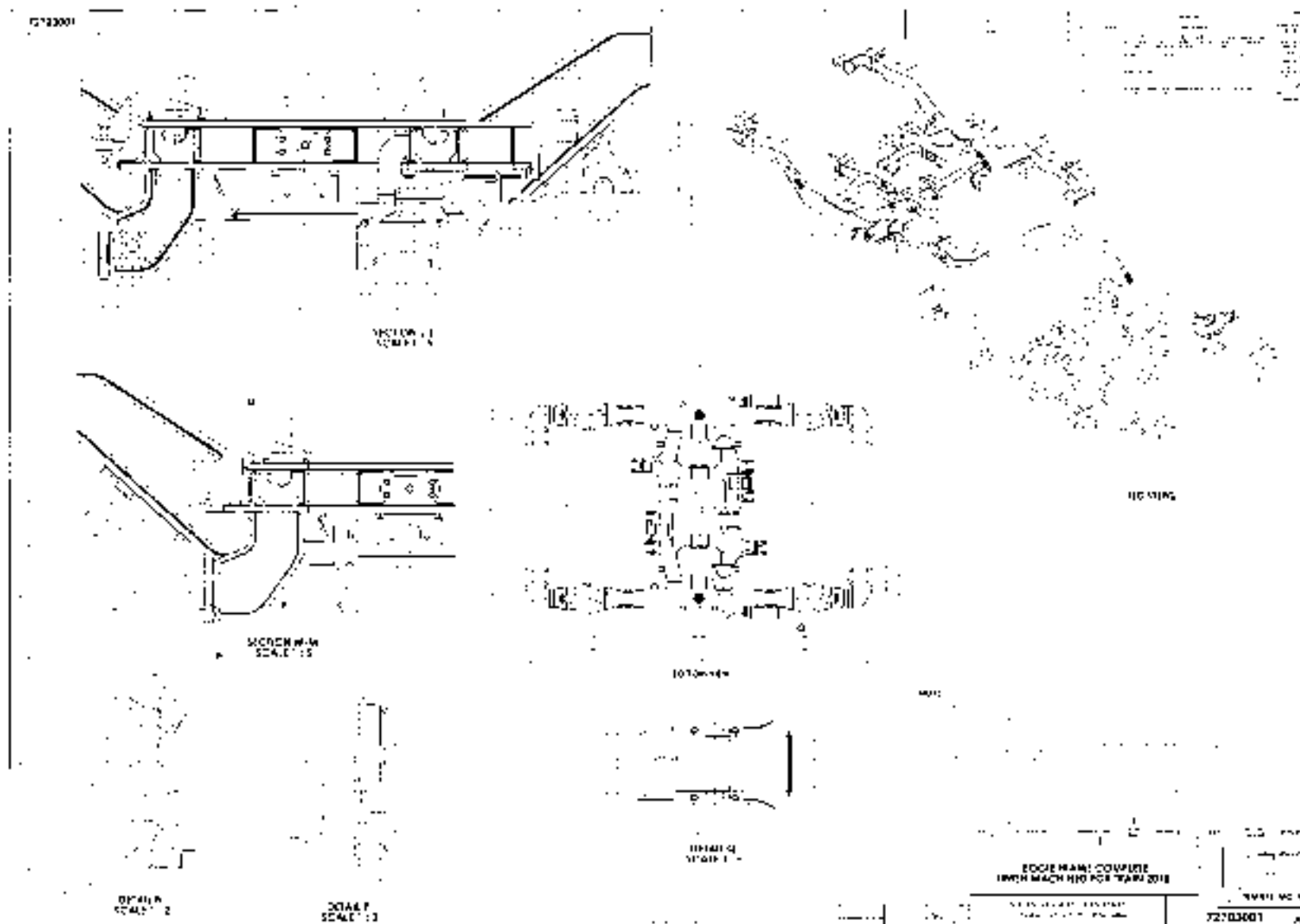


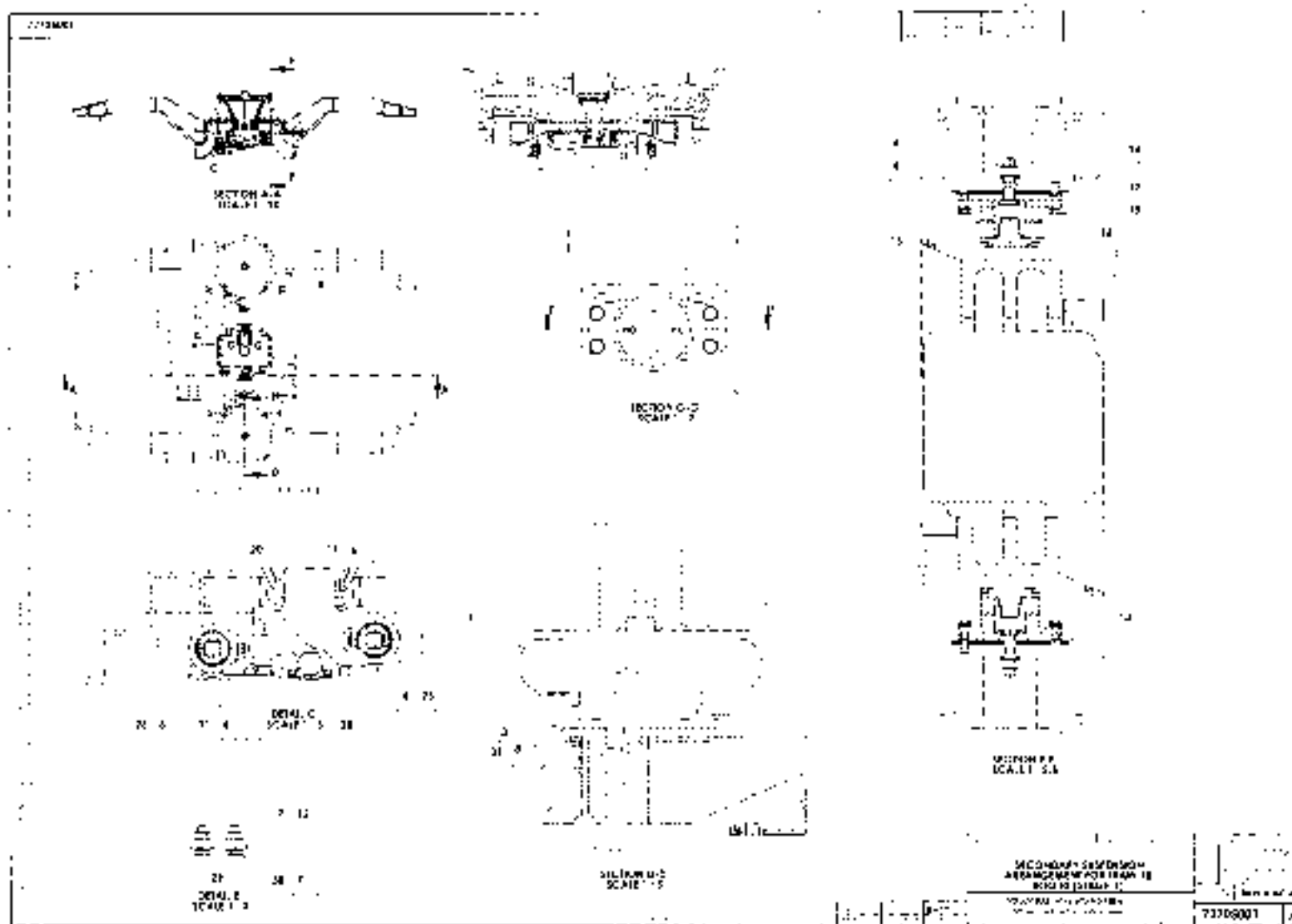










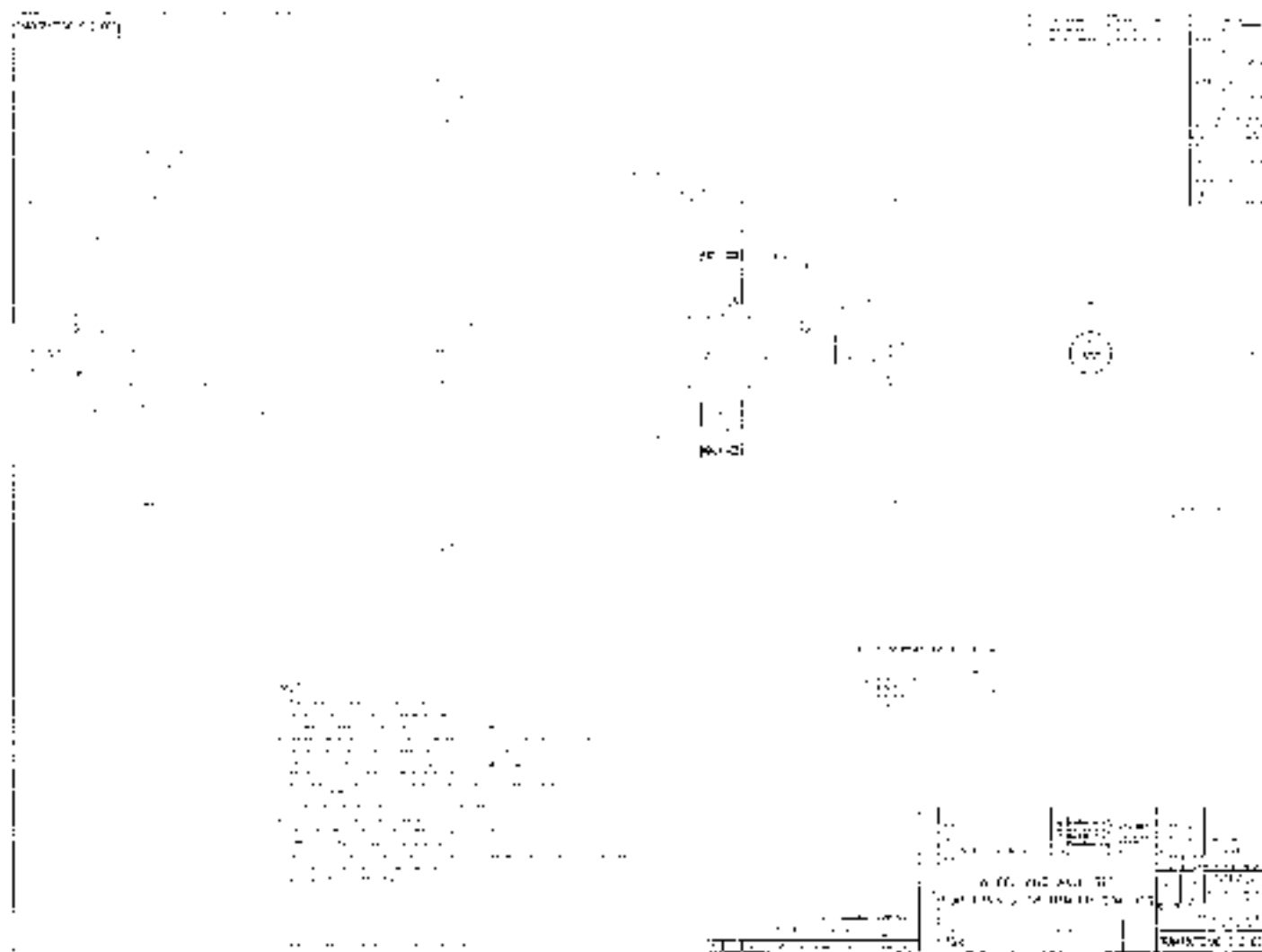


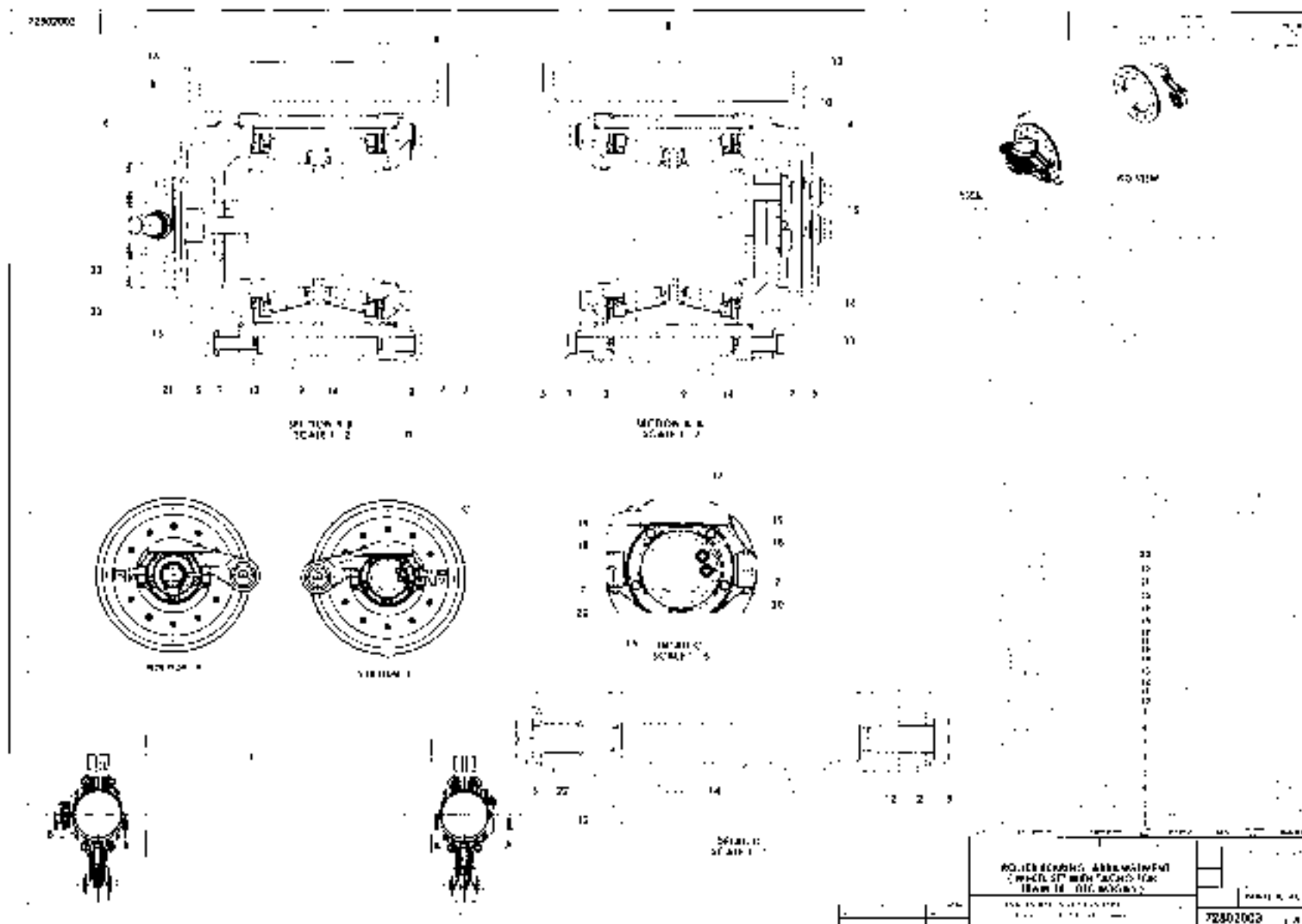


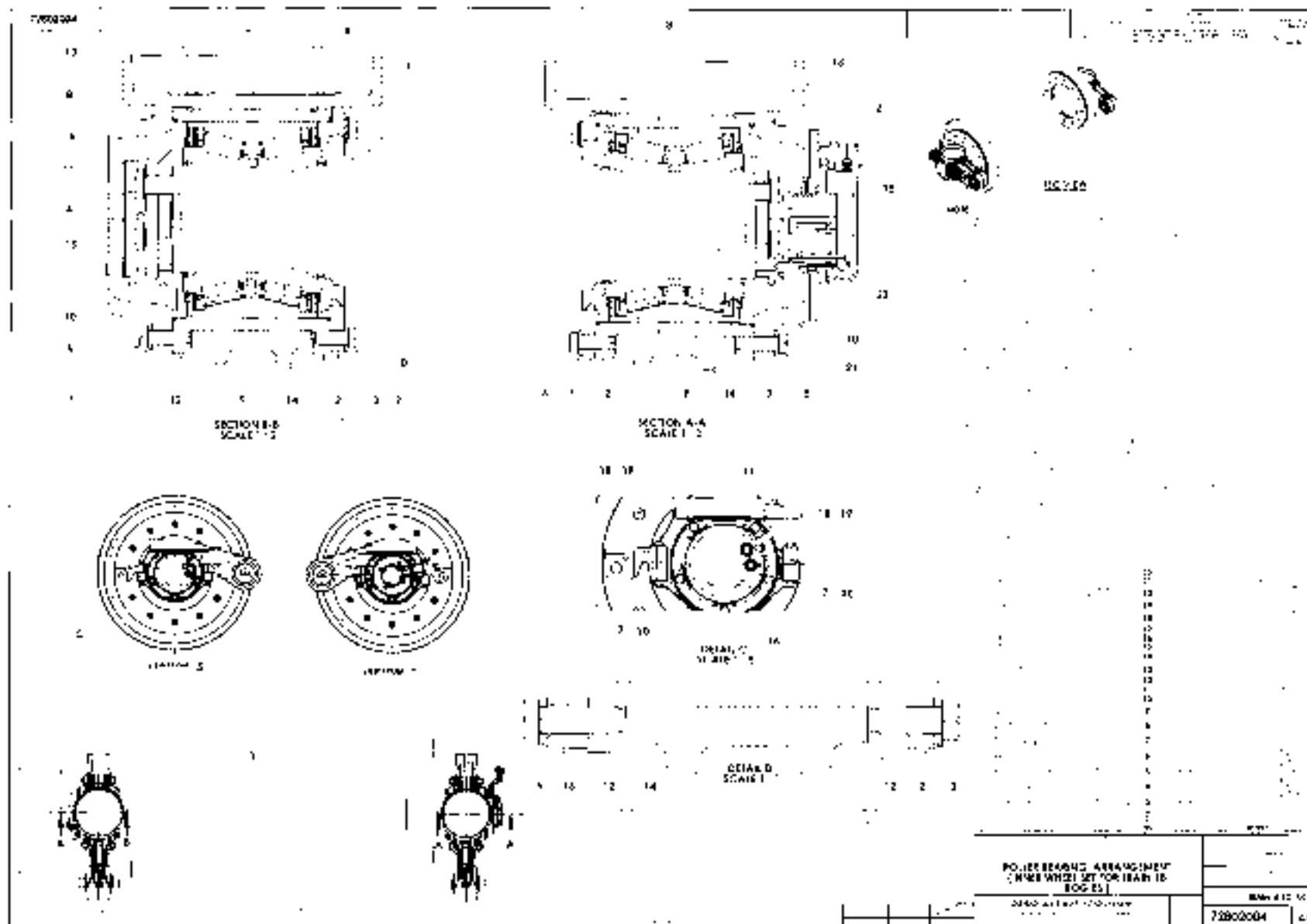
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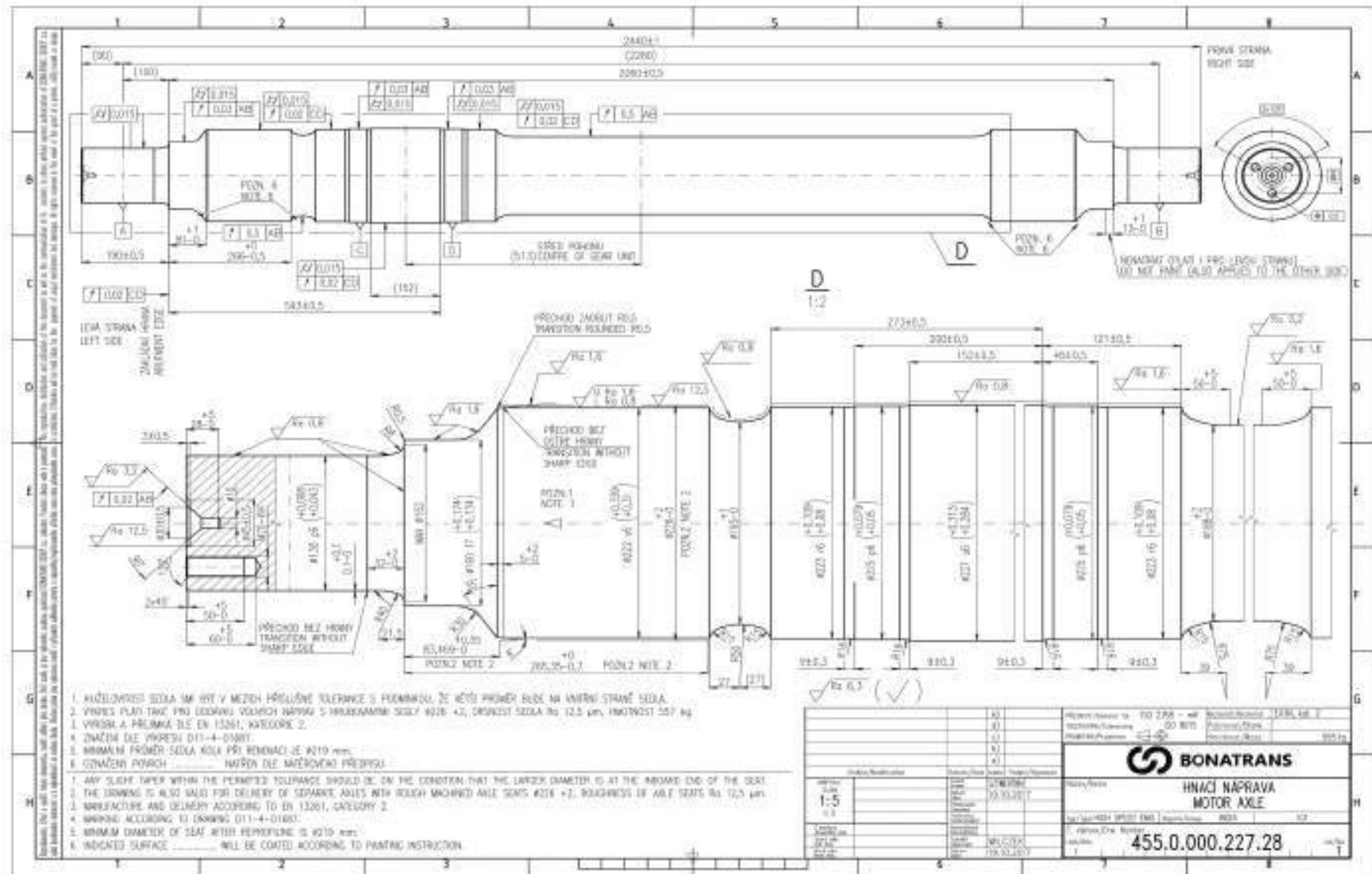


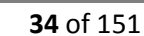


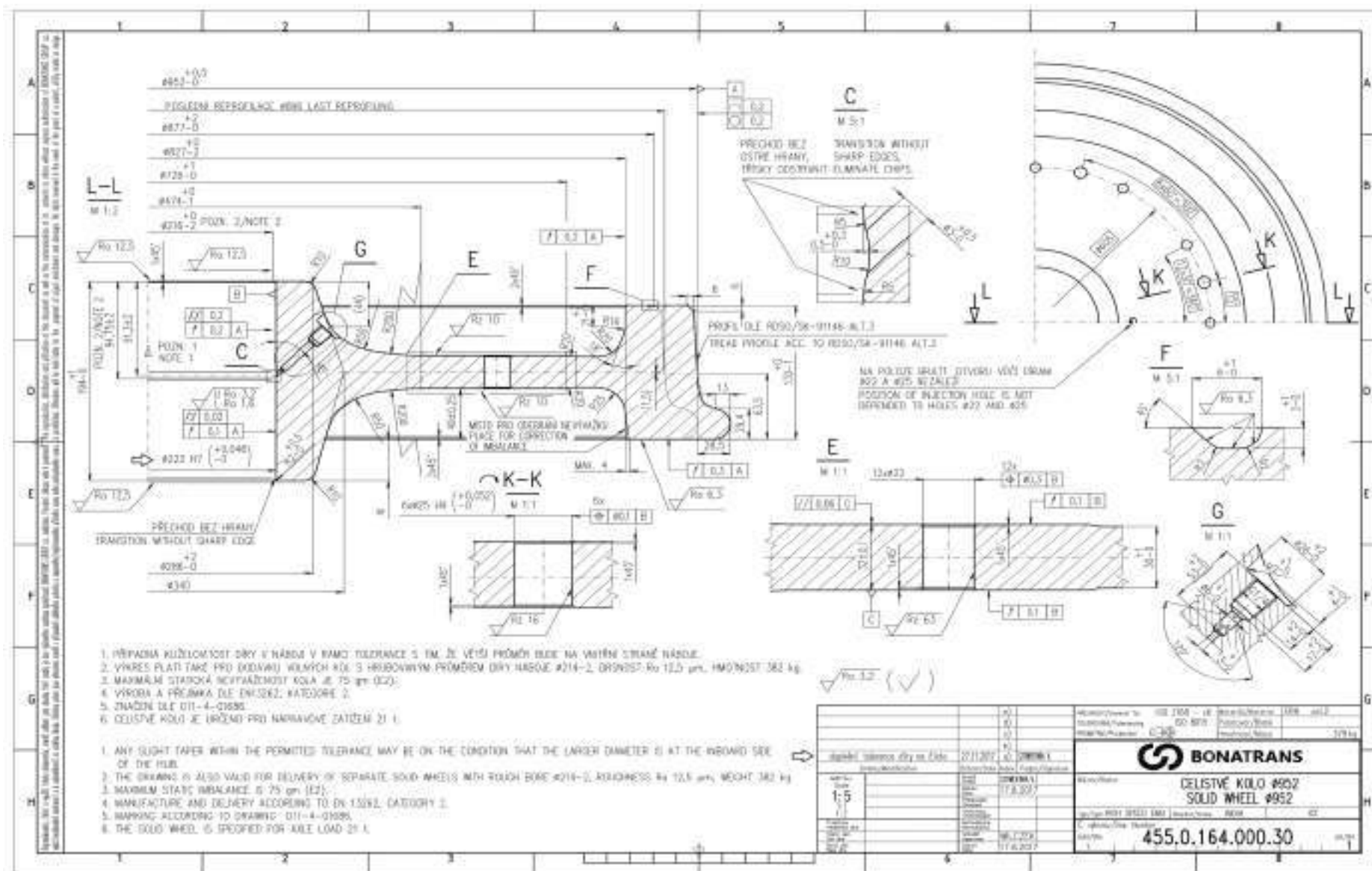
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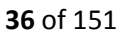
6.2 Wheel & Axle

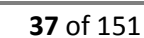
Designation	Drawing
Motor Axle	455.0.000.227.28
Trailer Axle	455.0.000.227.35
Solid Wheel	455.0.164.000.30
Wheel Assembly	455.8.164.000.30
Motor Wheel-Set	455.9.164.227.00-30.28
Trailer Wheel-Set	455.9.164.227.00-30.35
Solid Wheel Marking	D11-4-01686
Axle Marking	D11-4-01687

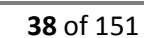


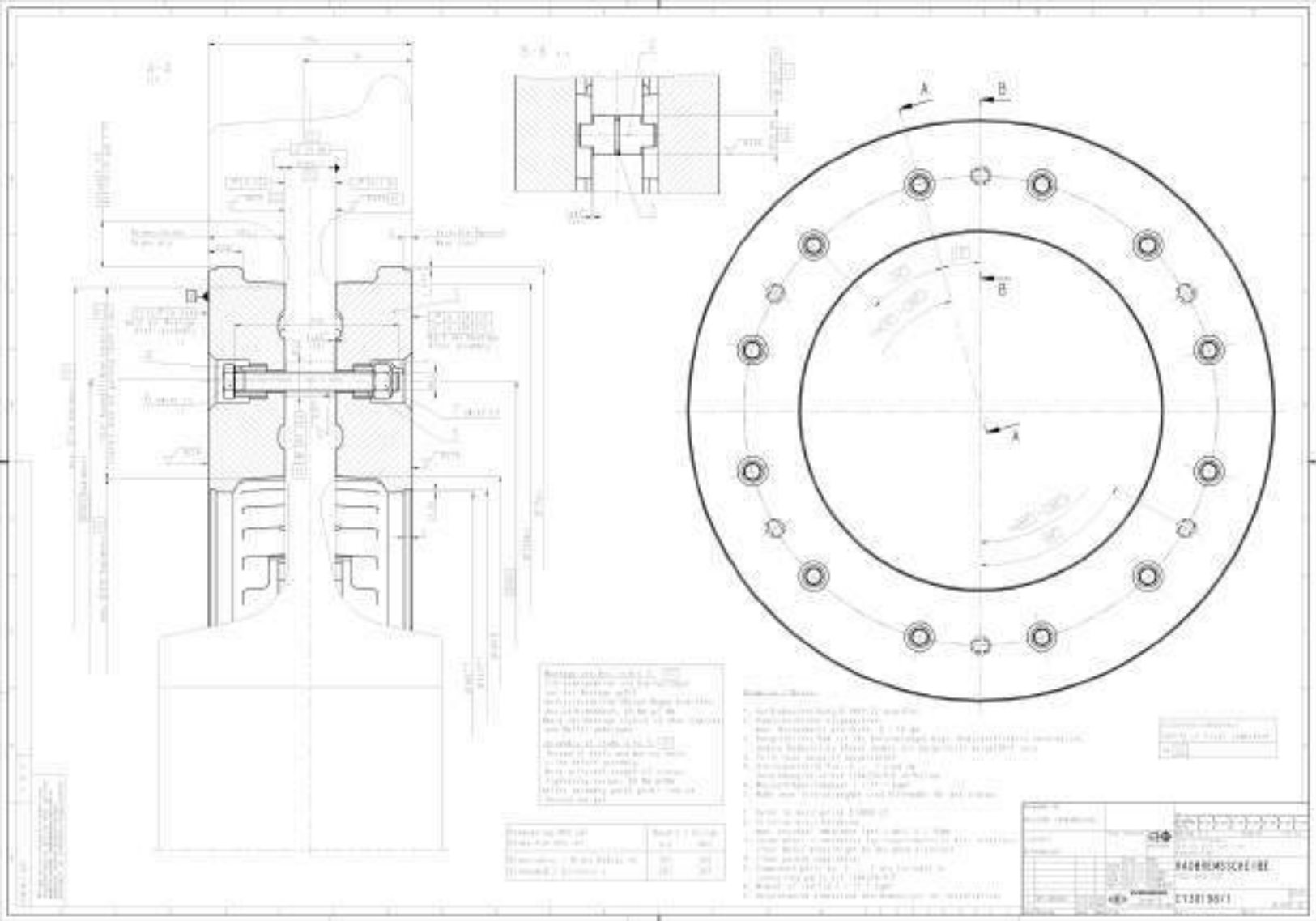


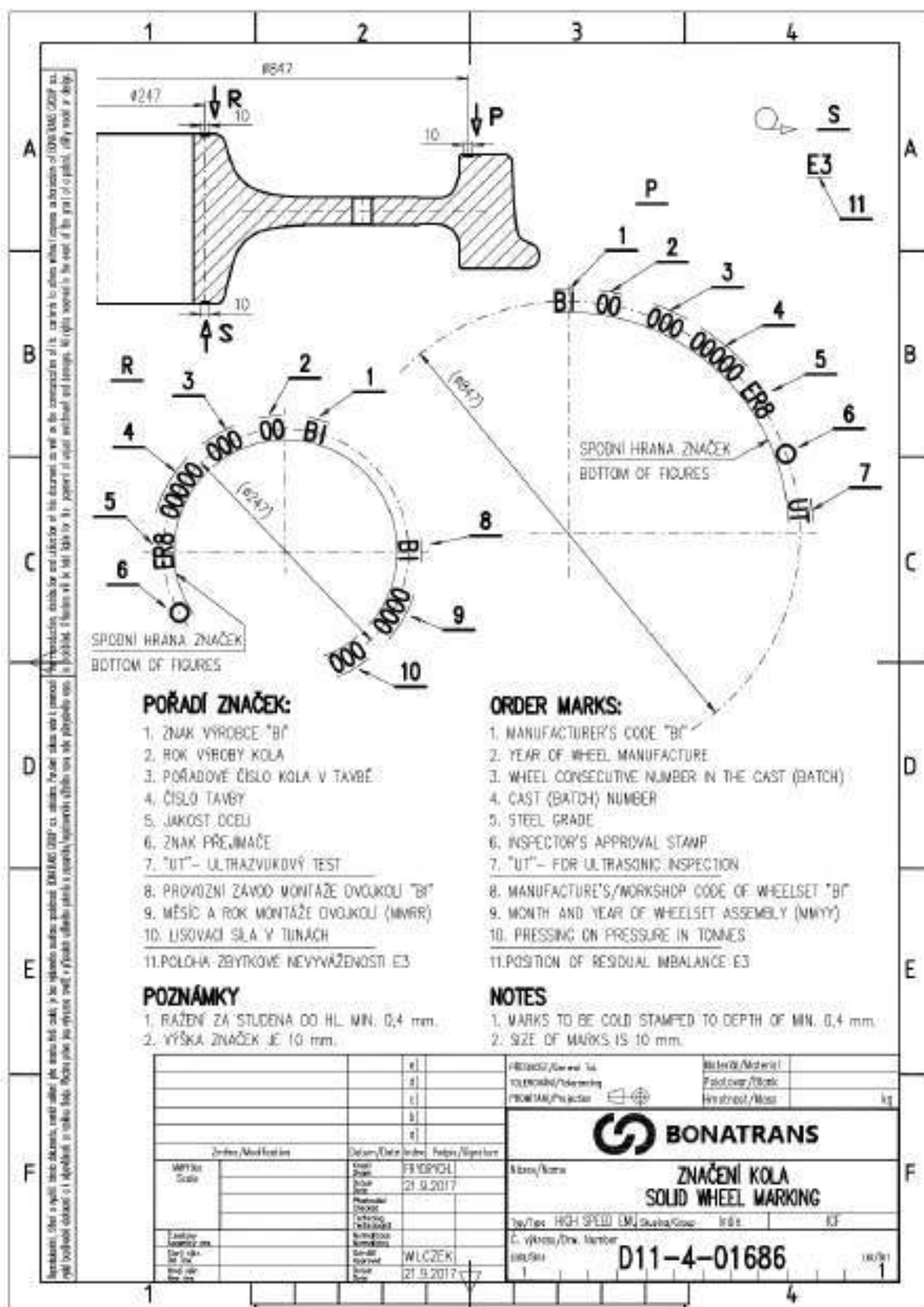










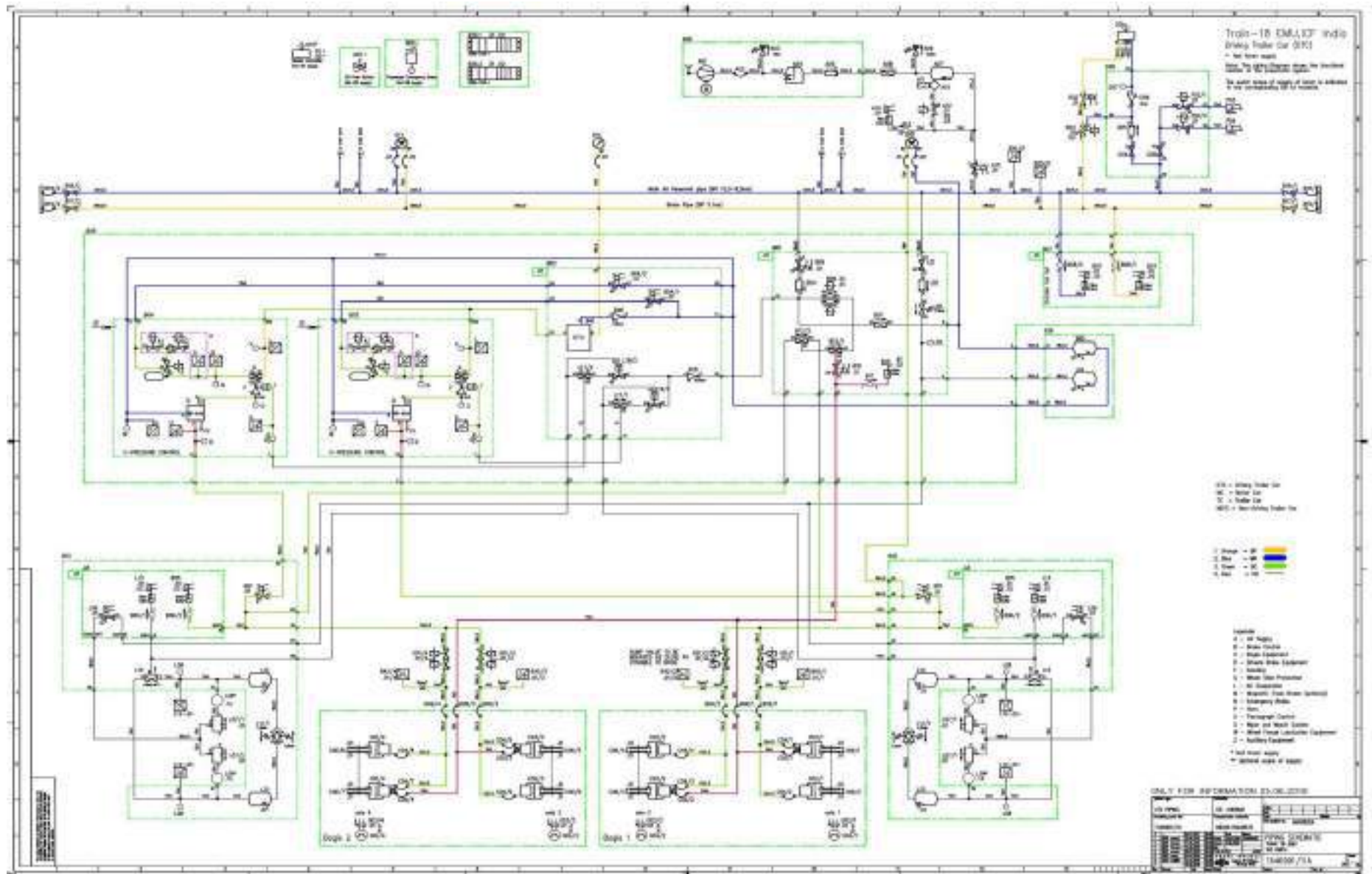


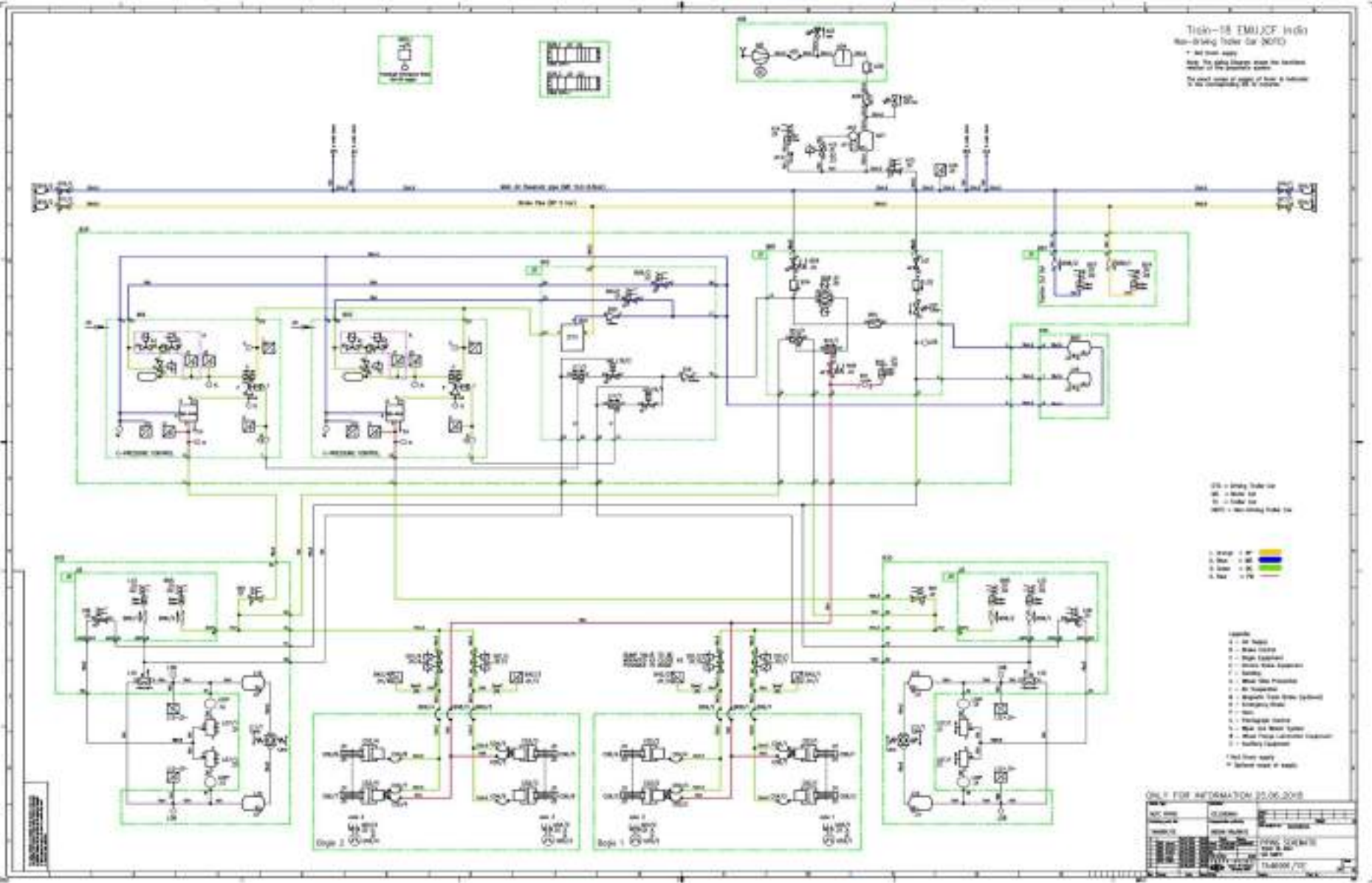
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C	<p>LEFT SIDE – THE NEAR SIDE OF DRIVING GEAR FOR M-AXLE LEVÁ STRANA NÁPRAVY</p> <p>RIGHT SIDE – THE OPPOSITE SIDE OF DRIVING GEAR FOR M-AXLE PRAVÁ STRANA NÁPRAVY</p>																																																			
D	<p>POŘADÍ ZNAČEK</p> <ol style="list-style-type: none"> 1. ZNAK VÝROBCE "BI" 2. ROK VÝROBY 3. POŘADOVÉ ČÍSLO NÁPRAVY V TAVBĚ 4. ČÍSLO TAVBY 5. ZNAK PŘEJÍMAČE 6. "UT" – ULTRAZVUKOVÝ TEST 7. JAKOST OCELI 																																																			
E	<p>ORDER MARKS:</p> <ol style="list-style-type: none"> 1. MANUFACTURER'S CODE "BI" 2. YEAR OF MANUFACTURE 3. AXLE CONSECUTIVE NUMBER IN THE CAST (BATCH) 4. CAST (BATCH) NUMBER 5. INSPECTOR'S APPROVAL STAMP 6. "UT" – FOR ULTRASONIC TESTING 7. STEEL GRADE 																																																			
F	<p>POZNÁMKY</p> <ol style="list-style-type: none"> 1. ZNAČKY VYRAŽET NA JEDNO ČELO DO HL. MIN 0,4 mm. 2. VÝŠKA ZNAČEK 5 mm. <p>NOTES</p> <ol style="list-style-type: none"> 1. STAMPS SHALL BE COLD STAMPED TO DEPTH MIN 0,4 mm. 2. STAMP SIZE 5 mm. 																																																			
	<table border="1"> <tr> <td colspan="2">Značka / Mark</td> <td colspan="2">Datum / Date</td> <td colspan="2">Podpis / Signature</td> </tr> <tr> <td colspan="2">MPT/As</td> <td colspan="2">21.9.2017</td> <td colspan="2">WLCZEK</td> </tr> <tr> <td colspan="2">Scale</td> <td colspan="2">21.9.2017</td> <td colspan="2">21.9.2017</td> </tr> <tr> <td colspan="2">Lasting</td> <td colspan="2">21.9.2017</td> <td colspan="2">21.9.2017</td> </tr> <tr> <td colspan="2">Signature</td> <td colspan="2">21.9.2017</td> <td colspan="2">21.9.2017</td> </tr> <tr> <td colspan="2">Date</td> <td colspan="2">21.9.2017</td> <td colspan="2">21.9.2017</td> </tr> <tr> <td colspan="2">Time</td> <td colspan="2">21.9.2017</td> <td colspan="2">21.9.2017</td> </tr> <tr> <td colspan="2">Place</td> <td colspan="2">21.9.2017</td> <td colspan="2">21.9.2017</td> </tr> </table>				Značka / Mark		Datum / Date		Podpis / Signature		MPT/As		21.9.2017		WLCZEK		Scale		21.9.2017		21.9.2017		Lasting		21.9.2017		21.9.2017		Signature		21.9.2017		21.9.2017		Date		21.9.2017		21.9.2017		Time		21.9.2017		21.9.2017		Place		21.9.2017		21.9.2017	
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	<table border="1"> <tr> <td colspan="2">PŘEDKUP / Purchase</td> <td colspan="2">Materiál / Material</td> </tr> <tr> <td colspan="2">VÝROBA / Production</td> <td colspan="2">Přelozp / Transfer</td> </tr> <tr> <td colspan="2">PROMĚNA / Conversion</td> <td colspan="2">Hmotnost / Mass</td> </tr> <tr> <td colspan="2"></td> <td colspan="2">kg</td> </tr> <tr> <td colspan="4" style="text-align: center;"> BONATRANS </td> </tr> <tr> <td colspan="4" style="text-align: center;"> ZNAČENÍ NÁPRAVY AXLE MARKING </td> </tr> <tr> <td colspan="4">Typ / Type: HIGH-SPEED EMU</td> </tr> <tr> <td colspan="4">C. výkres / Draw. Number: D11-4-01687</td> </tr> <tr> <td colspan="4">Materiál / Material: 16Mn</td> </tr> </table>				PŘEDKUP / Purchase		Materiál / Material		VÝROBA / Production		Přelozp / Transfer		PROMĚNA / Conversion		Hmotnost / Mass				kg		BONATRANS				ZNAČENÍ NÁPRAVY AXLE MARKING				Typ / Type: HIGH-SPEED EMU				C. výkres / Draw. Number: D11-4-01687				Materiál / Material: 16Mn															
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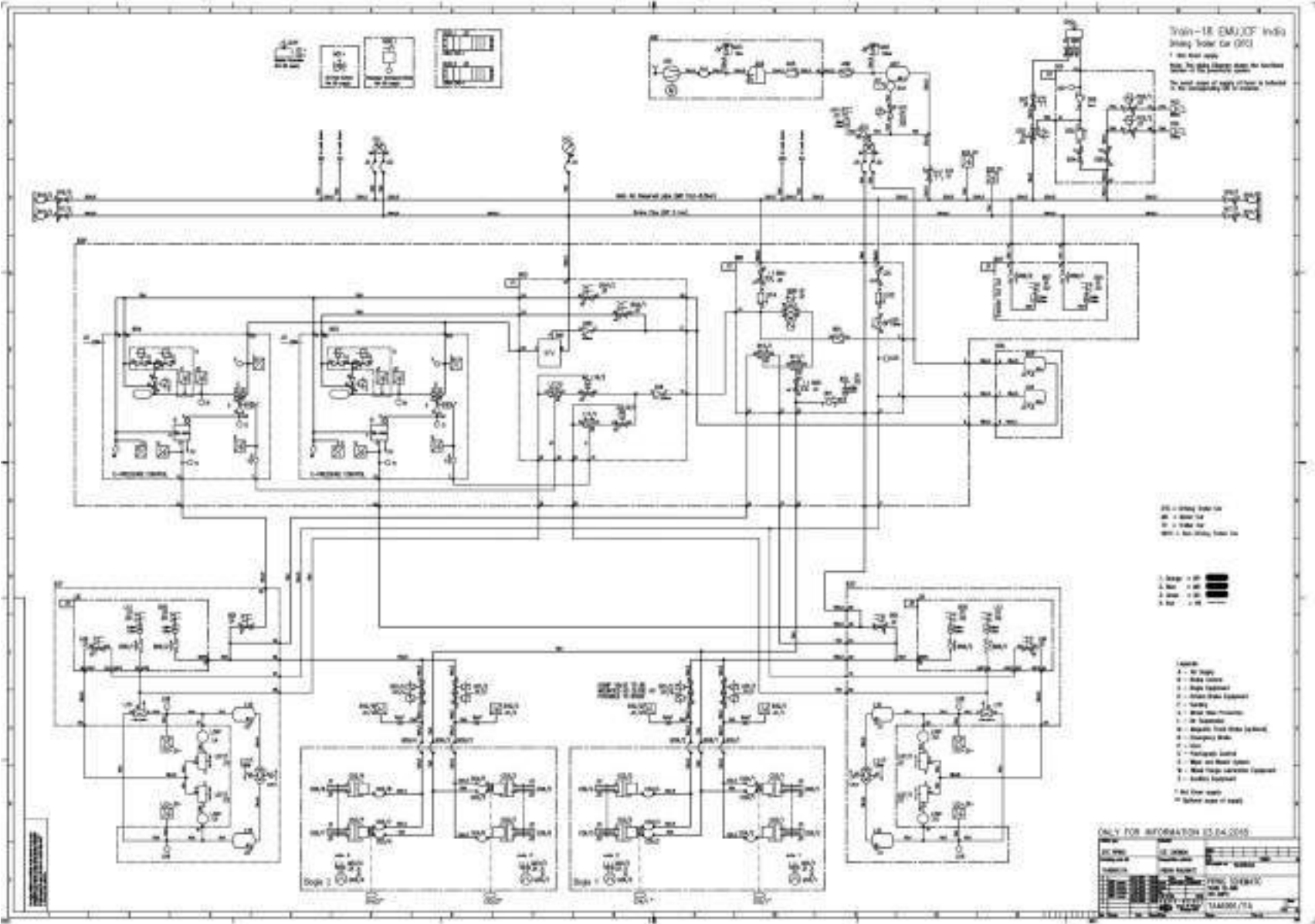
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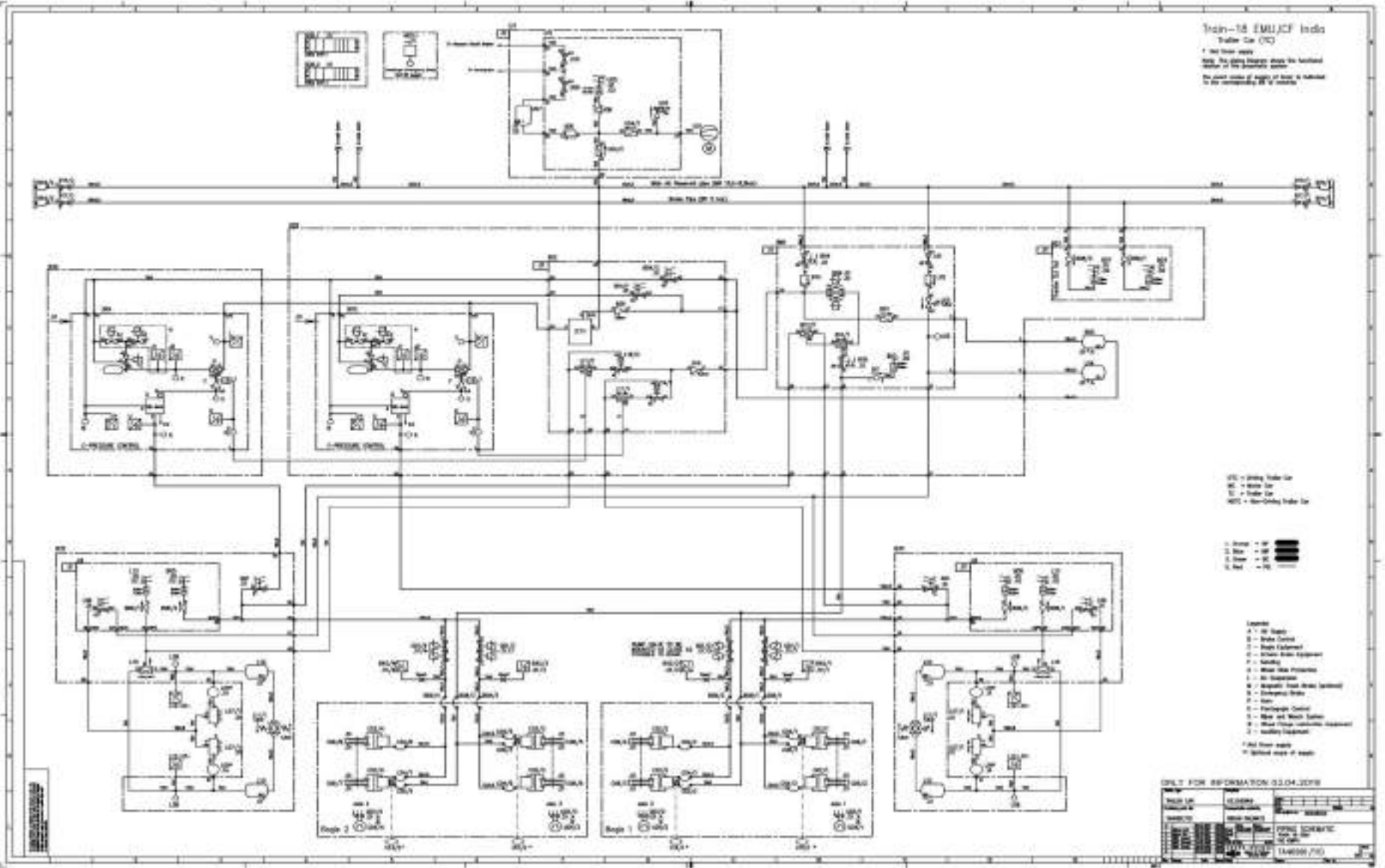
6.3 Braking System

Designation	Drawing
Piping Schematic DTC	TA46991/11A
Piping Schematic MC	TA46991/11B
Piping Schematic TC	TA46991/11D
Piping Schematic NDTC	TA46991/11E





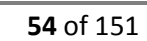


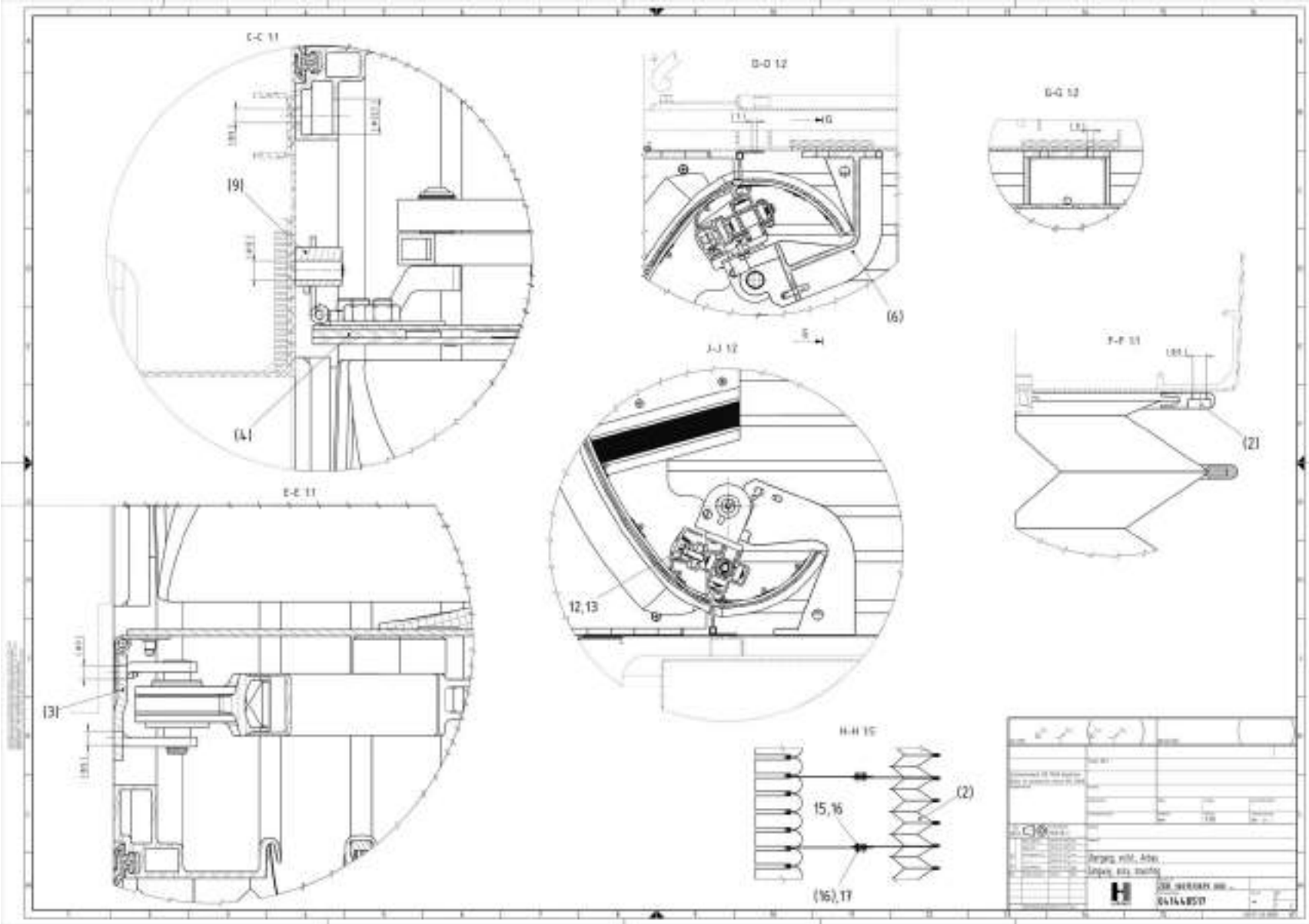


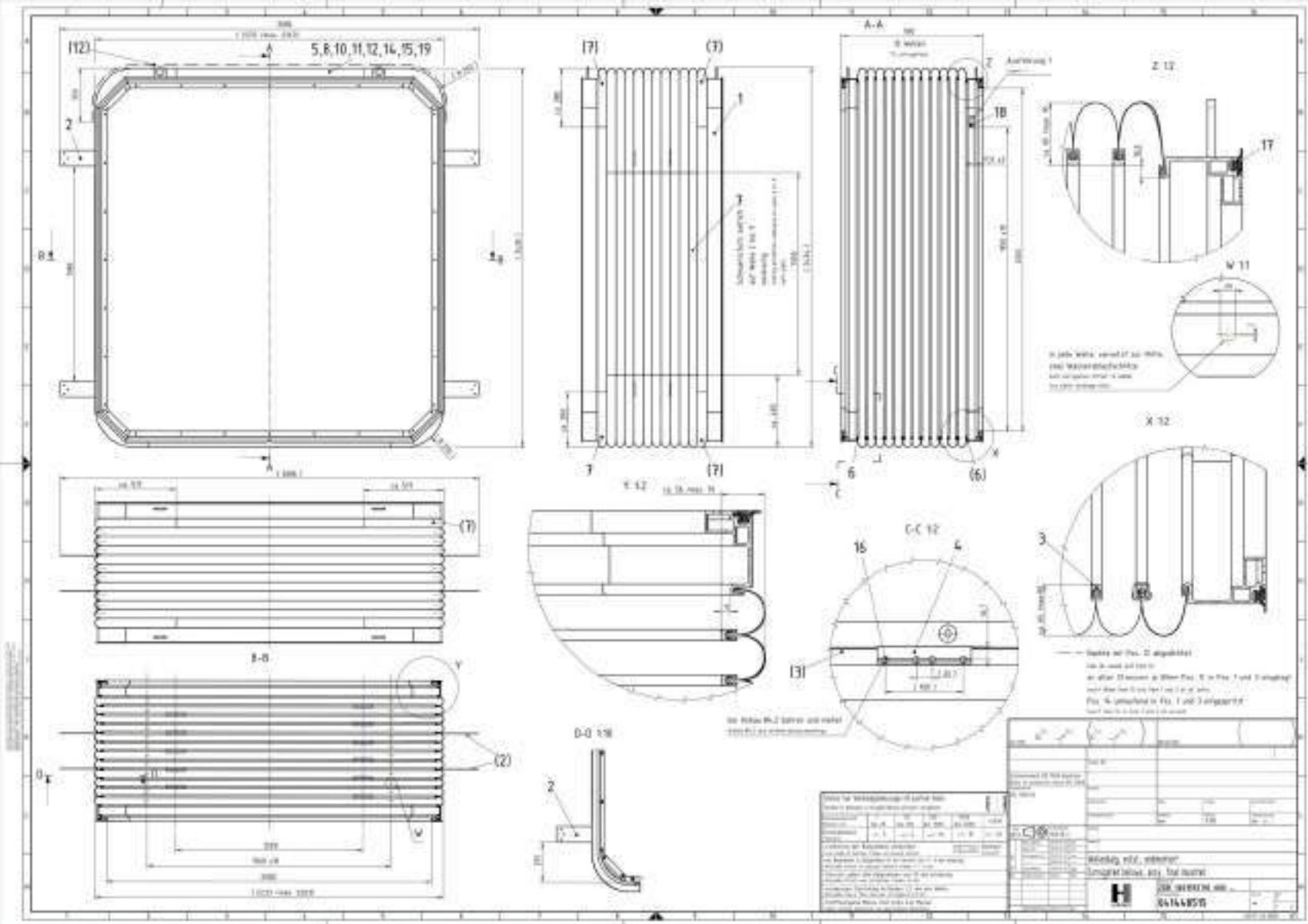
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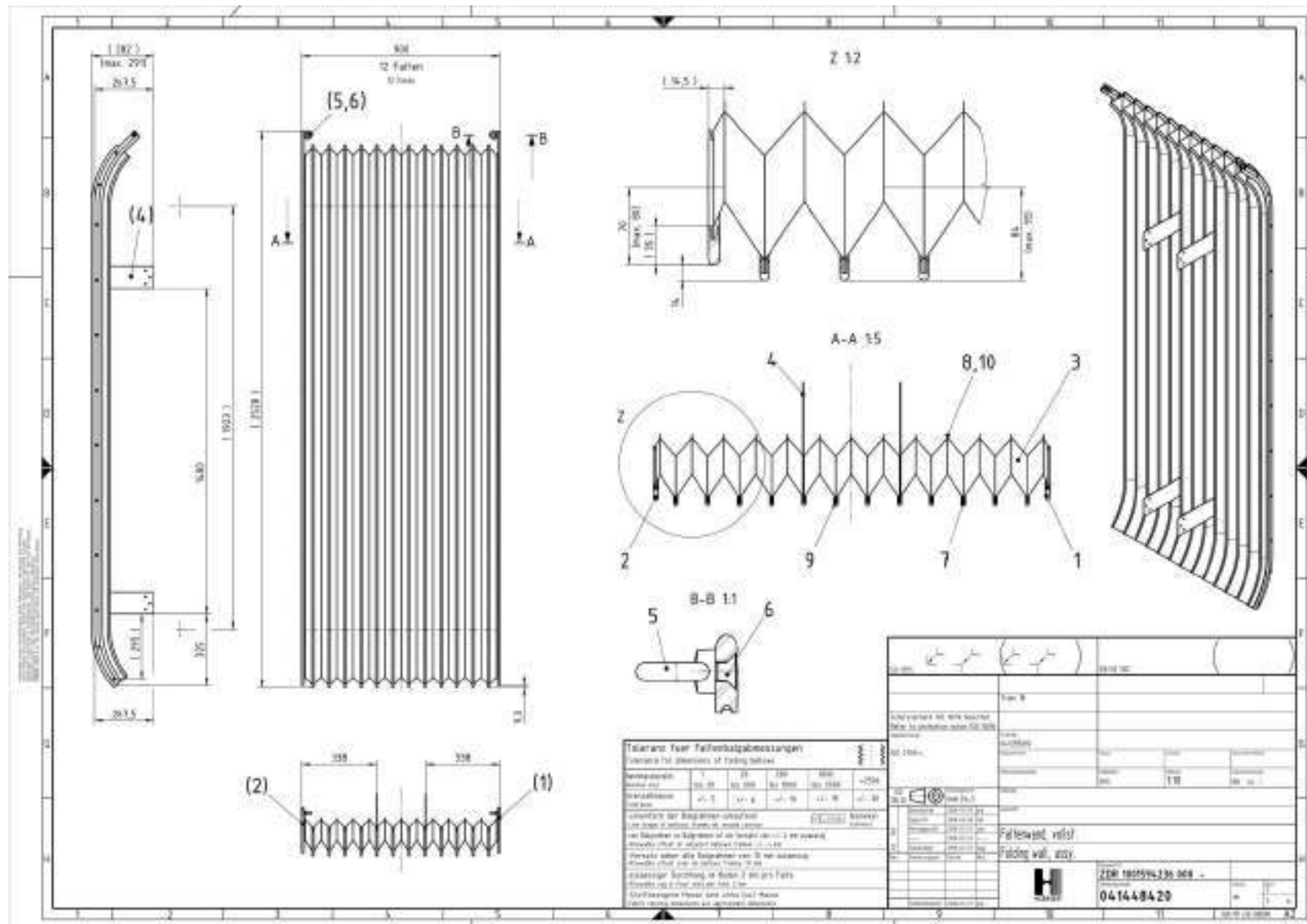
6.4 Gangway

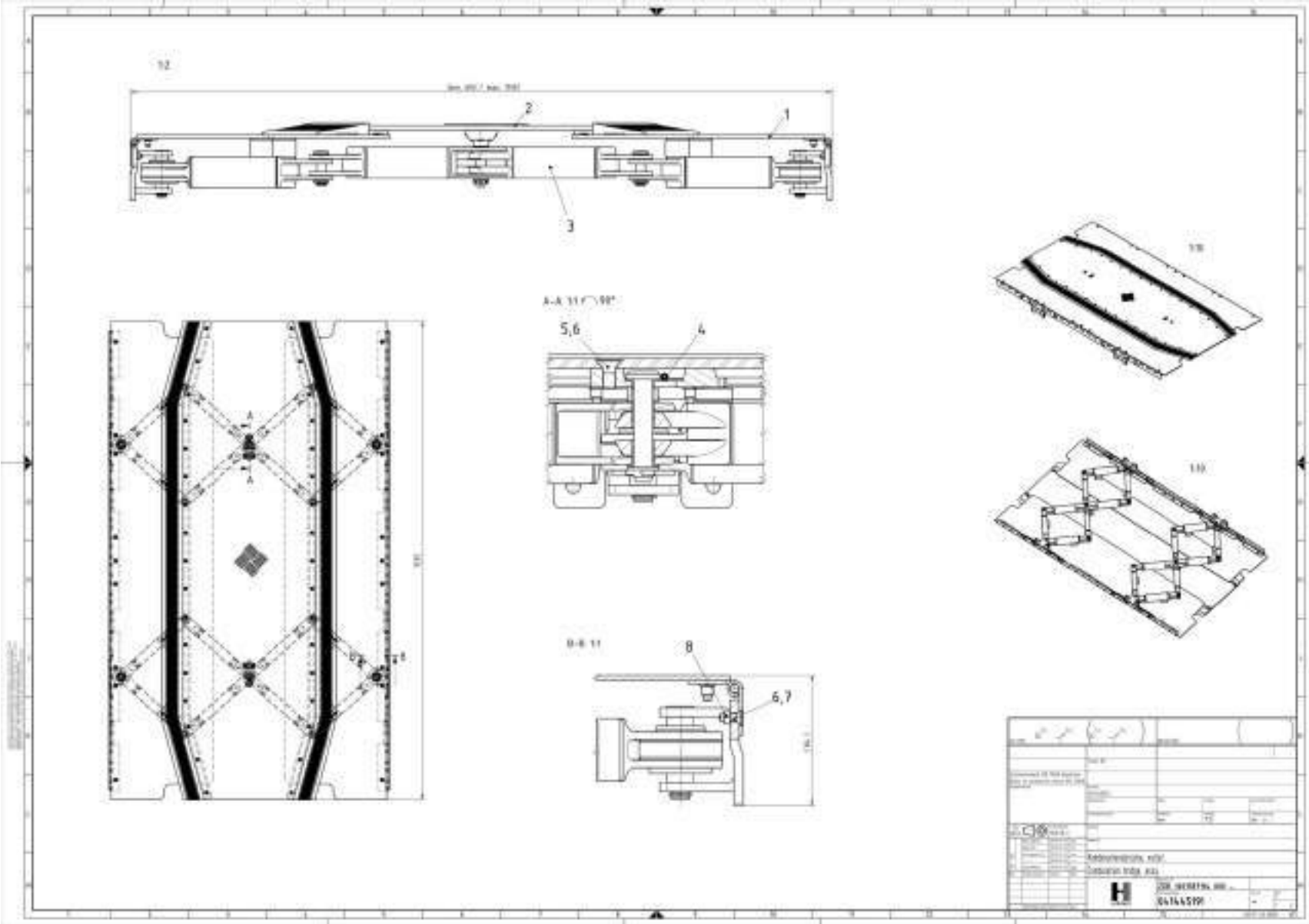
Designation	Drawing
Gangway Assy. Mounting (SH-1)	041448517
Gangway Assy. Mounting (SH-2)	041448517
Corrugated Bellows assy. final Mounting	041448515
Folding wall assy.	041448420
Combination bridge assy.	041445191
Linking ceiling assy.	041448481
Side wall assy. inner covering	041445174
Guiding body assy. locking side	041448060
Guiding body assy. screw on side	041448066
Covering brush assy.	041448476

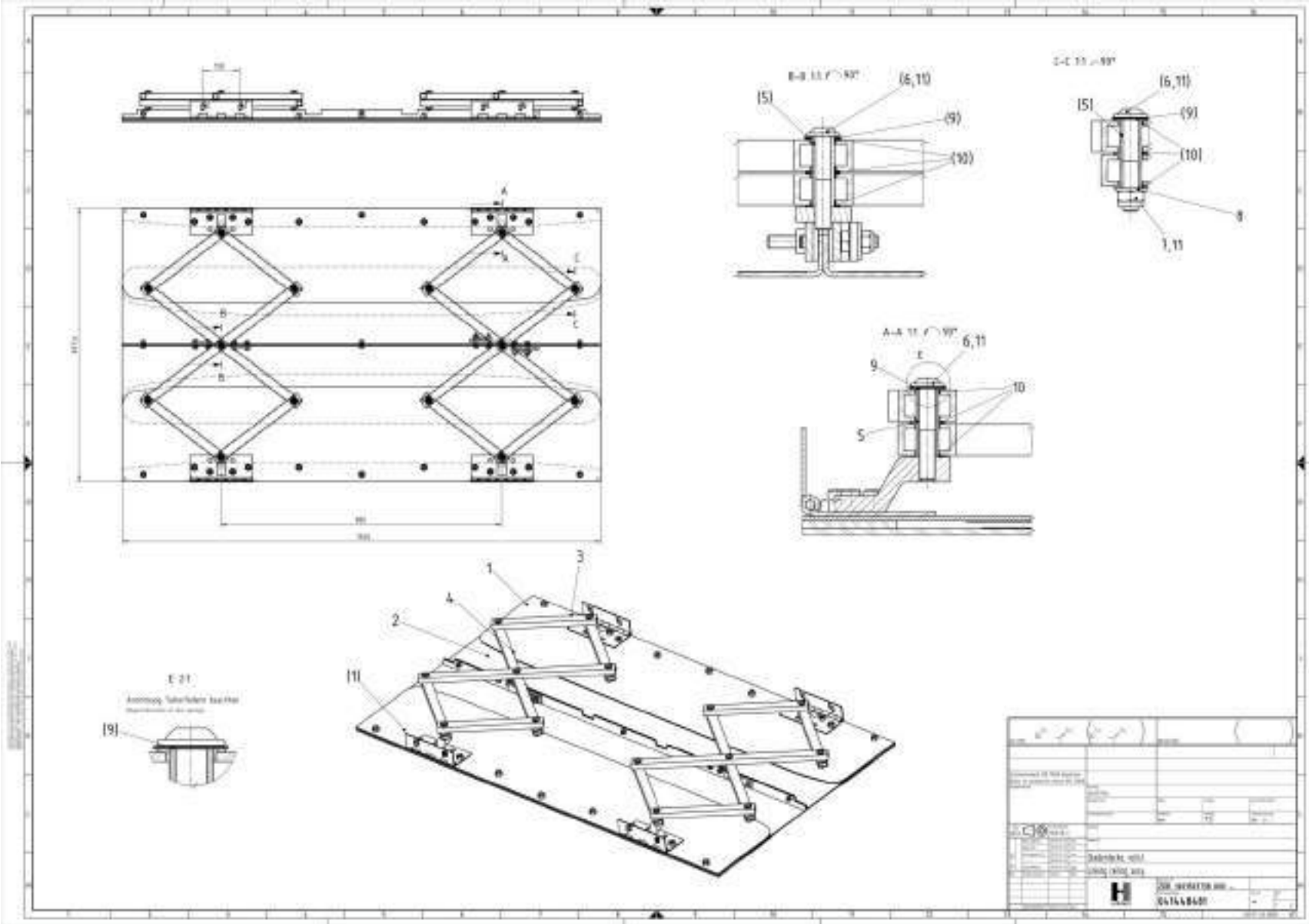


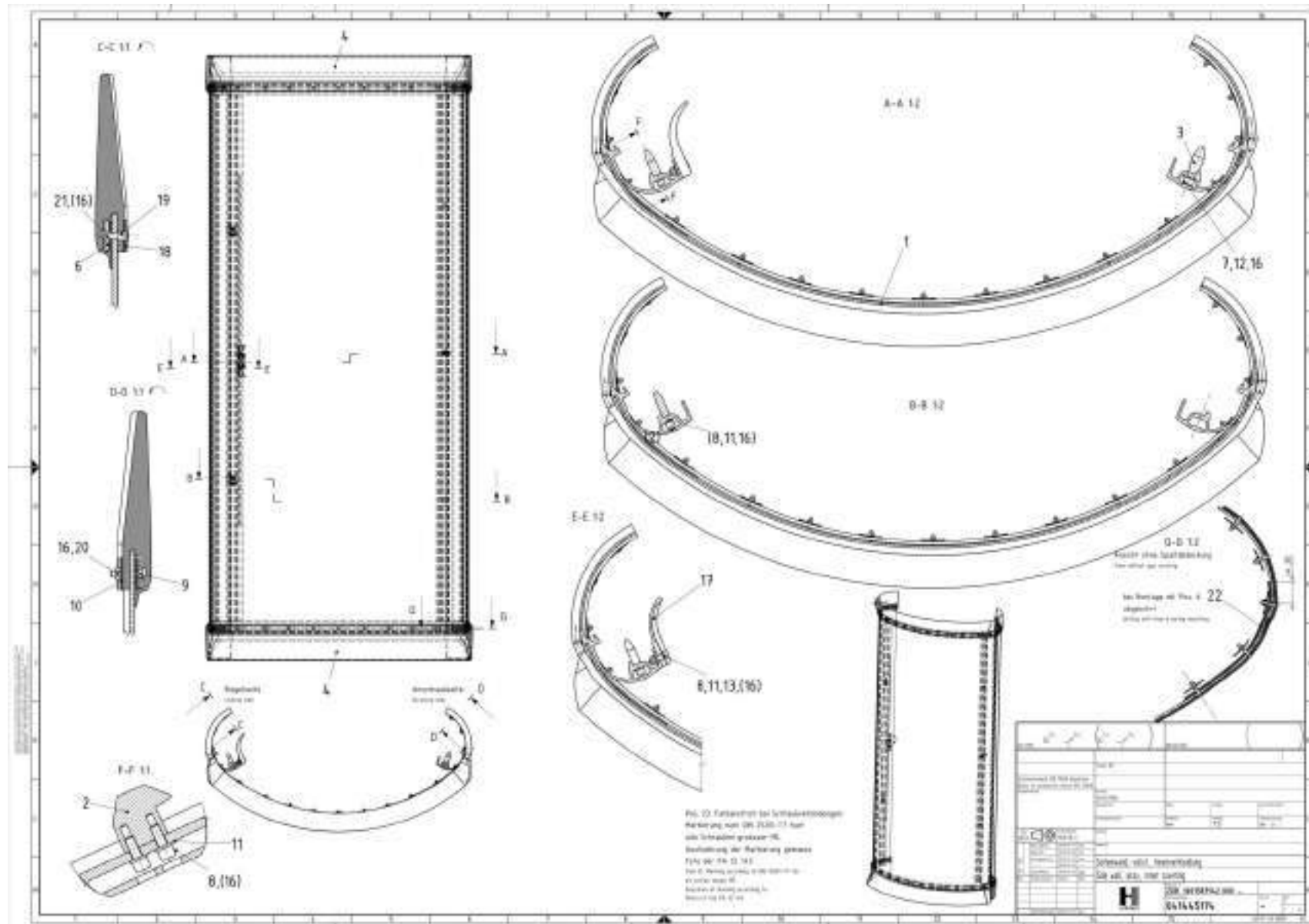


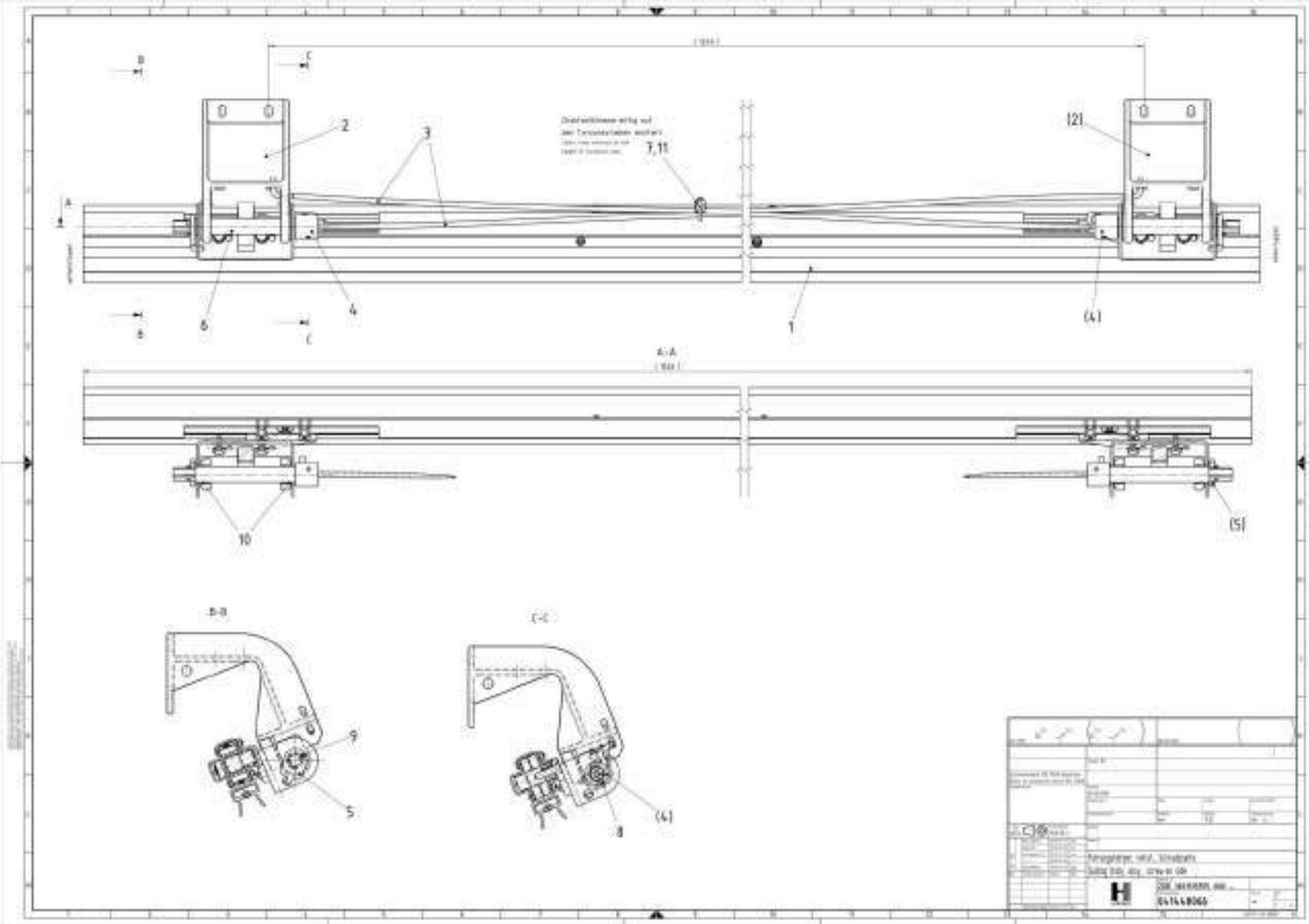


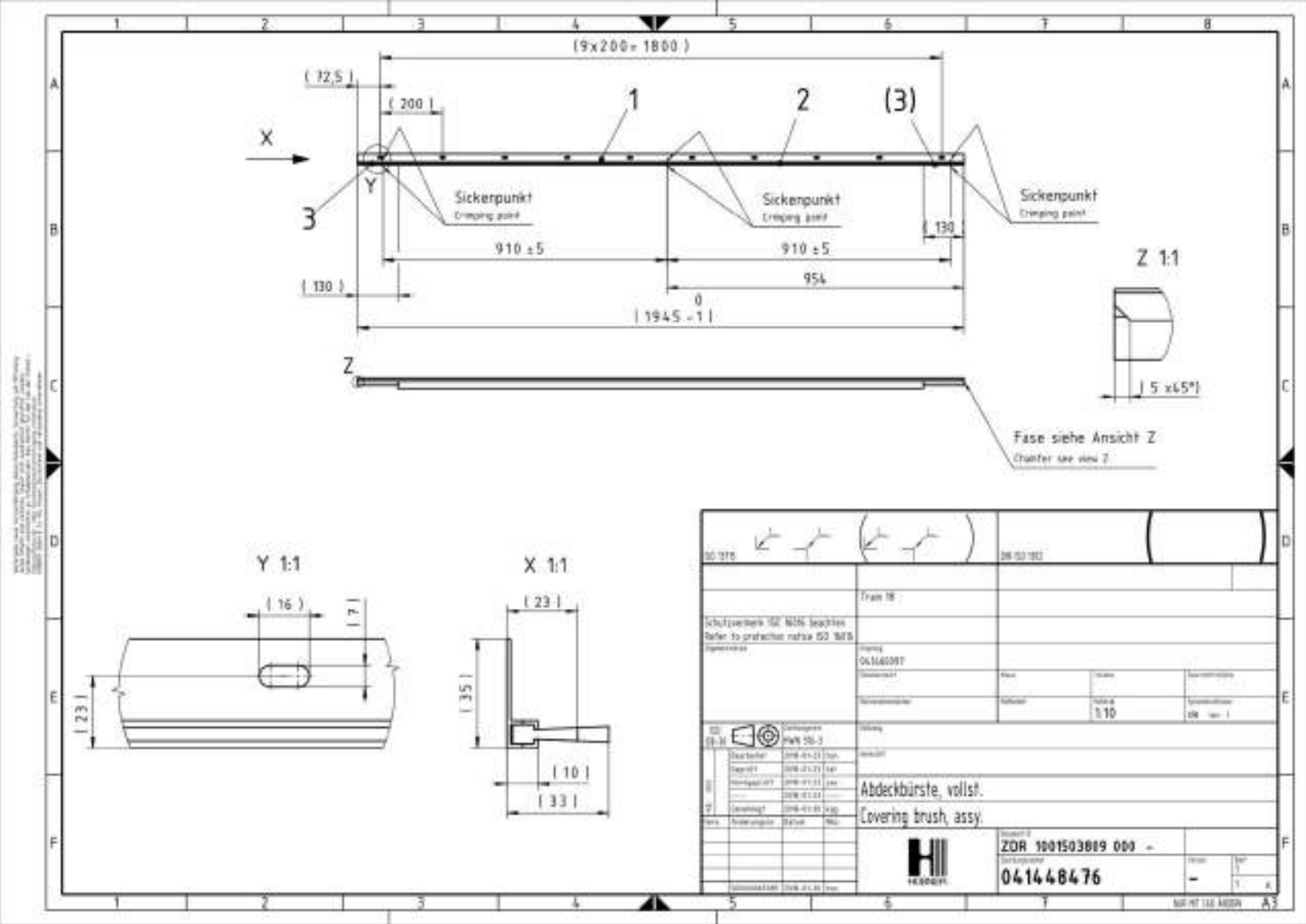








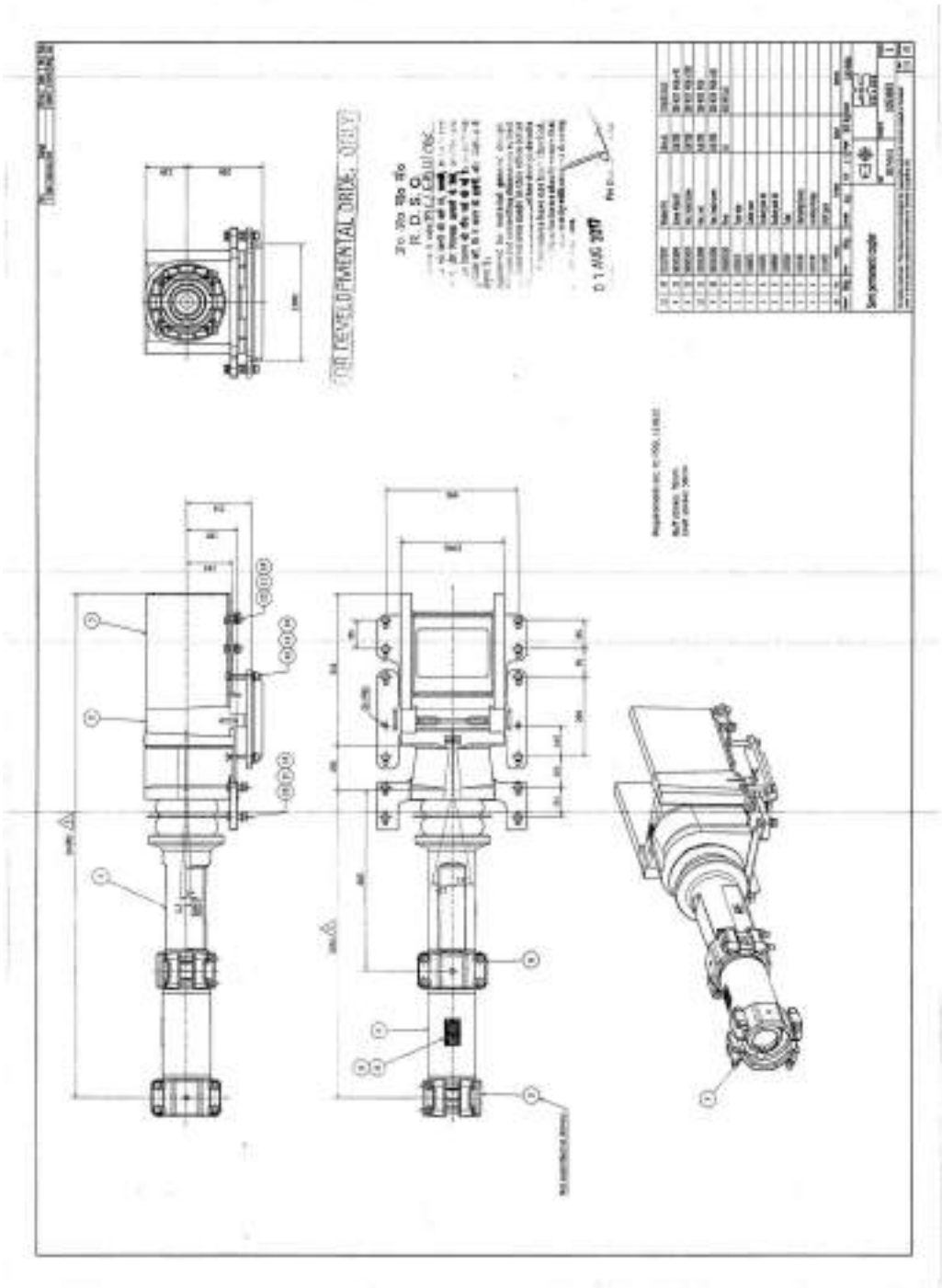


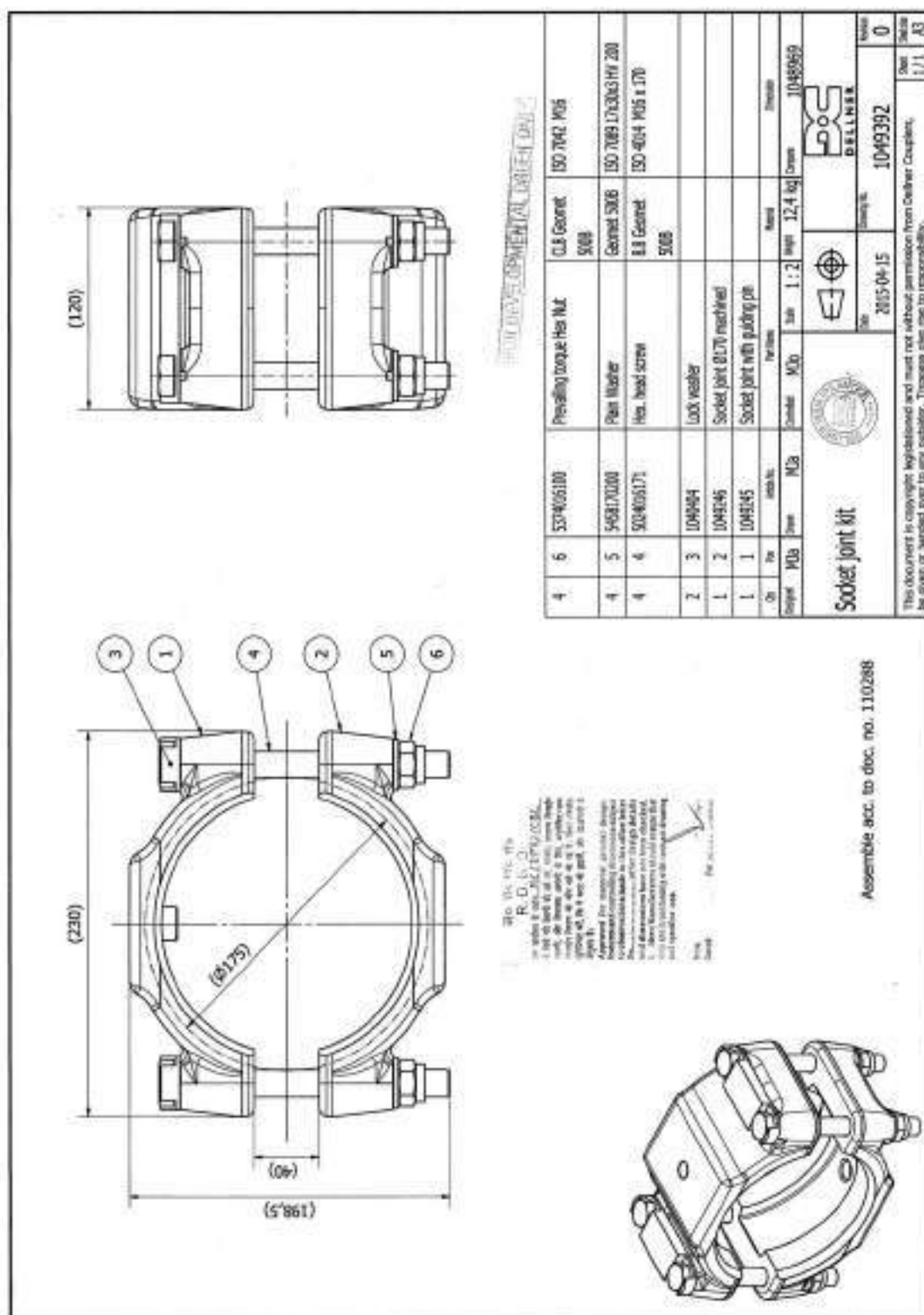


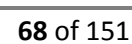
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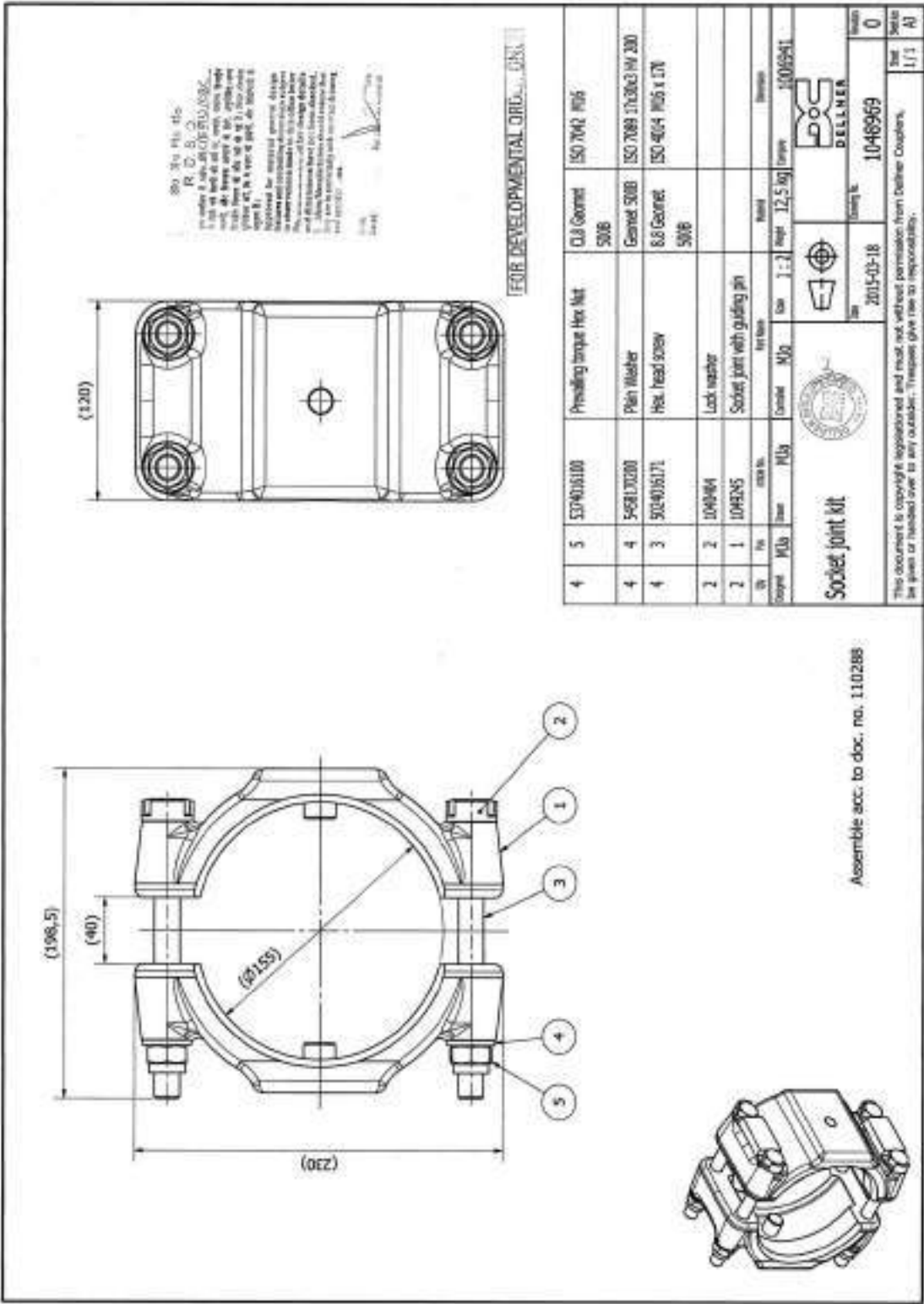
6.5 SPC

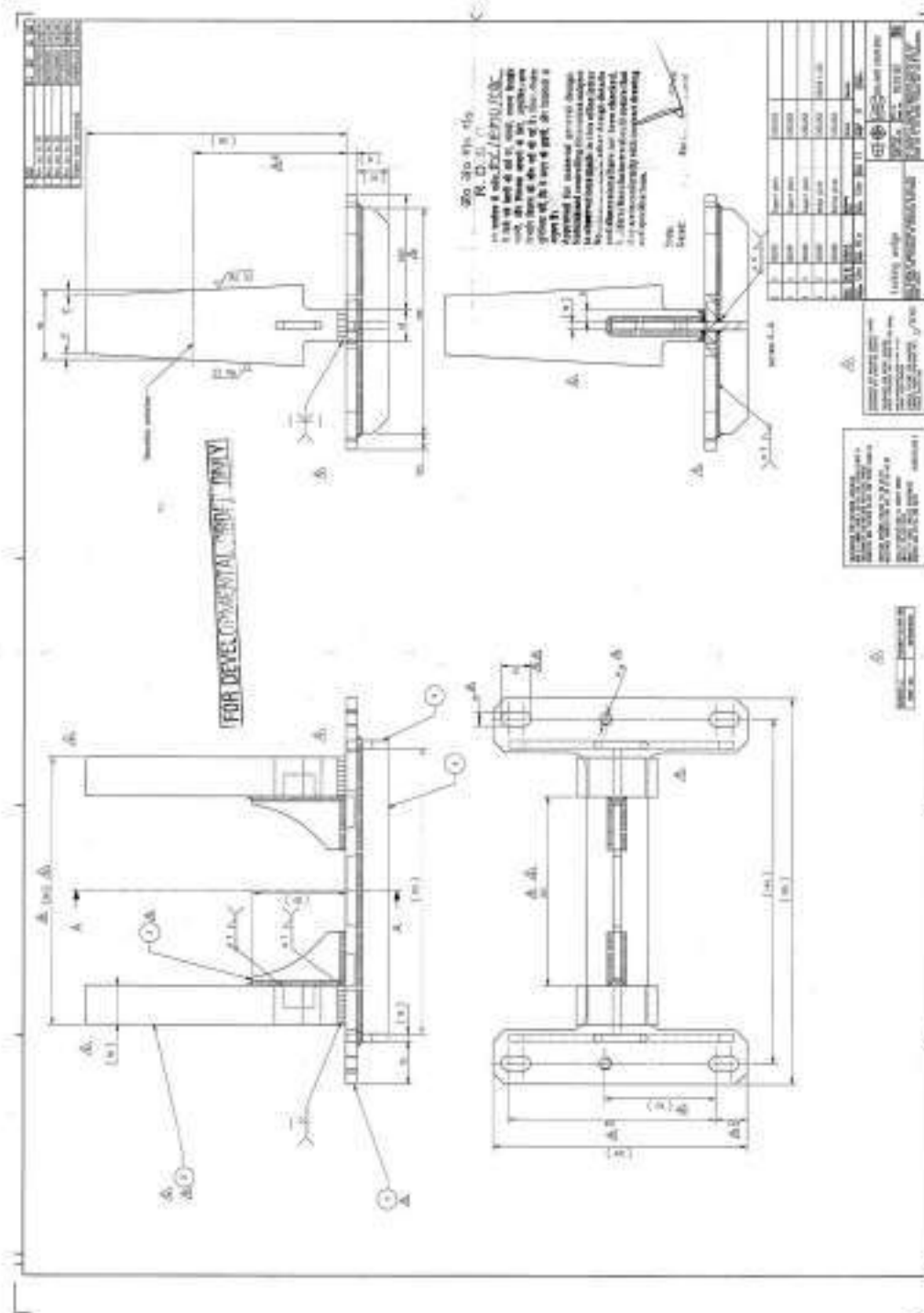
Designation	Drawing
Semi Permanent coupler	1053693
Socket Joint Kit	1048969
Guide Cone	1048970
Locking Wedge	1020187
Draft Gear	1011453
Tube	1055509
Socket Joint Kit	1049392

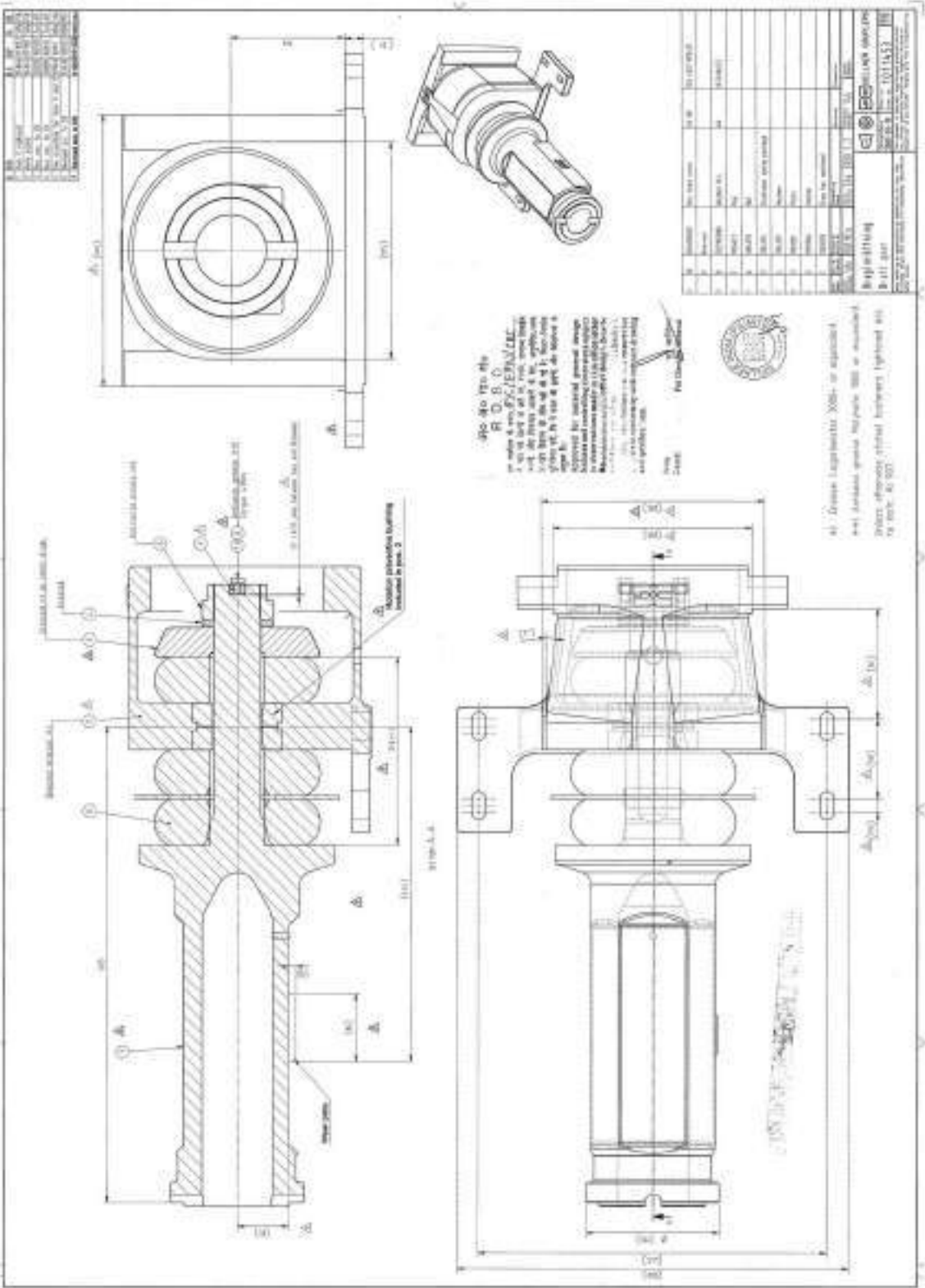


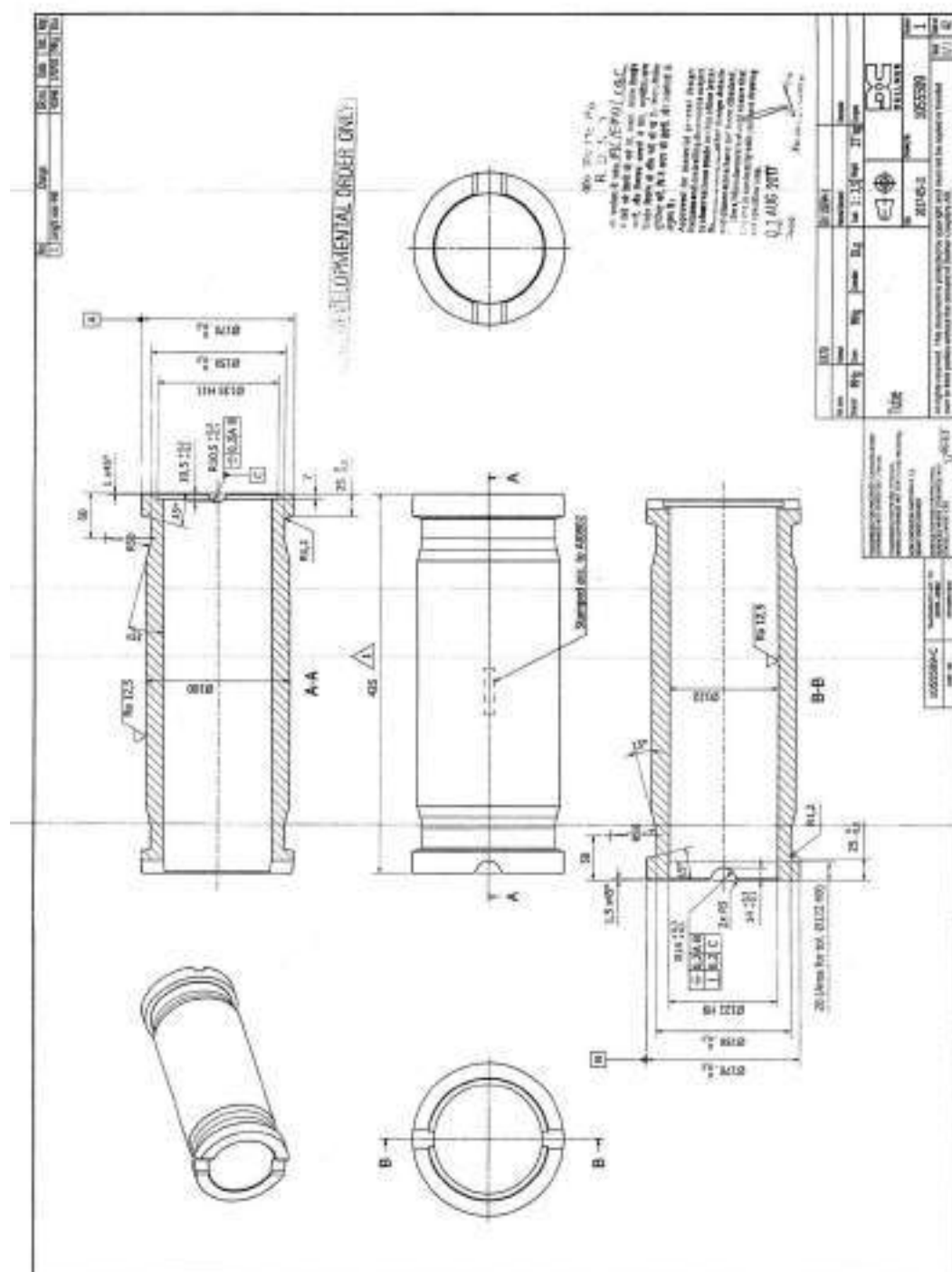








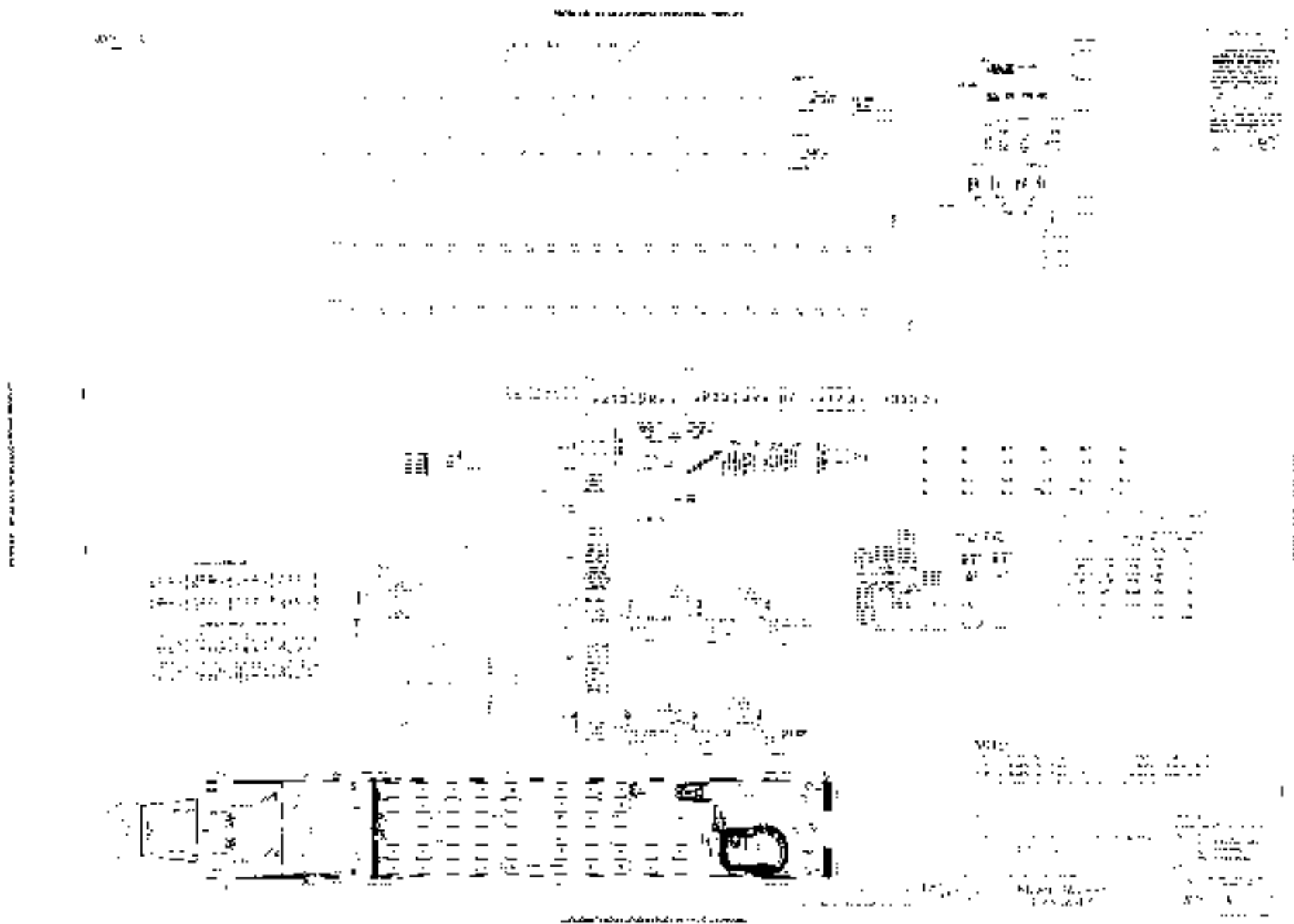


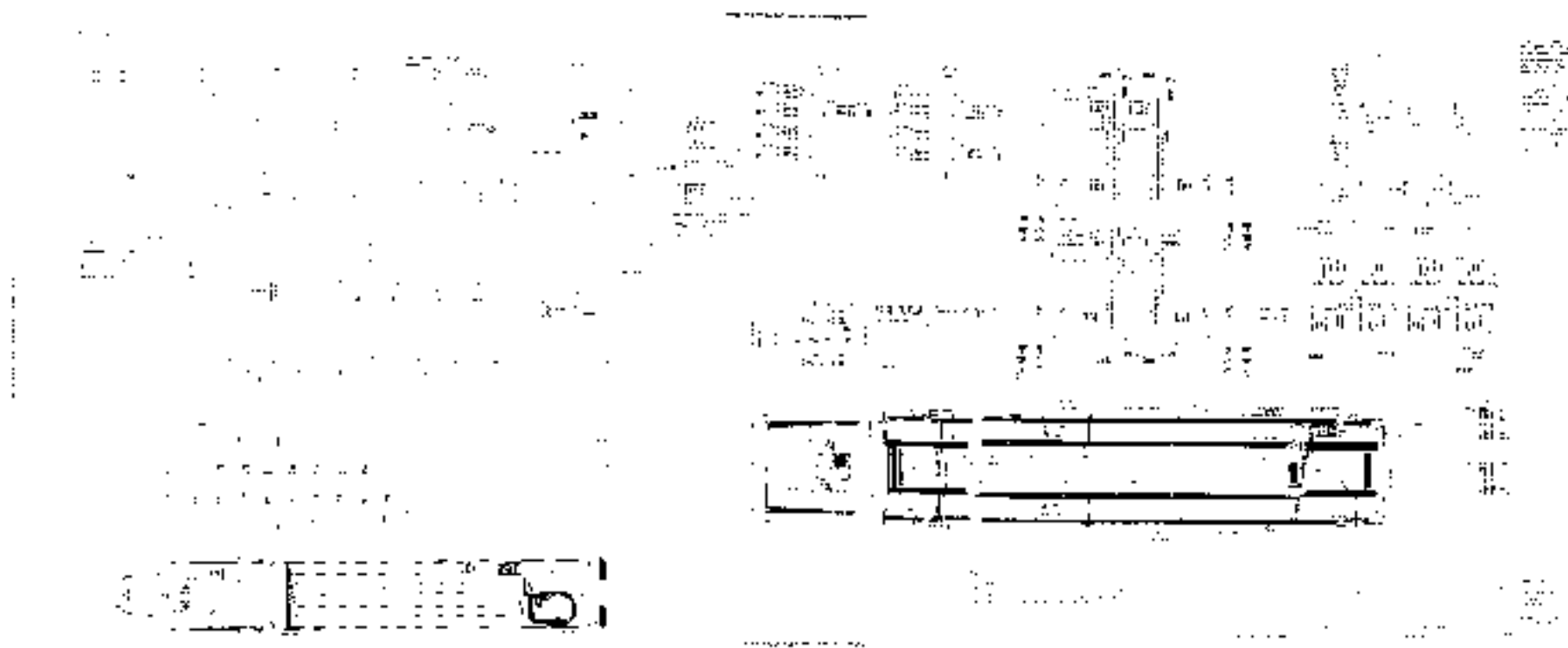


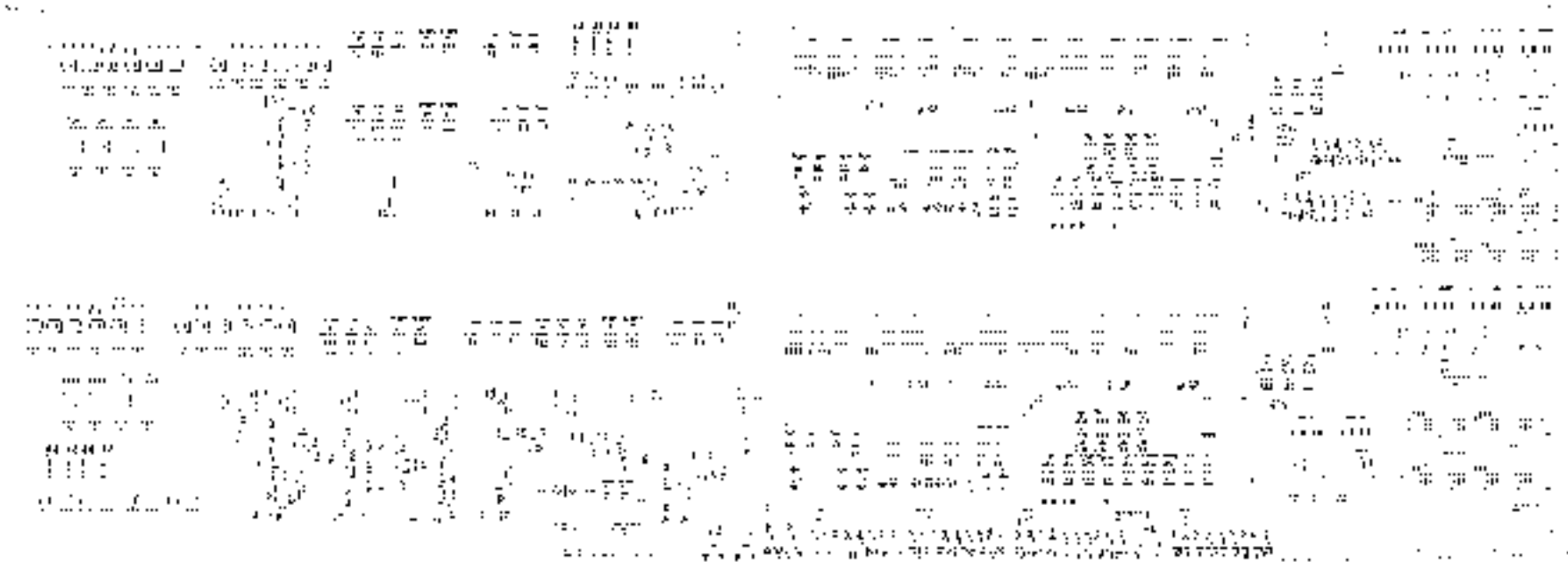
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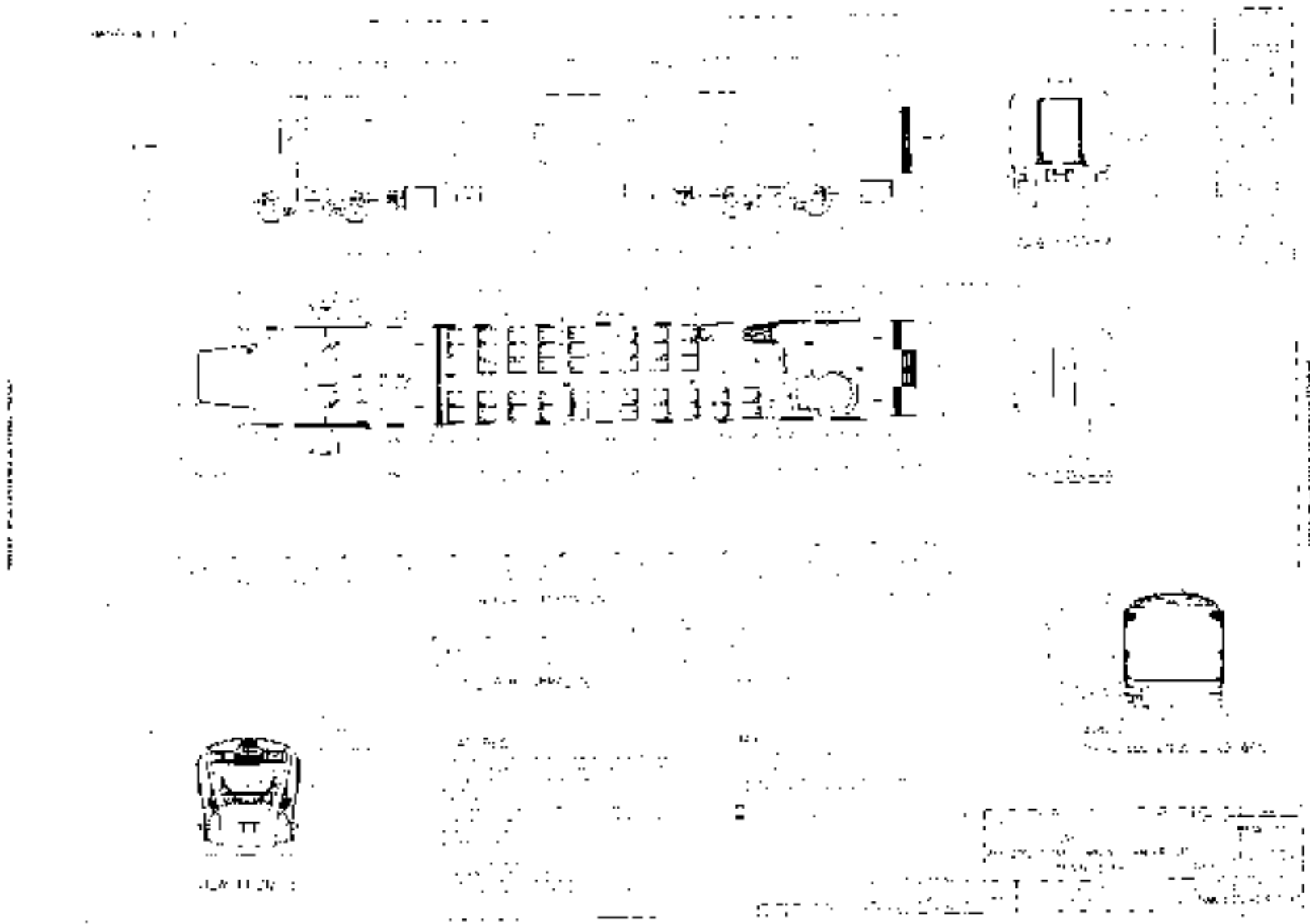
6.6 Electrical Schematic

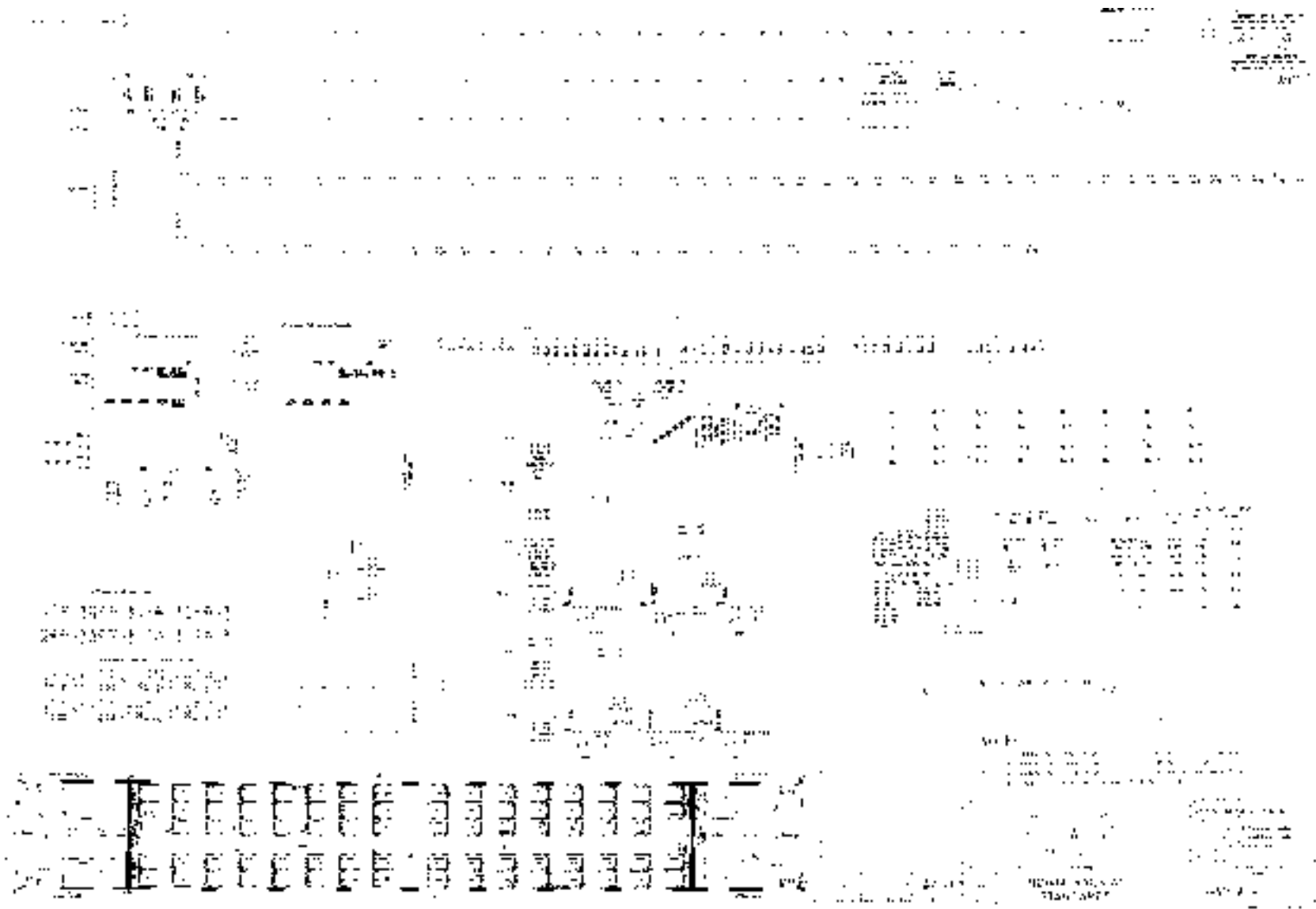
Designation	Drawing
Schematic Diagram for Roof Wiring-DTC	Train18/DTC/AC-7-0-001
Schematic Diagram for Roof Wiring	Train18/DTC/AC-7-0-002
Brake Schematic and Wiring	Train18/DTC/AC-7-0-015
Layout of Air Conditioning Driving Trailer Car	Train18/DTC/AC-9-0-001
Schematic Diagram for Roof Wiring- MC	Train18/MC/AC-7-0-001
Wiring Diagram for Roof MC/AC	Train18/MC/AC-7-0-002
Train Line formation and Pin Assignment Couplers	Train18/MC/AC-7-0-007
Power Schematic Diagram	Train18/MC/AC-7-0-008
Auxiliary Schematic for DTC, MC,TC & NDTC	Train18/MC/AC-7-0-011
Door Schematic	Train18/MC/AC-7-0-012
Brake Schematic & Wiring	Train18/MC/AC-7-0-013
Schematic & Wiring for PIS	Train18/MC/AC-7-0-015
ETB, ECN, PCU, EPCU & MCU Wiring	Train18/MC/AC-7-0-018
Battery Control Scheme	Train18/MC/AC-7-0-019
Layout of Air Conditioned Motor Car	Train18/MC/AC-9-0-001
Schematic Diagram for Roof Wiring (MC3/AC)	Train18/MC3/AC-7-0-001
Wiring Diagram for Roof (MC3/AC)	Train18/MC3/AC-7-0-002
Layout of Air Conditioned Motor Car (MC3/AC)	Train18/MC3/AC-9-0-001
Schematic Diagram For roof wiring (NDTC/AC)	Train18/NDTC/AC-7-0-001
Wiring Diagram for Roof NDTC/AC	Train18/NDTC/AC-7-0-002
Layout of Non-Driving Air Conditioned Trailer Car	Train18/NDTC/AC-9-0-001
Schematic Diagram for Roof Wiring (TC/AC)	Train18/TC/AC-7-0-001
Wiring Diagram for Roof (TC/AC)	Train18/TC/AC-7-0-002
Layout of Air Conditioned Trailer Car	Train18/TC/AC-9-0-001

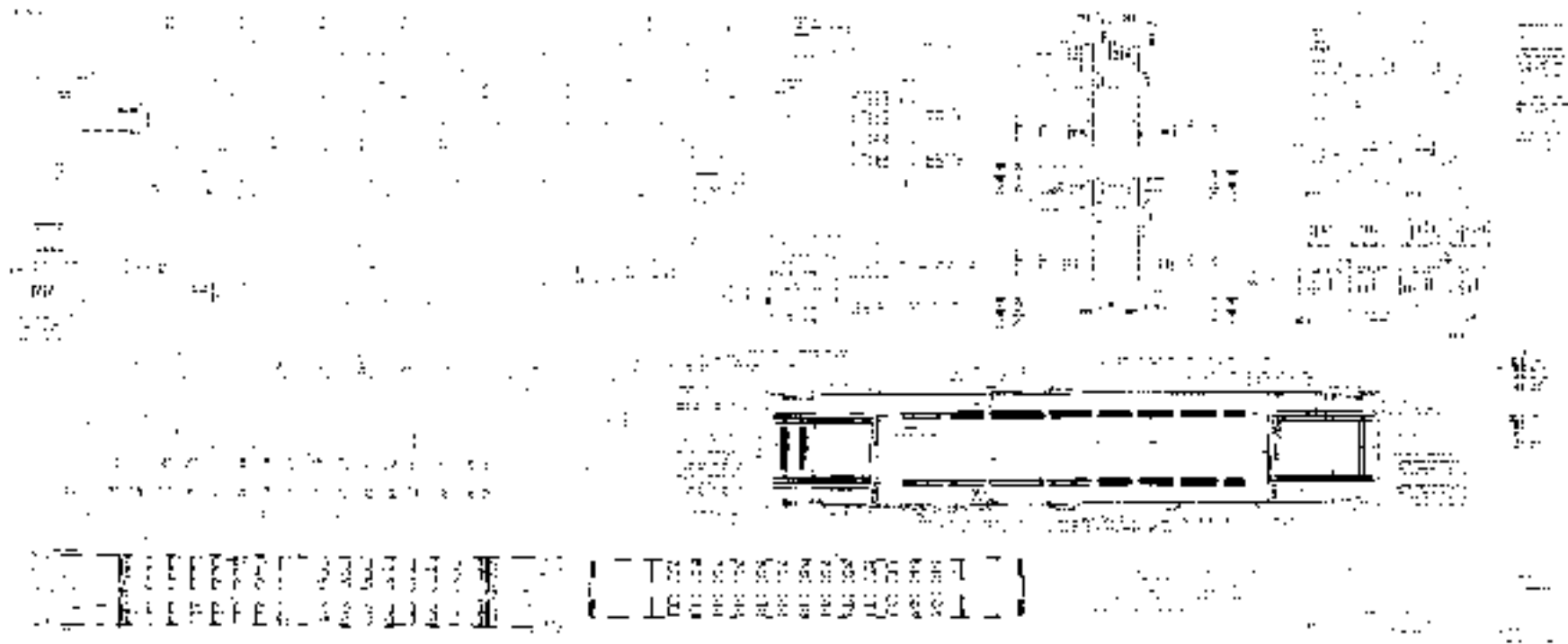


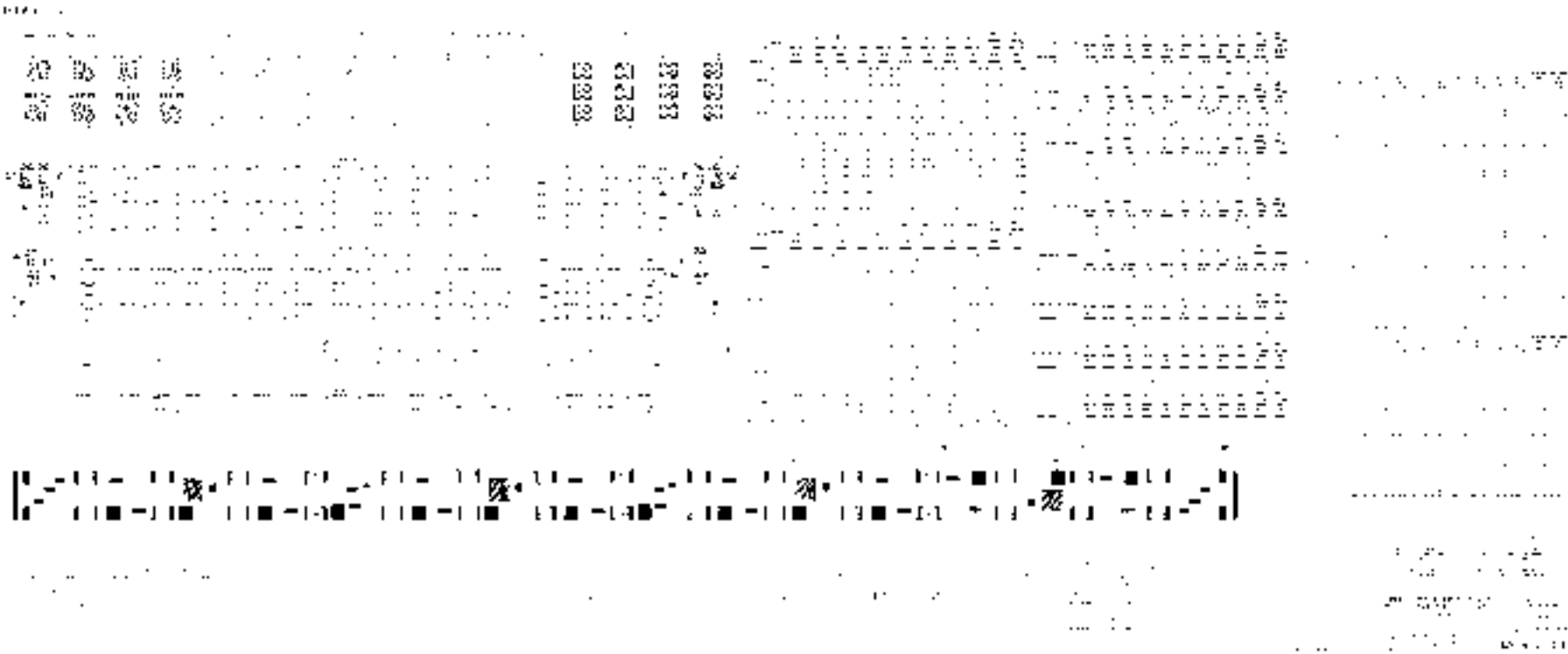


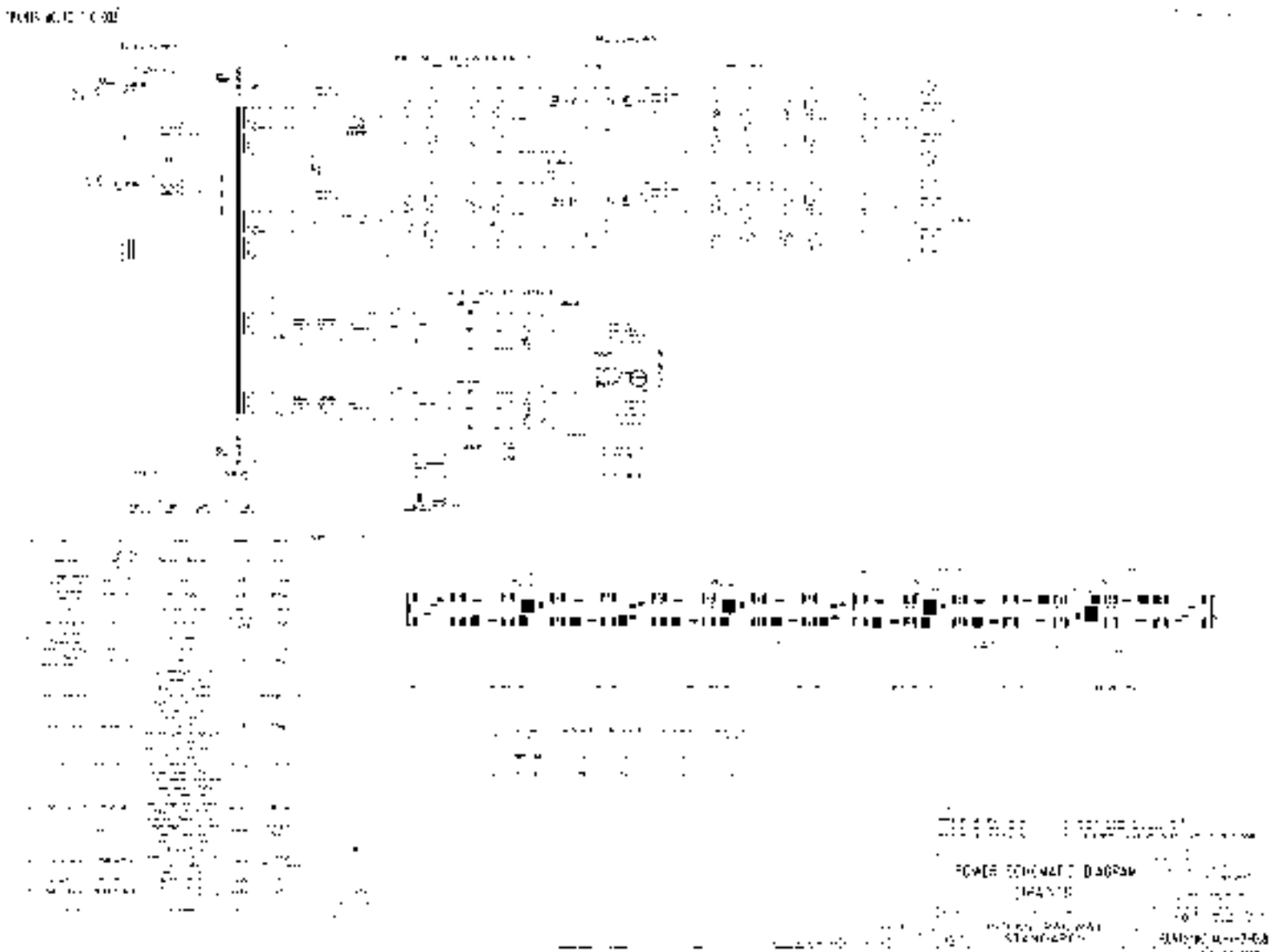


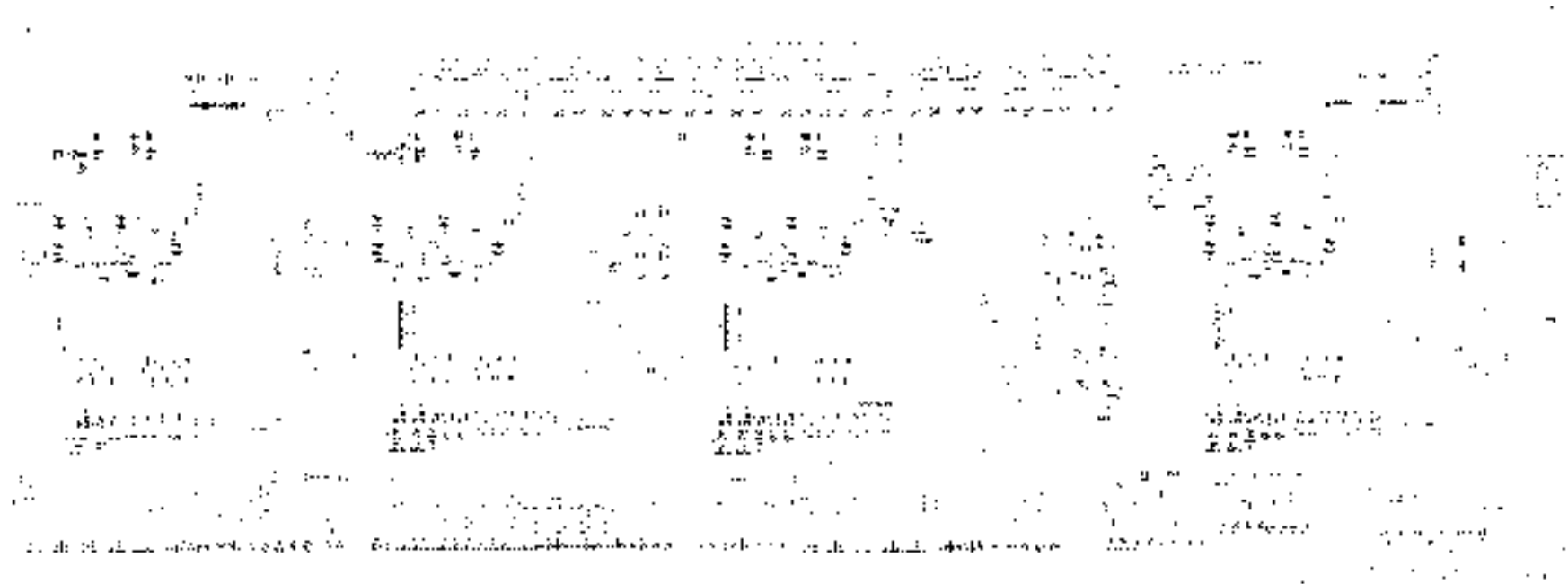


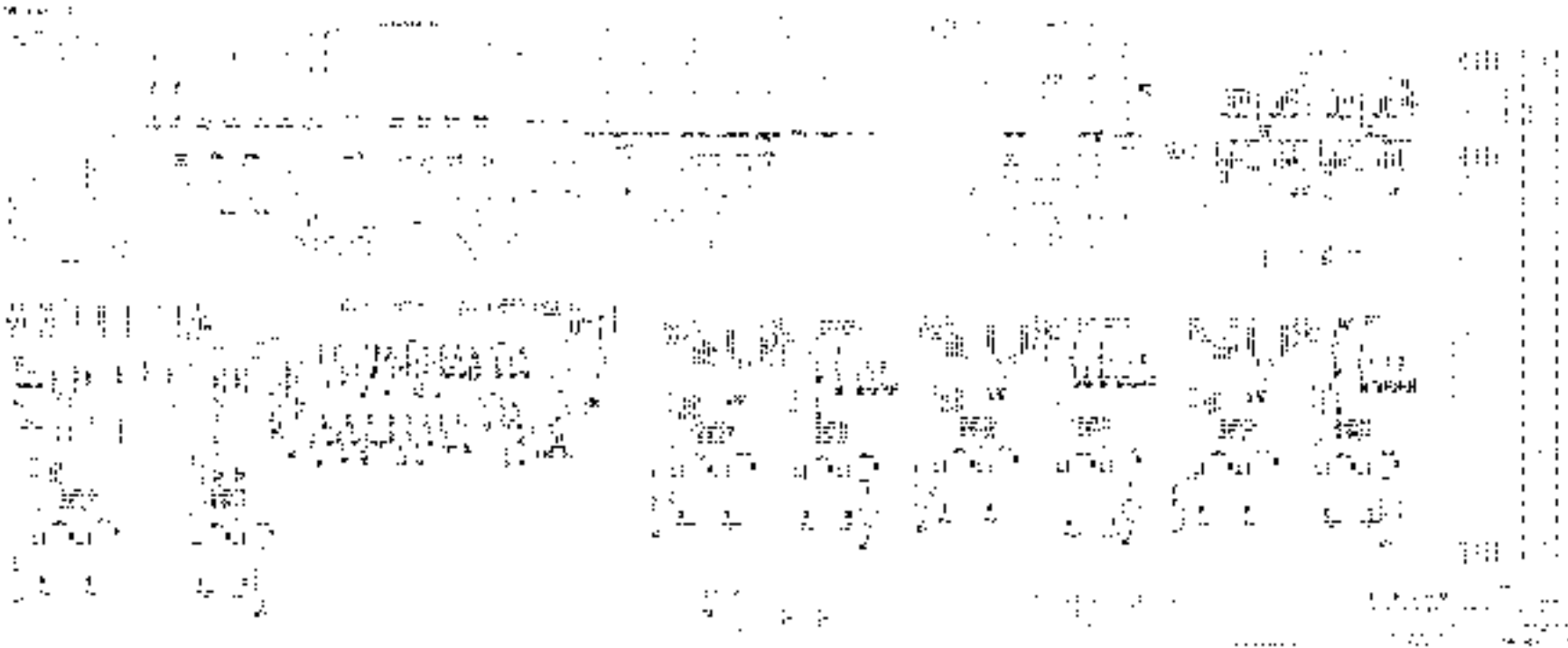




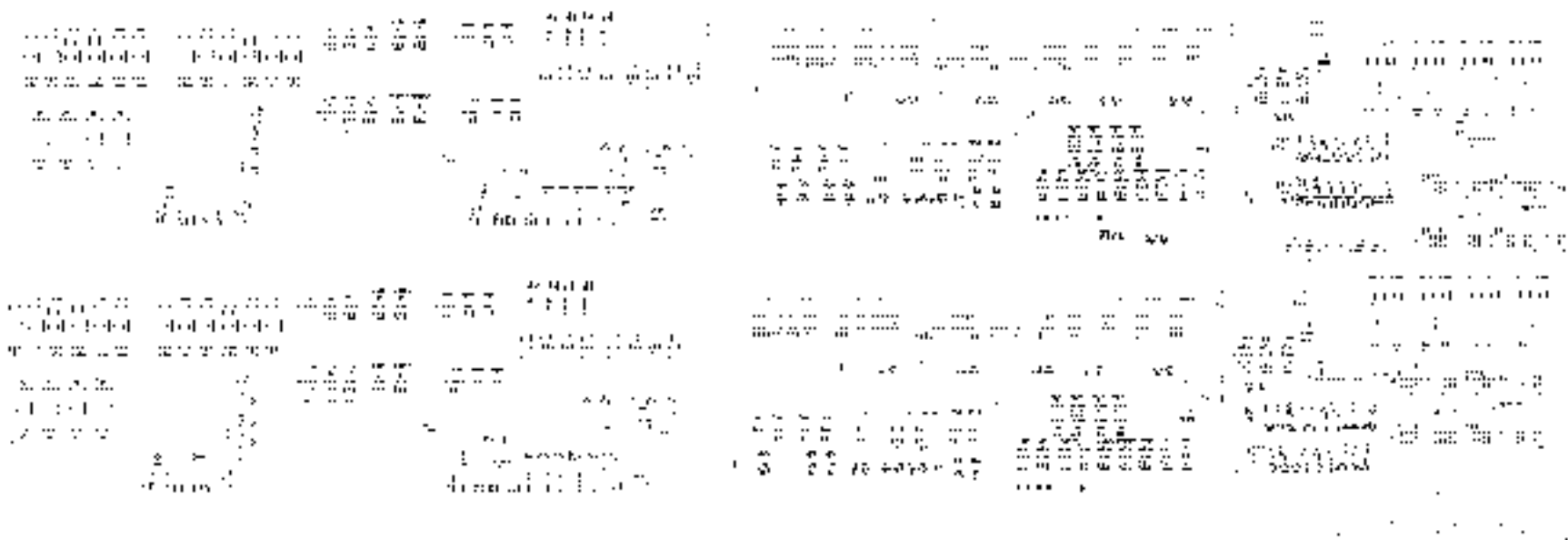




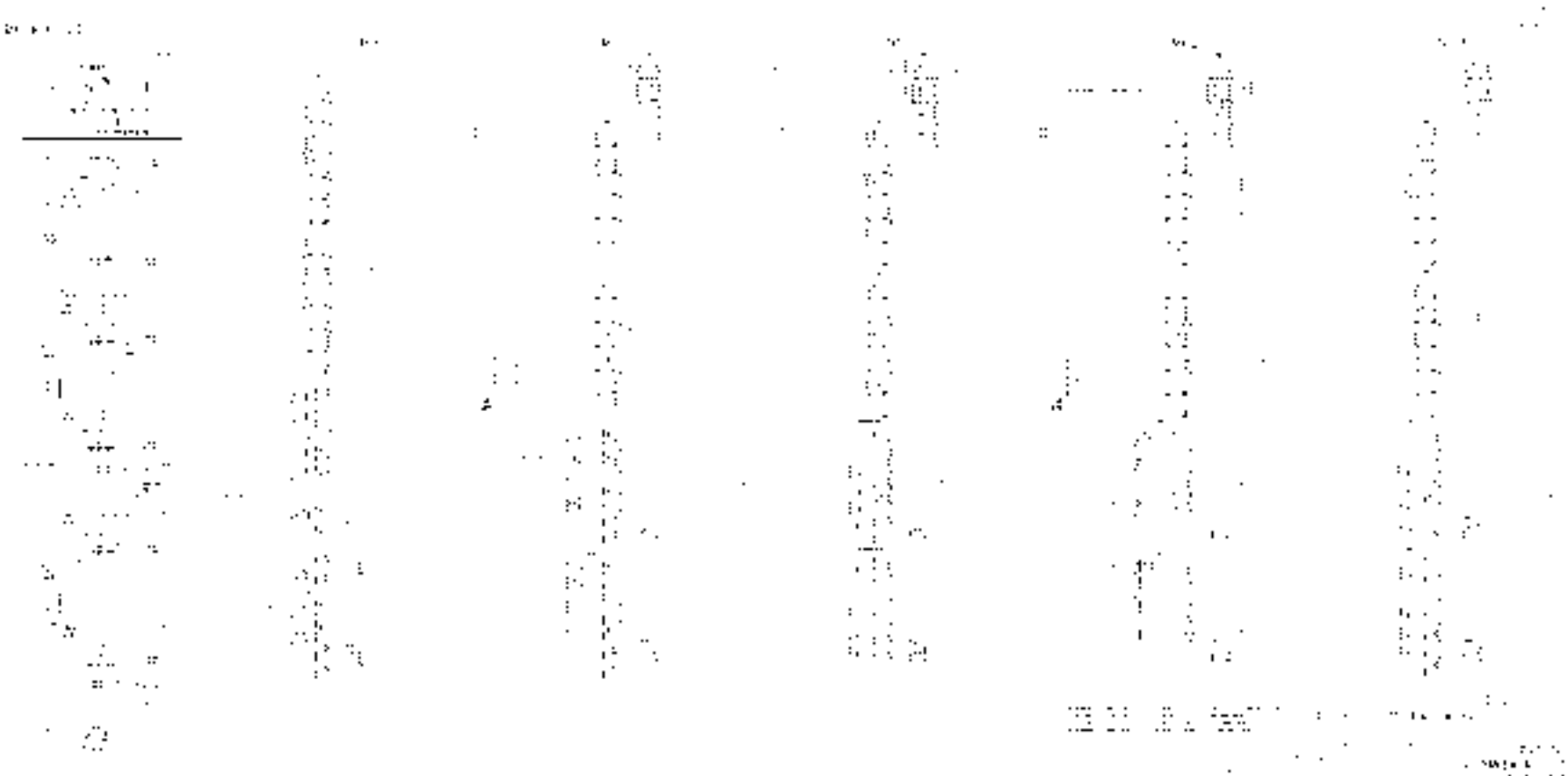


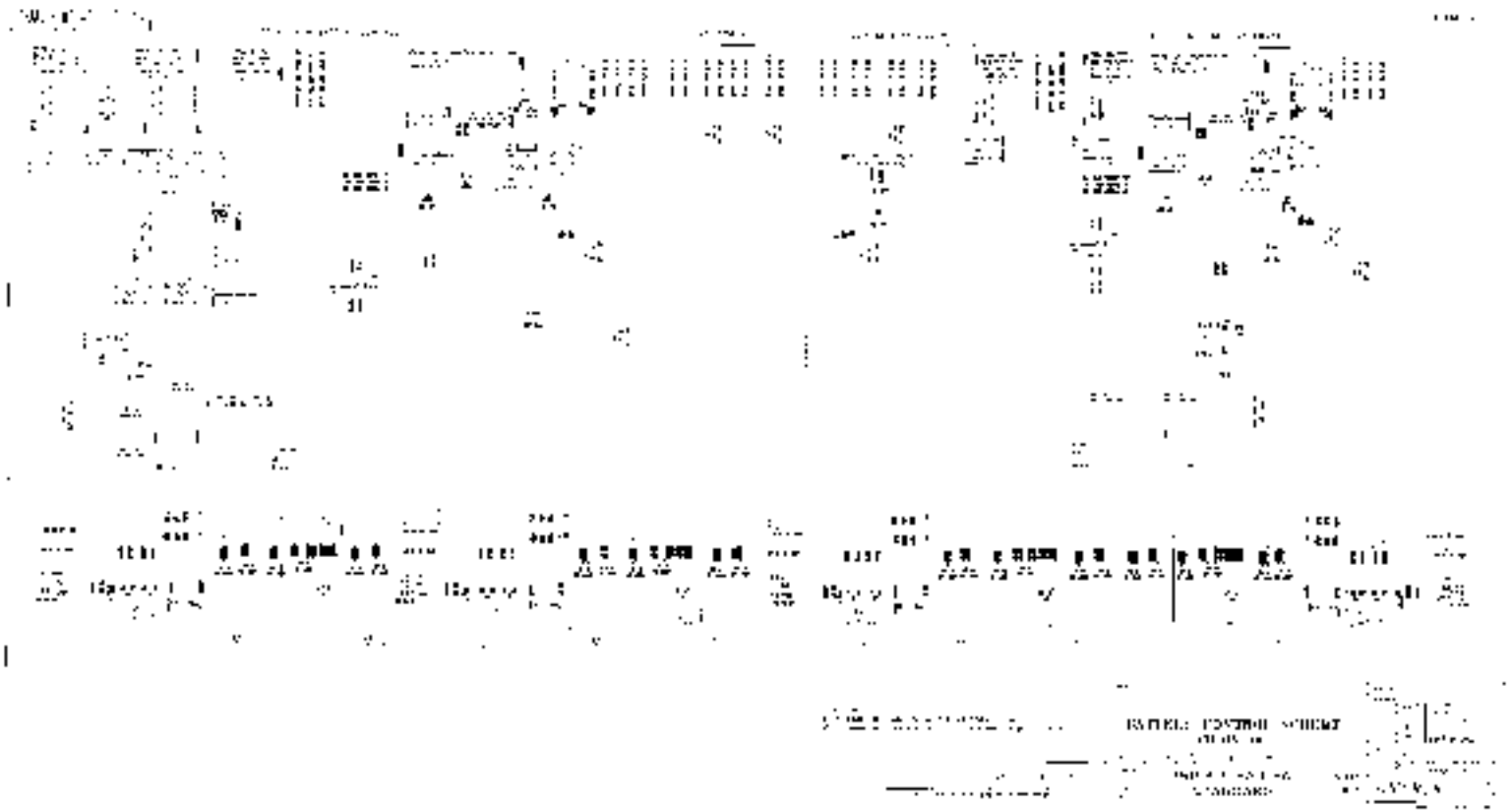


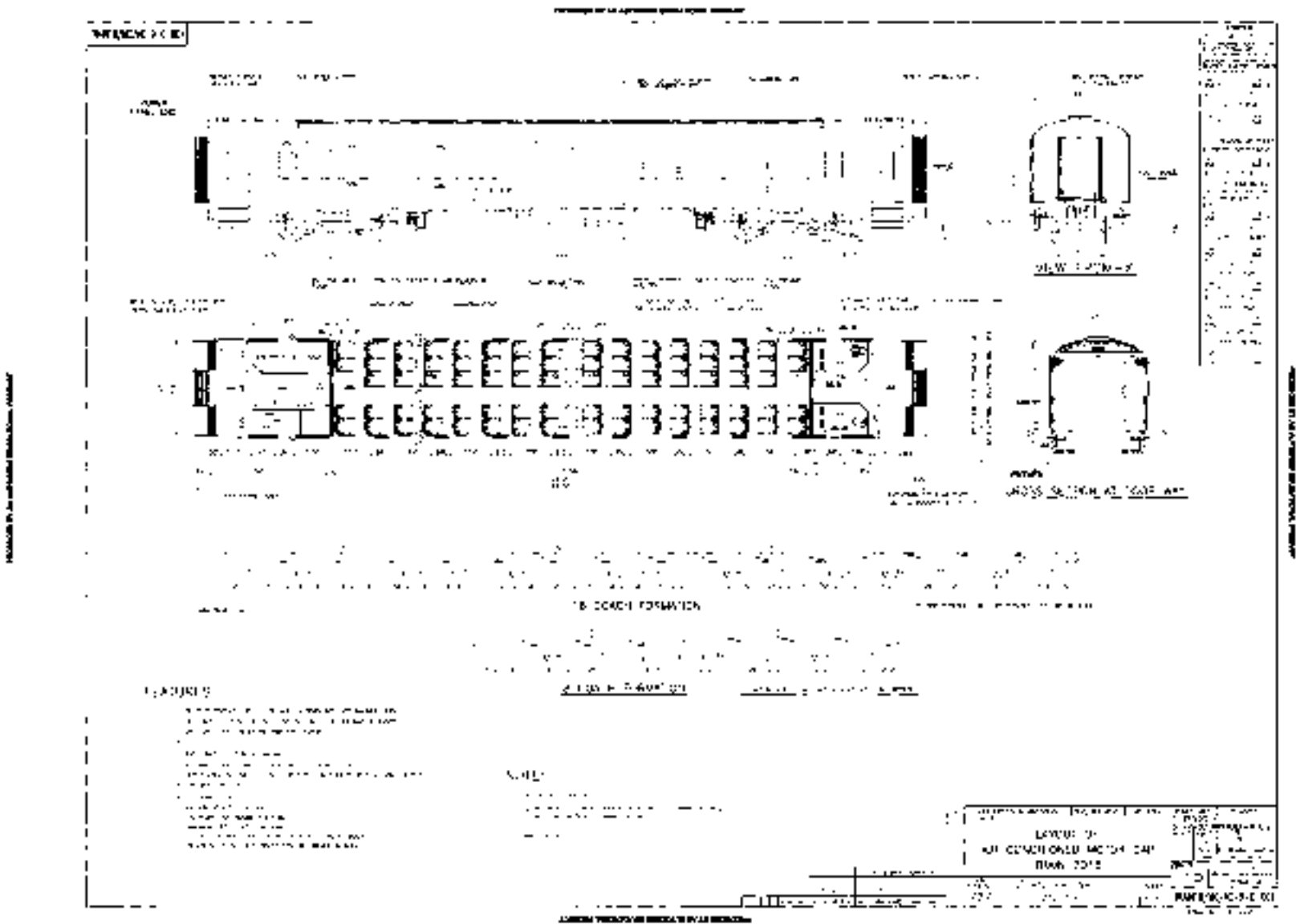
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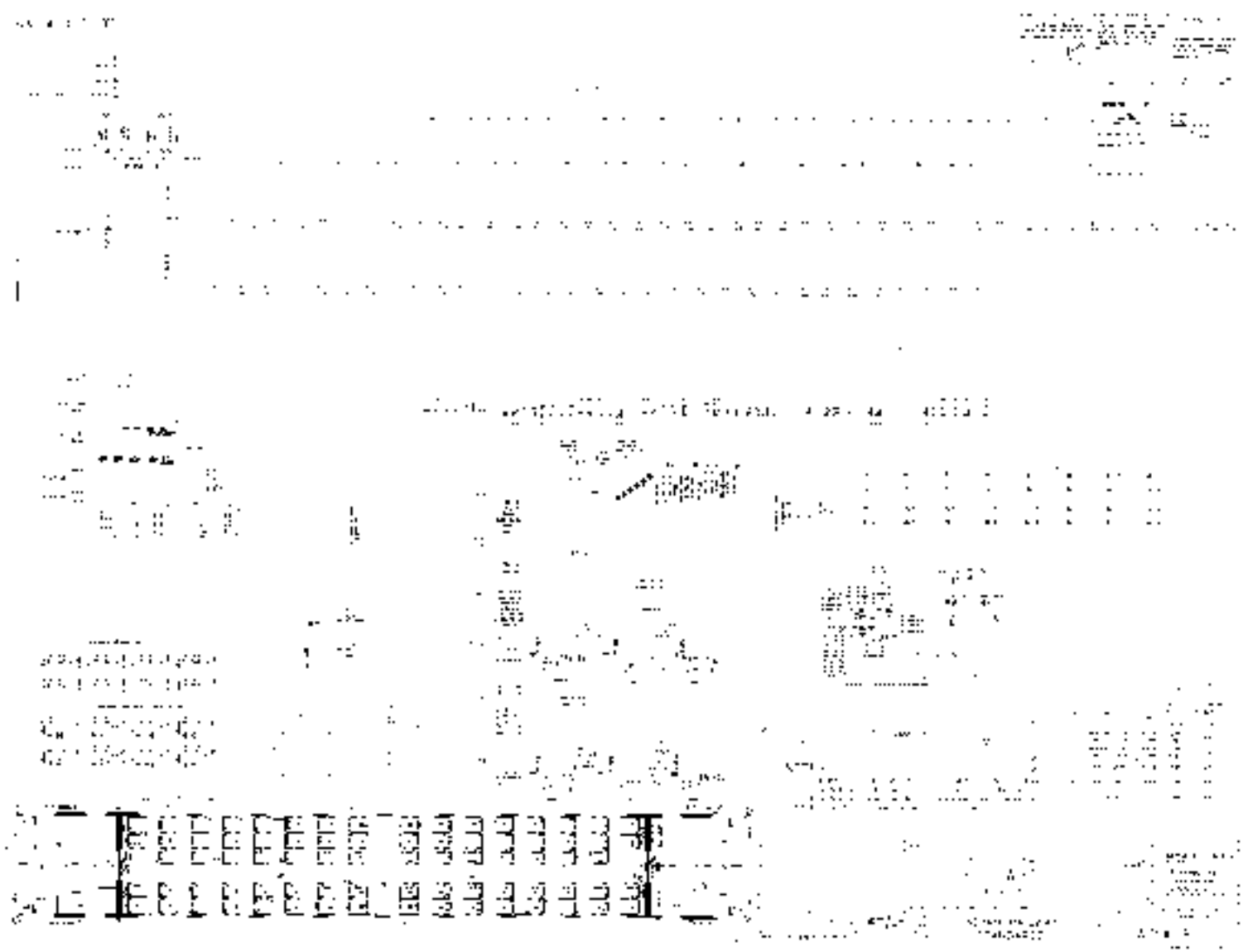


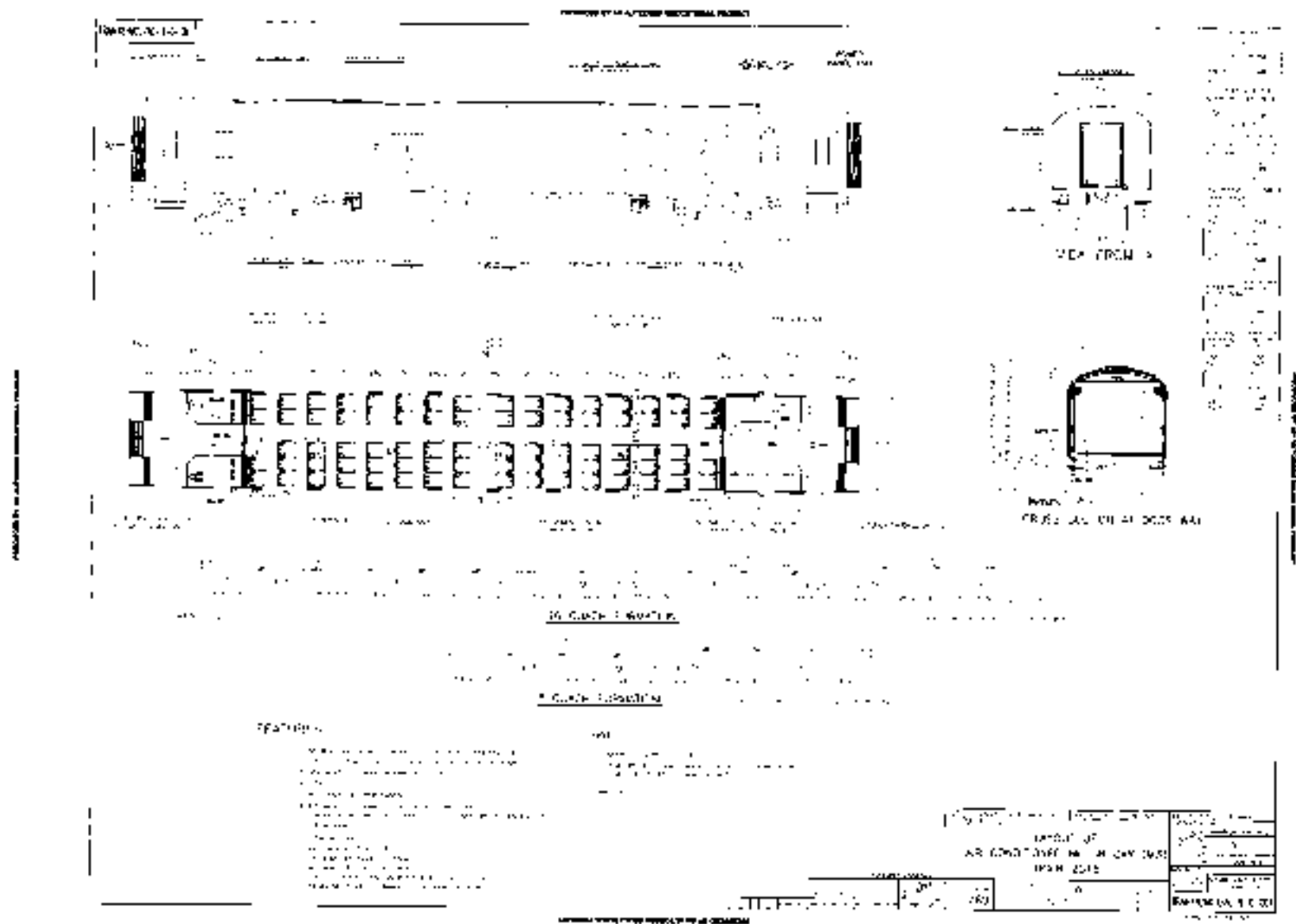


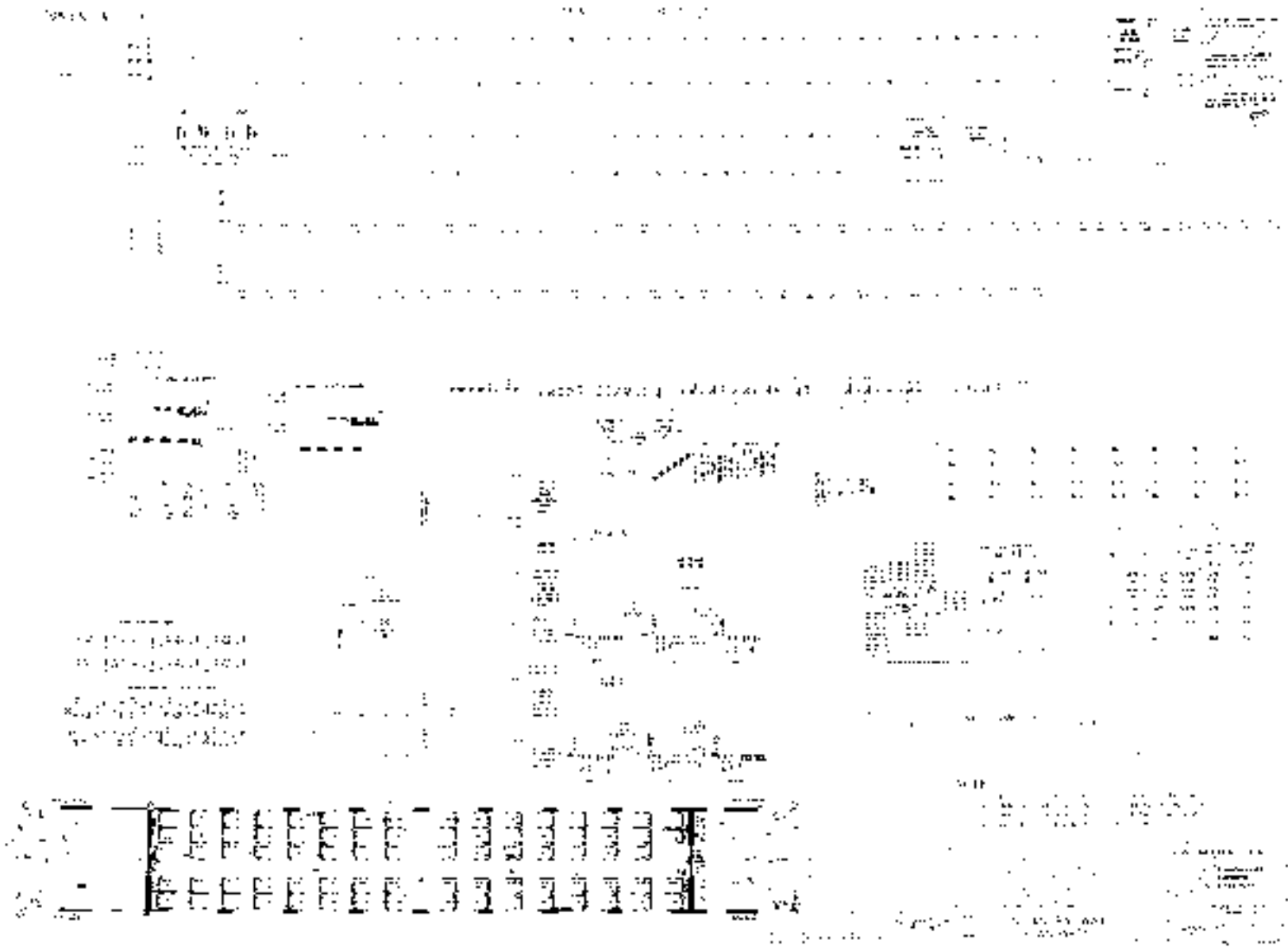


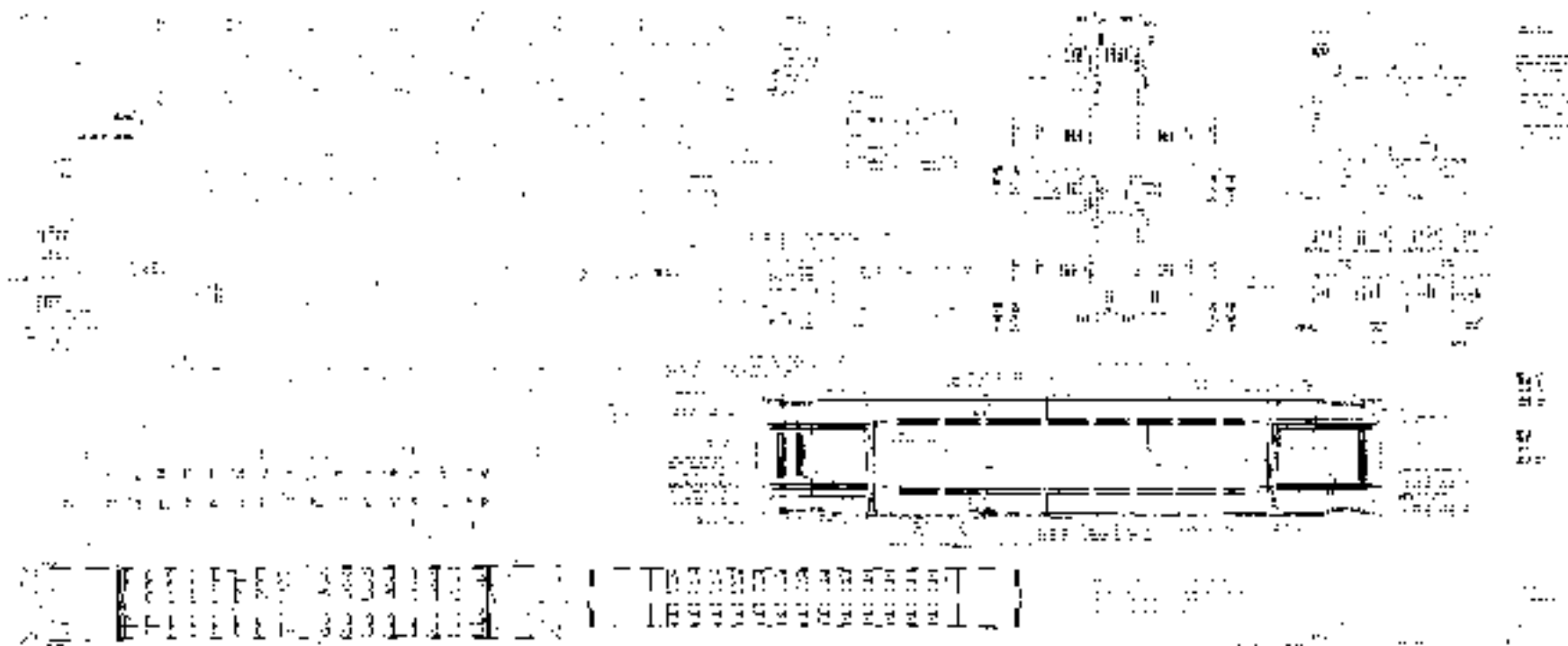


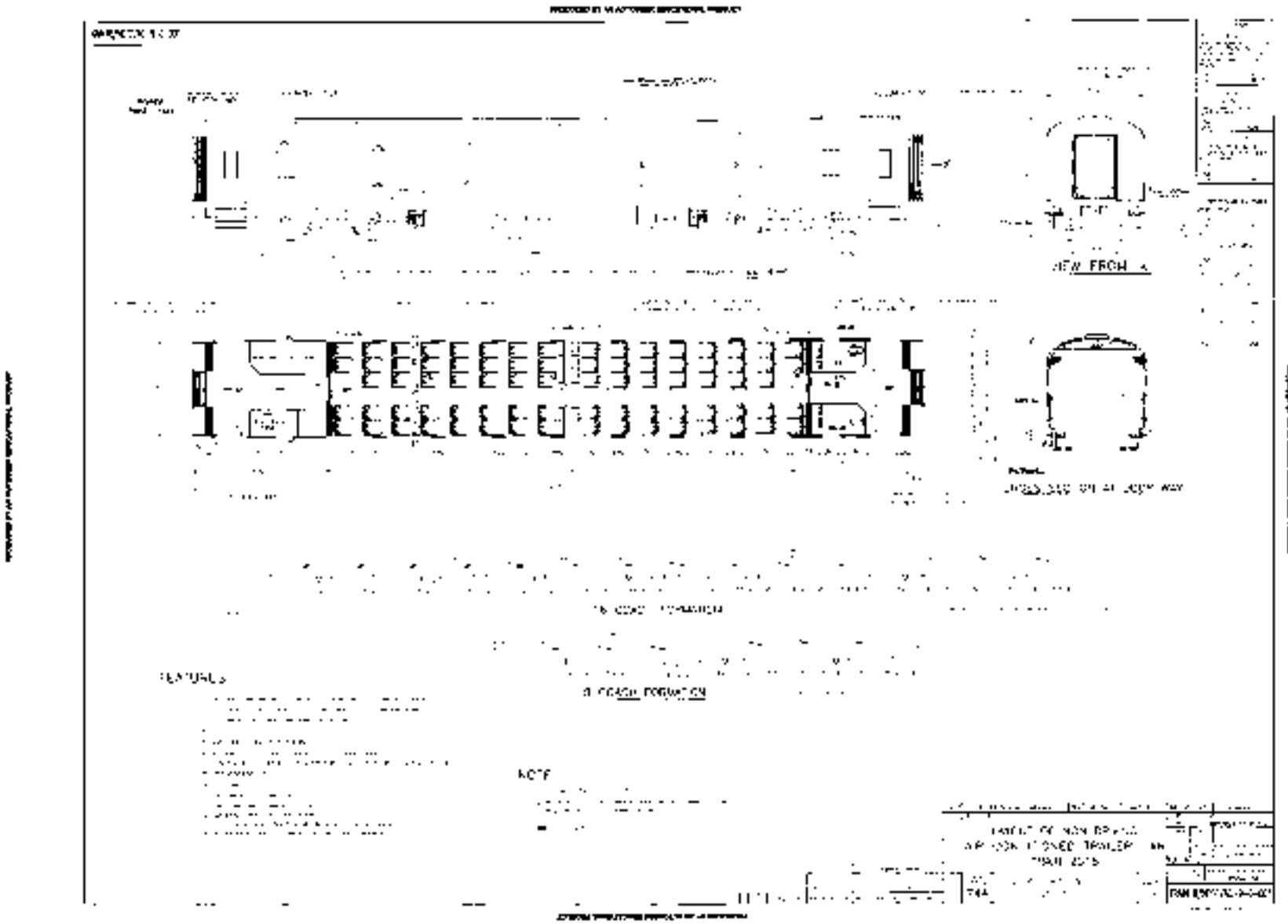


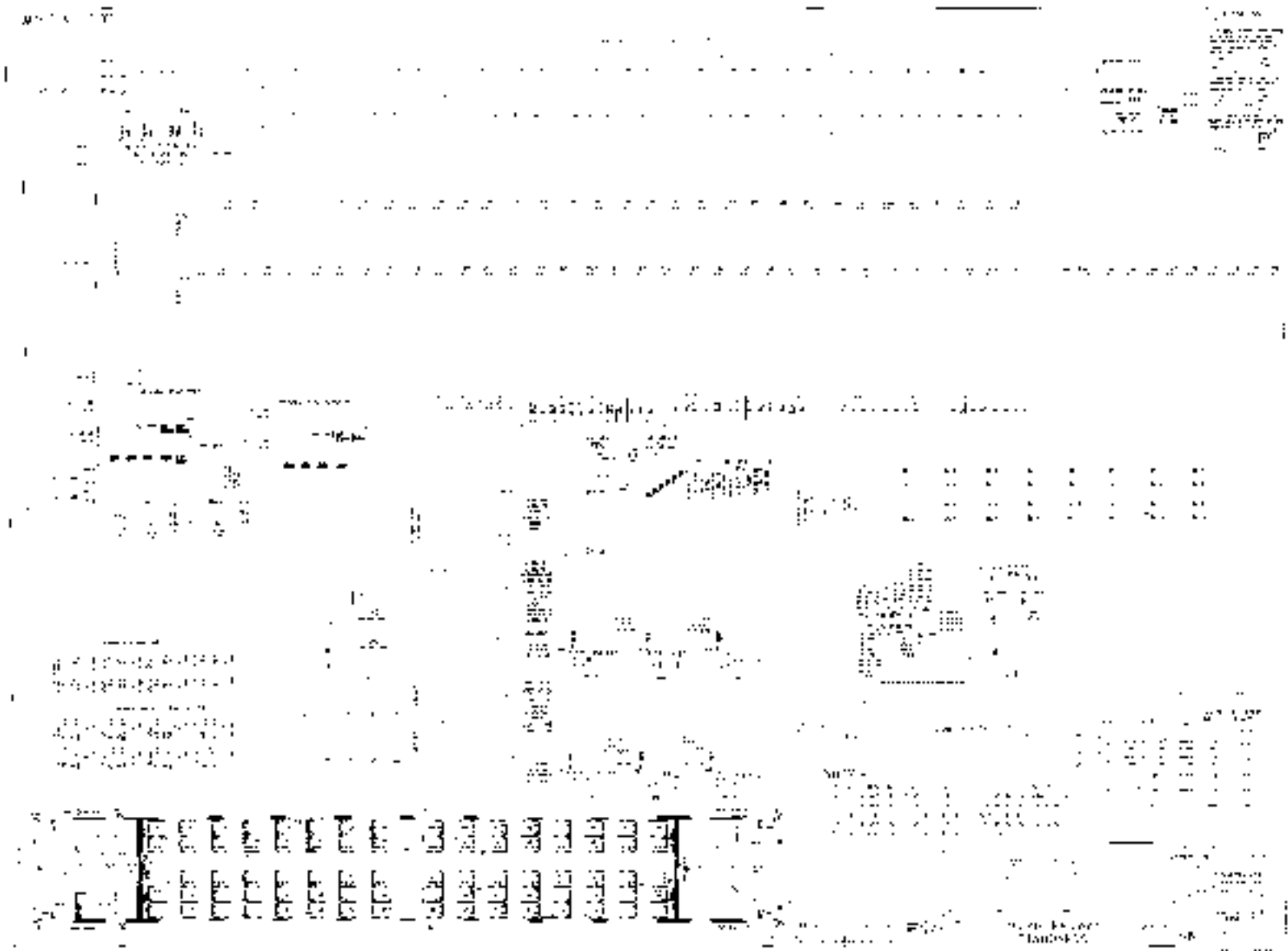


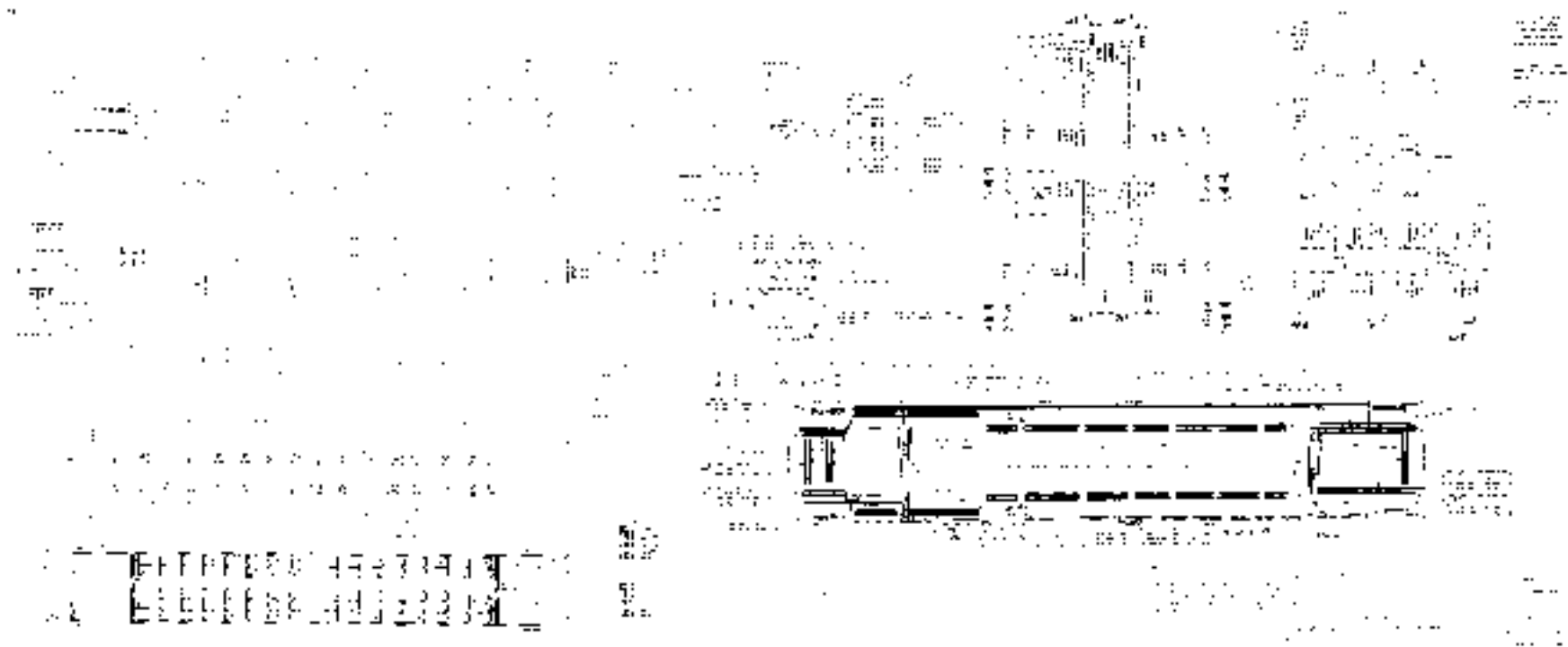


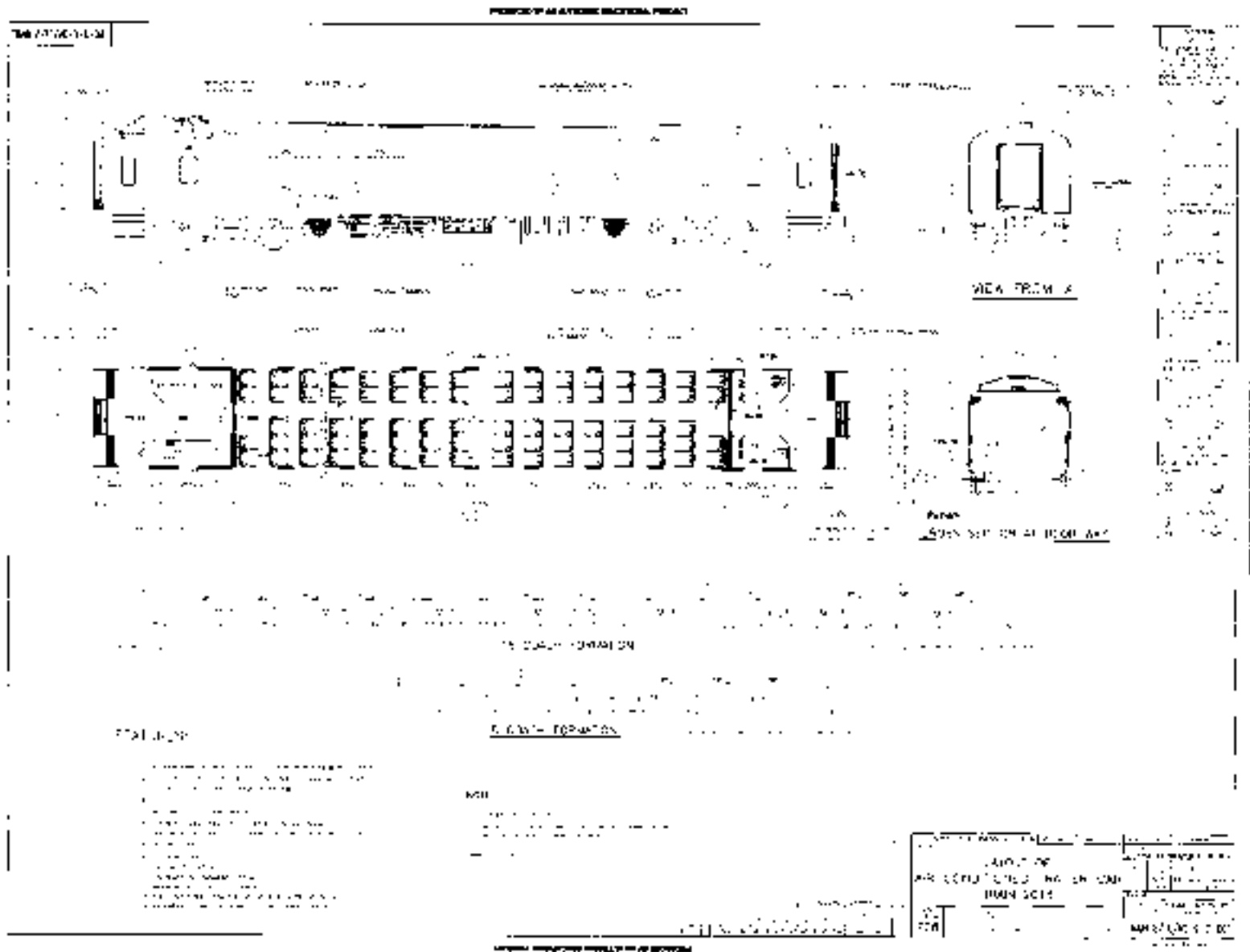










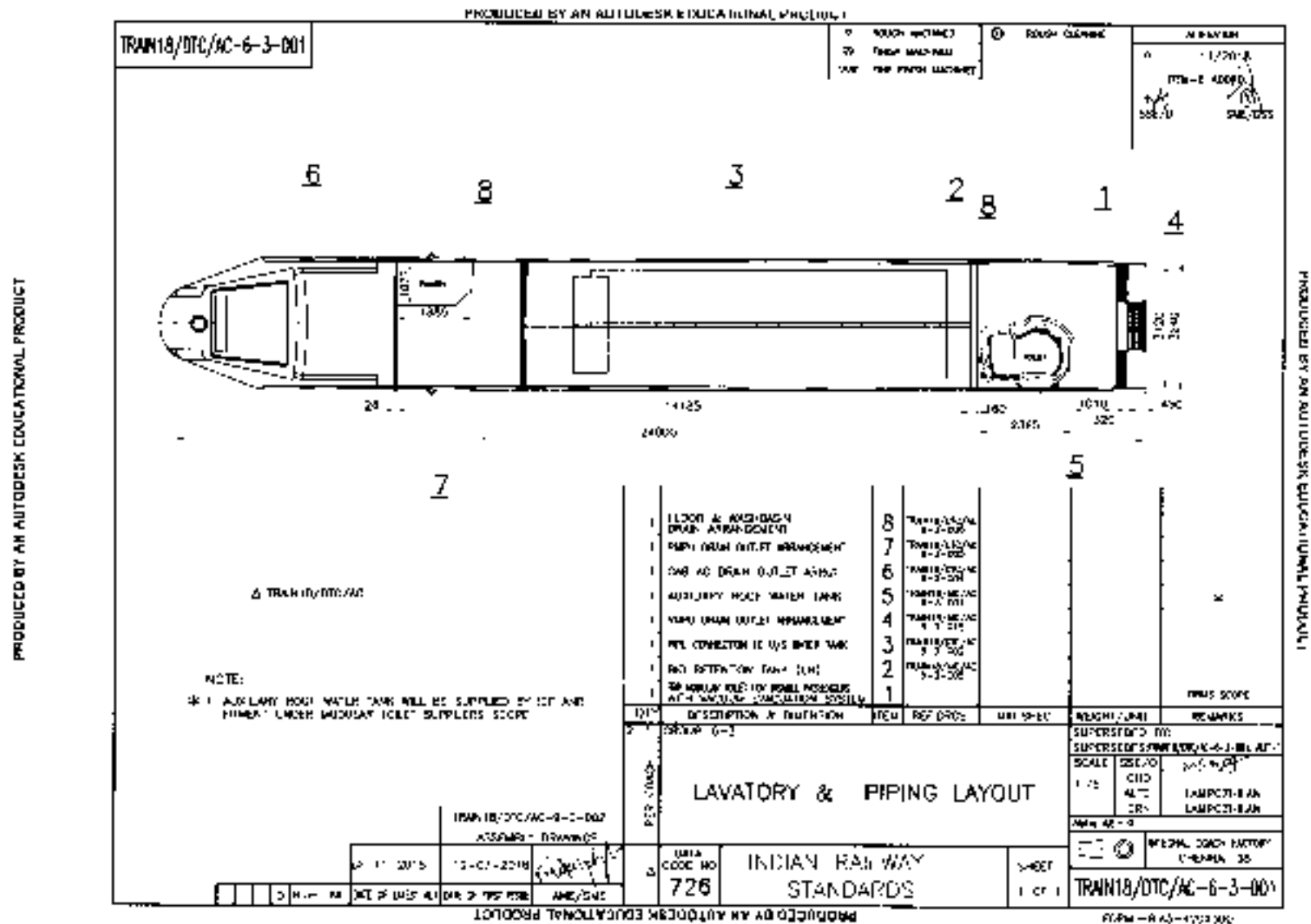


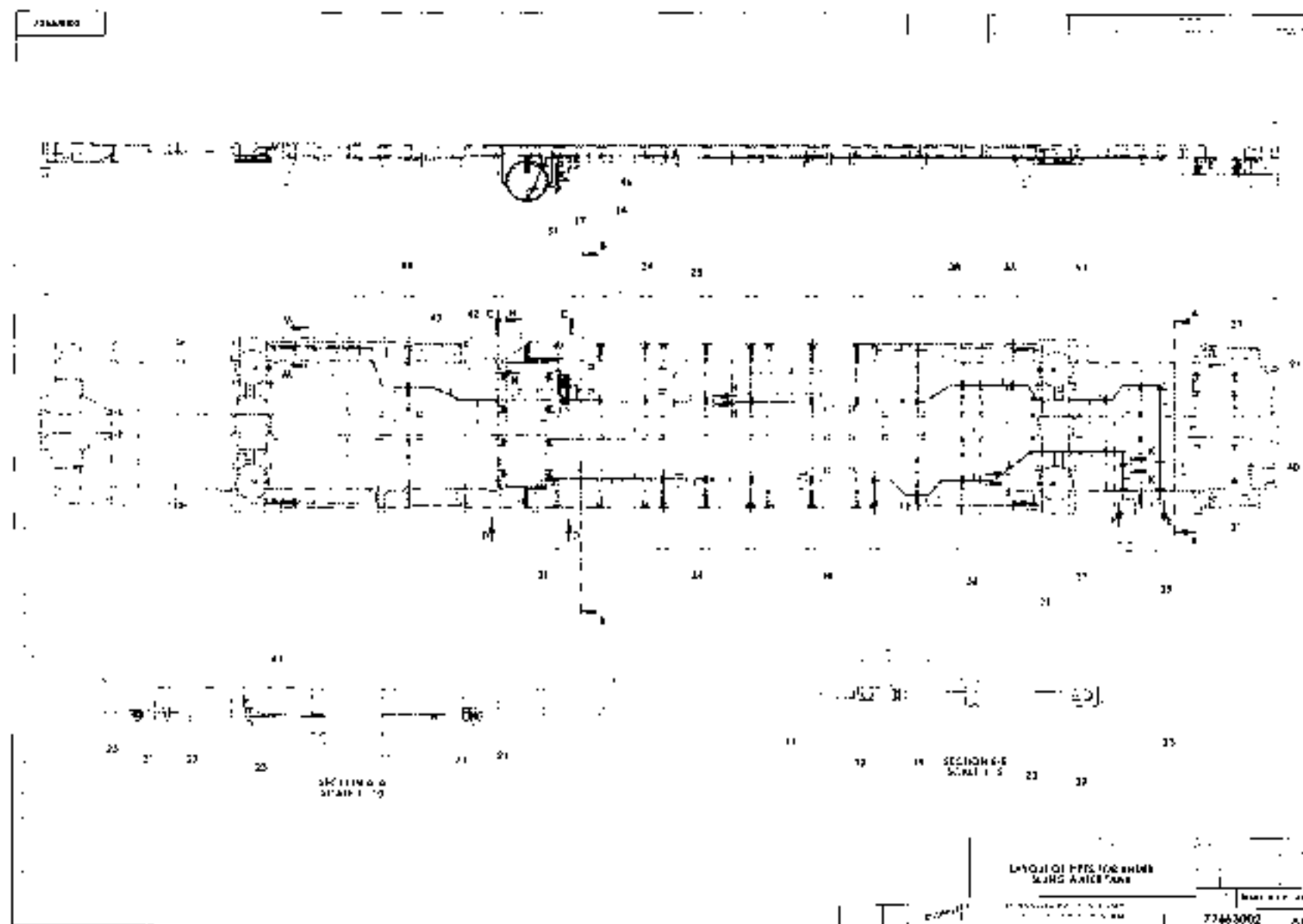
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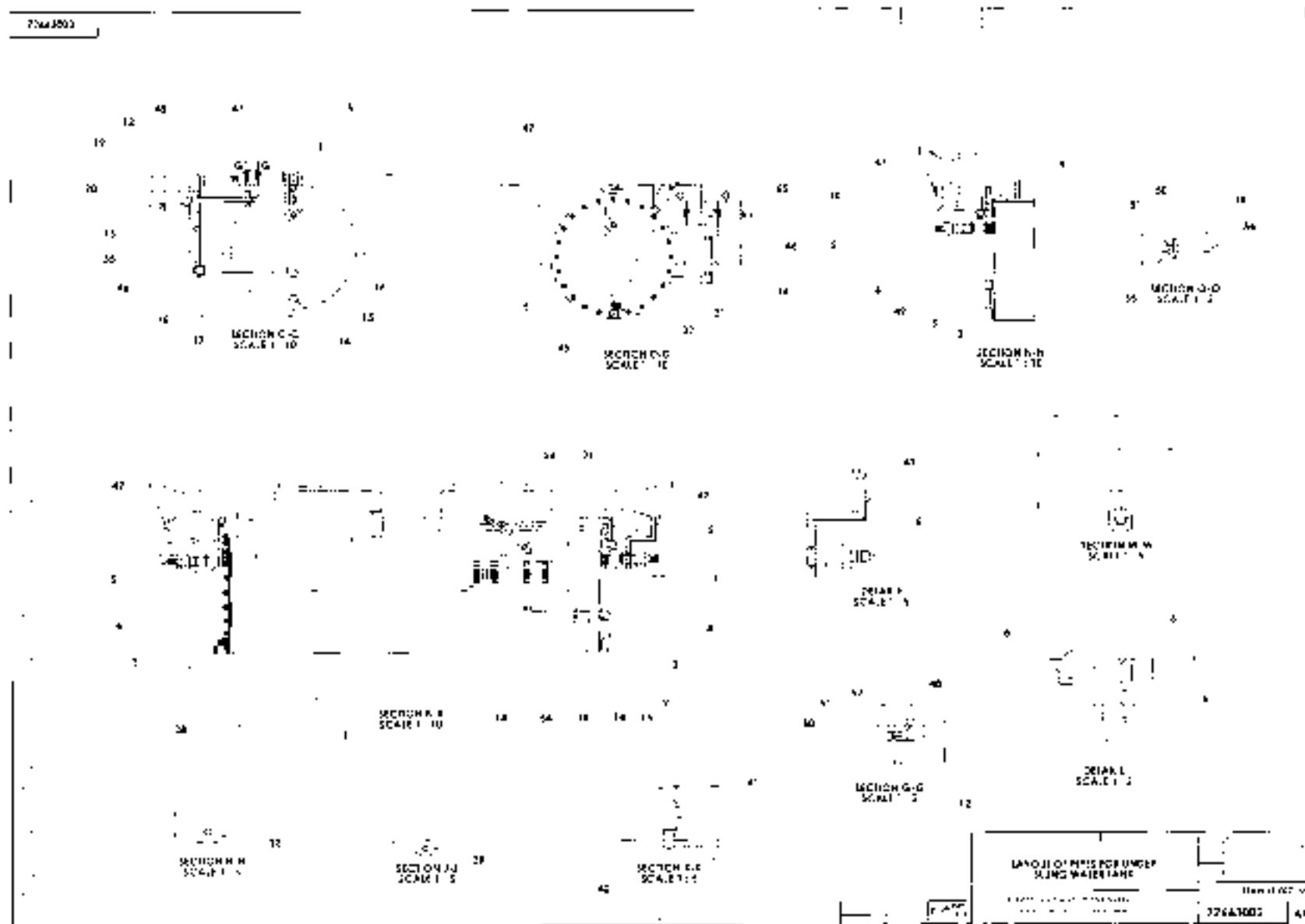
6.7 Water System

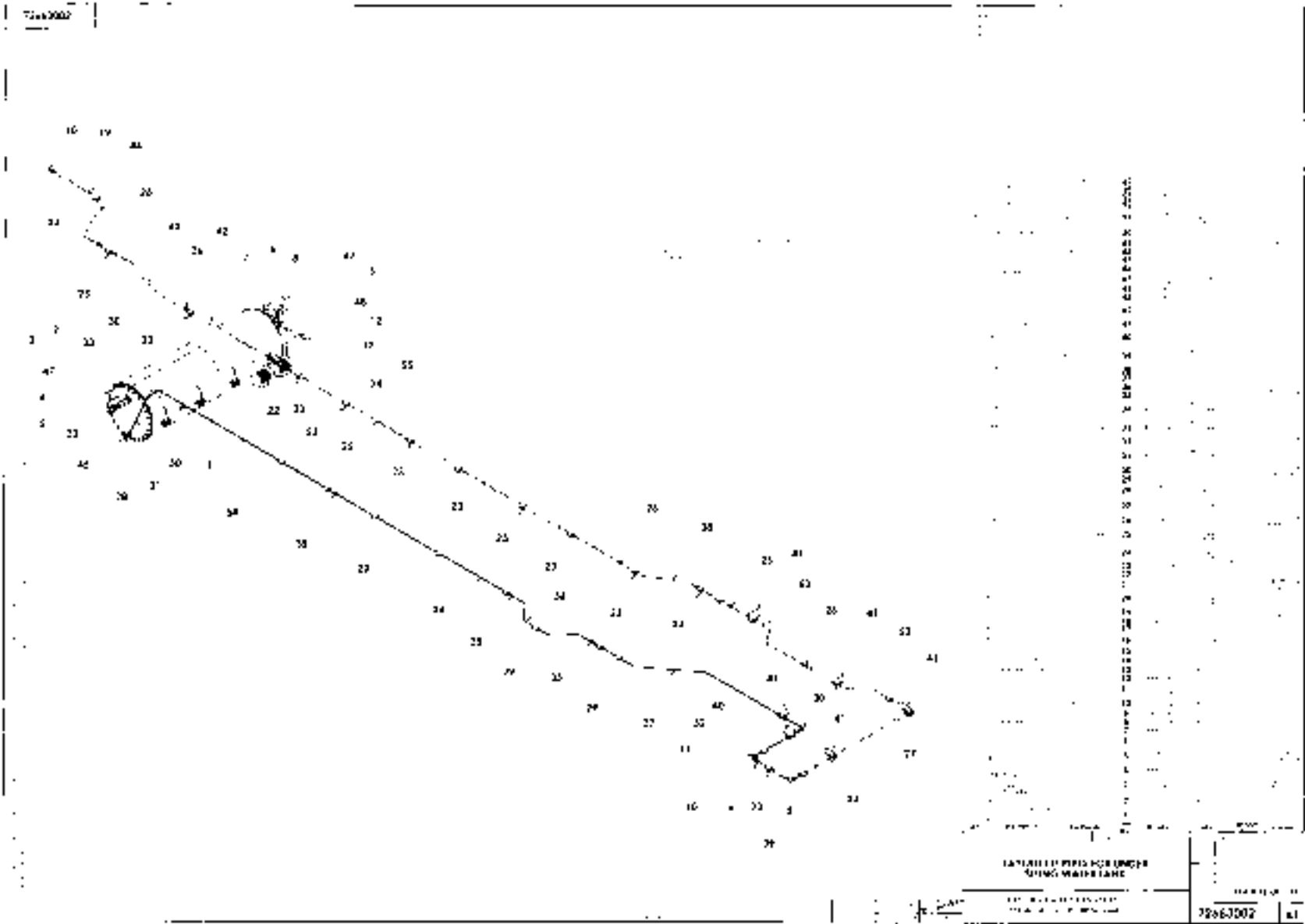
Designation	Drawing
Laboratory & Piping Layout	Train18/DTC/AC-6-3-001
Layout of pipe for under-slung water tank(SH-1)	72663002
Layout of pipe for under-slung water tank(SH-2)	72663002
Layout of pipe for under-slung water tank(SH-3)	72663002
UNDER-Slung water tank suspension arrangement	72663003
CAB AC Drain outlet arrangement	72663004
RMPU Drain outlet arrangement	72663005
Floor & Washbasin Drain arrangement	72663006
CAB AC & Drain Pipe arrangement	72663007
FRP Modular Toilet with commode for disabled passenger(SH-1)	72663008
FRP Modular Toilet with commode for disabled passenger(SH-2)	72663008
FRP Modular Toilet with commode for disabled passenger(SH-3)	72663008
Laboratory & Piping Layout	Train18/MC/AC-6-3-001
Under-Slung water Tank(SS)	72763002
Rib Assembly	72763003
Front Plate Assembly	72763004
DRDE Bio- Retention Tank Mounting Arrgt.	72763005
DRDE Bio- Retention Tank Assembly	72763006
Bio- Retention Tank	72763007
Fixing Piece Assembly	72763008
FRP Modular Toilet for Train-18	Train18/MC/AC-6-3-010
Auxiliary Water Tank	72763011
DRDE Bio- Retention Tank Mounting Arrgt.(RH)	72763012
Layout of pipe for under-slung water tank(SH-1)	72763013
Layout of pipe for under-slung water tank(SH-2)	72763013
Layout of pipe for under-slung water tank(SH-3)	72763013
UNDER-Slung water tank suspension arrangement	72763014
RMPU Drain outlet arrangement	72763015
Floor & Washbasin Drain arrangement (SH-1)	72763016
Floor & Washbasin Drain arrangement (SH-2)	72763016
FRP Modular Toilet for Train-18 (SH-1)	72763018
FRP Modular Toilet for Train-18 (SH-2)	72763018
FRP Modular Toilet for Train-18 (SH-3)	72763018
FRP Modular Toilet for Train-18 (SH-4)	72763018
FRP Modular Toilet for Train-18 (SH-5)	72763018
Laboratory & Piping Layout	Train18/TC/AC-6-3-001
UNDER-Slung water tank suspension arrangement	72863002
Layout of pipe for under-slung water tank(SH-1)	72863003
Layout of pipe for under-slung water tank(SH-2)	72863003
Layout of pipe for under-slung water tank(SH-3)	72863003

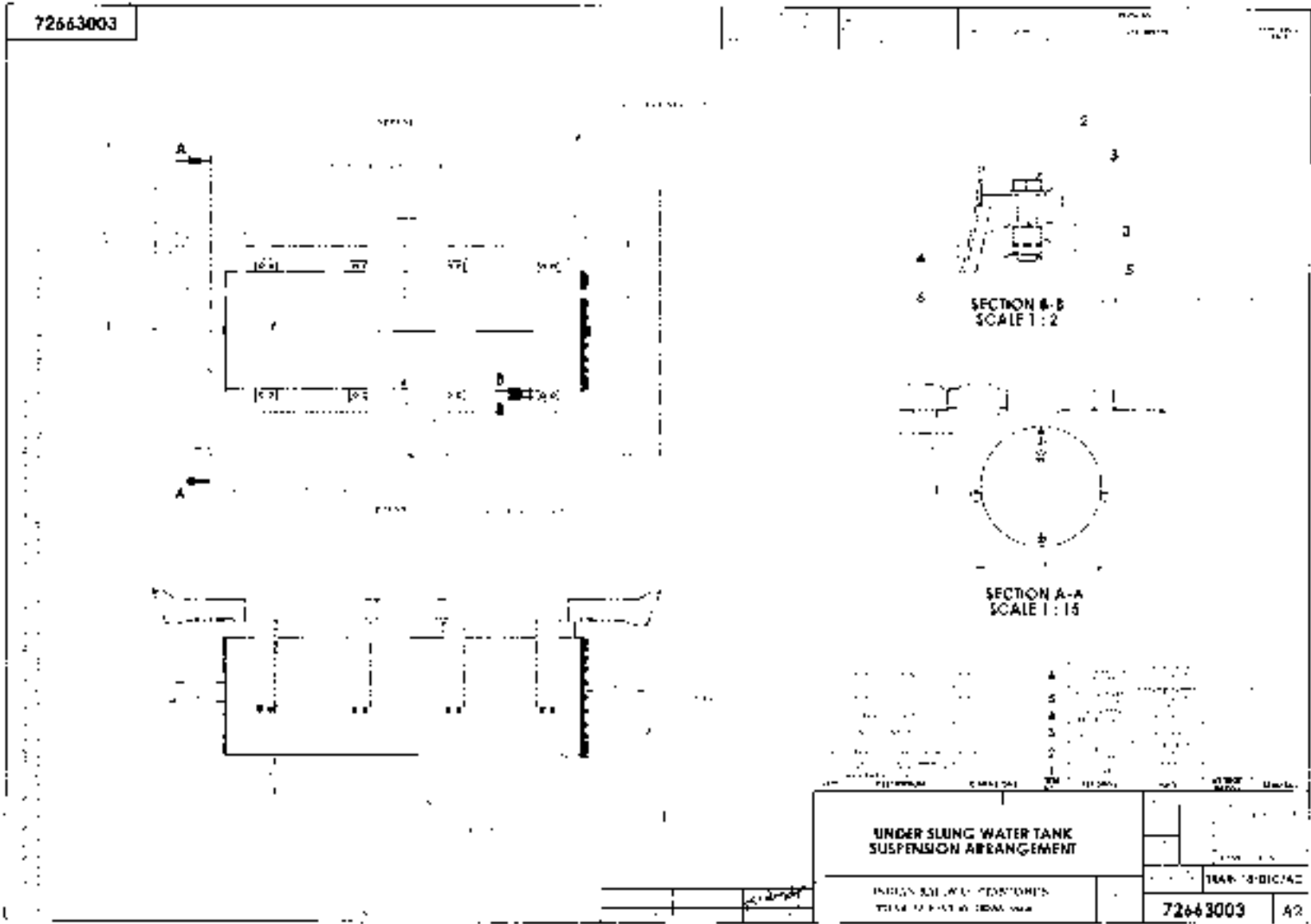
Laboratory & Piping Layout	Train18/NDTC/AC-6-3-001
Layout of pipe for under-slung water tank(SH-1)	74463002
Layout of pipe for under-slung water tank(SH-2)	74463002
Layout of pipe for under-slung water tank(SH-3)	74463002
UNDER-Slung water tank suspension arrangement	74463003
General Installation of Executive AC Motor Car	Train18/MC/EC//AC-9-0-002
General Installation of Executive AC Trailer Car	Train18/NDTC/EC//AC-9-0-002
General Installation of Executive AC Motor Car	Train18/MC2/EC//AC-9-0-002
General Installation of Executive AC Motor Car	Train18/MC3/EC//AC-9-0-002

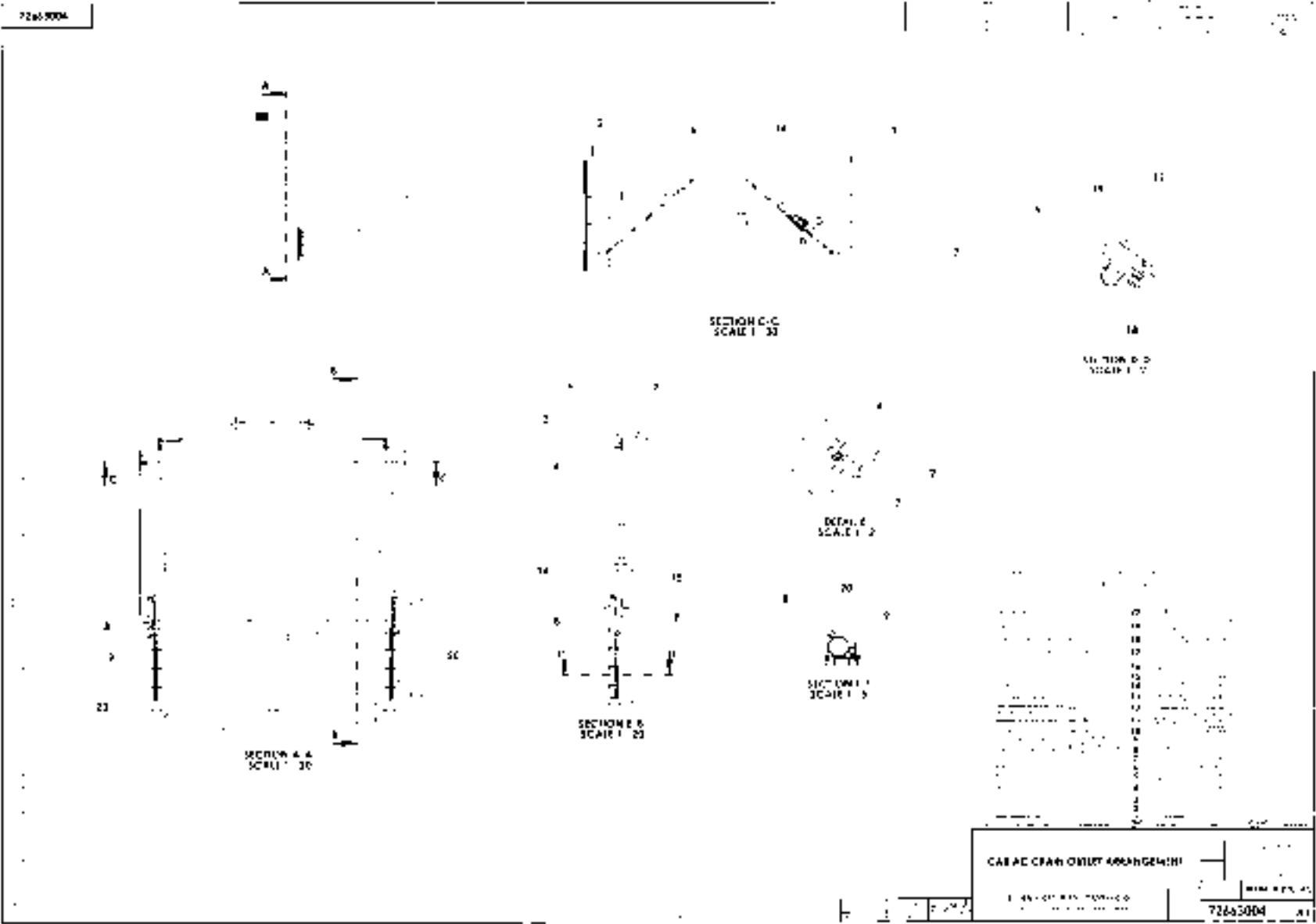


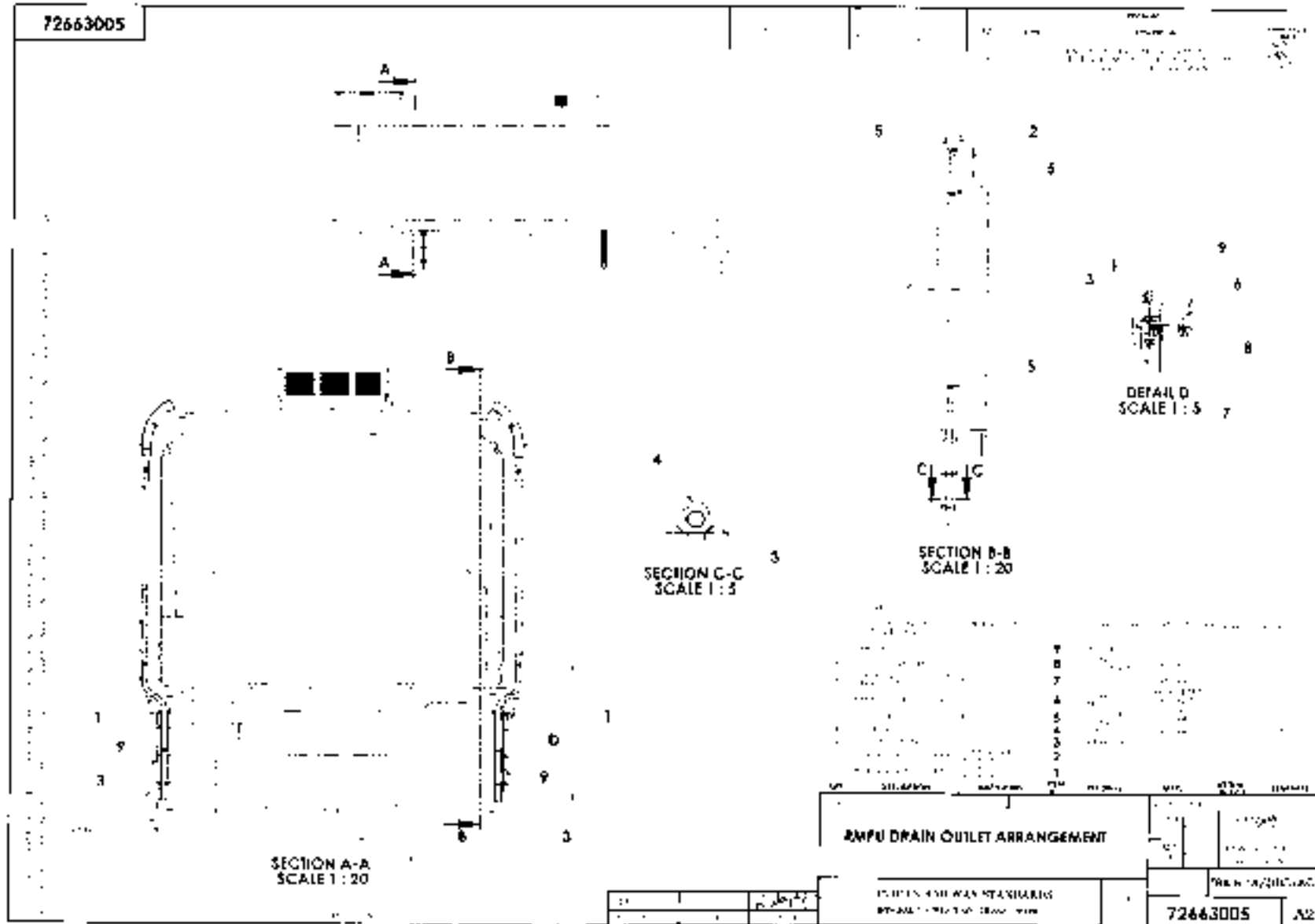


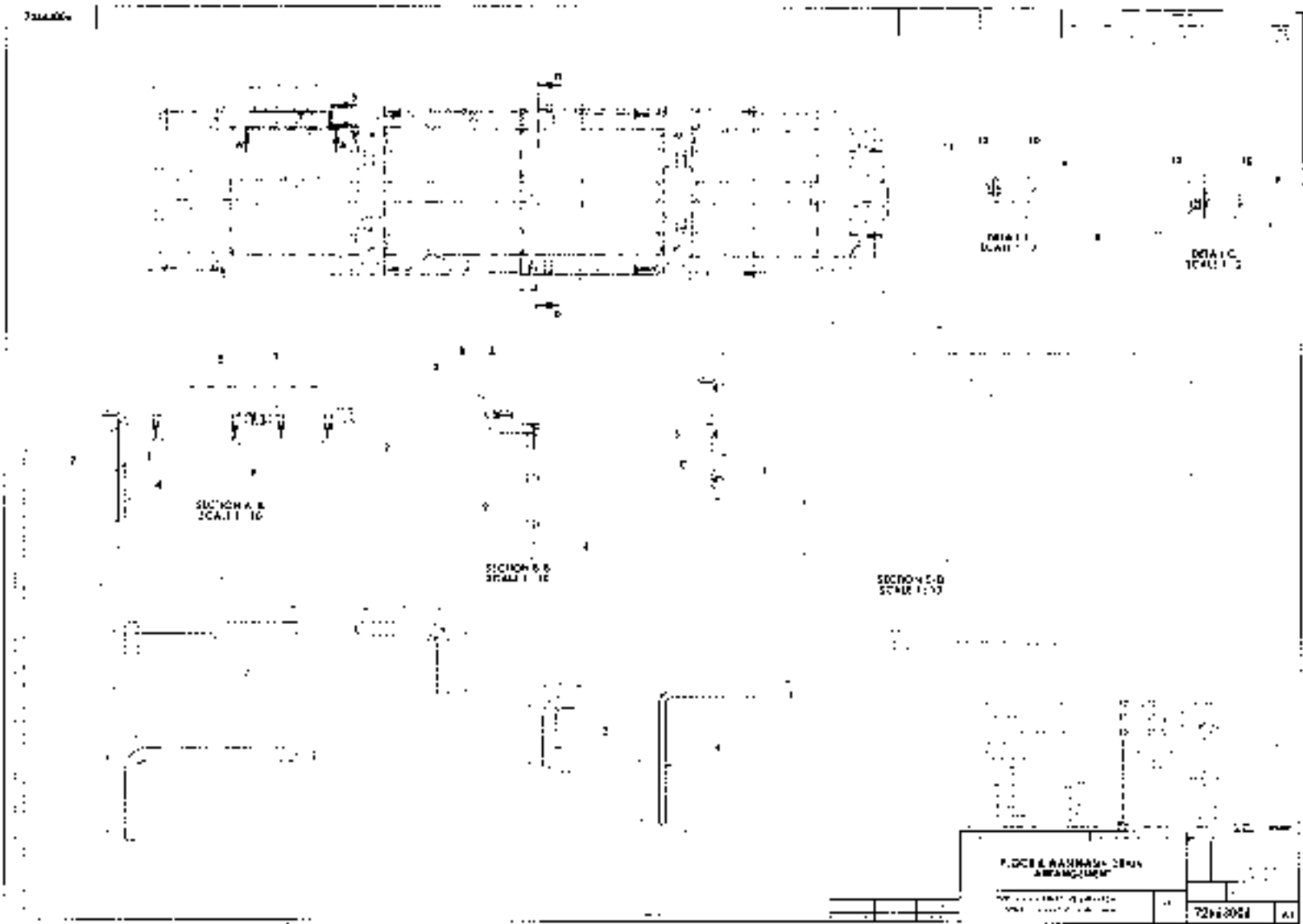


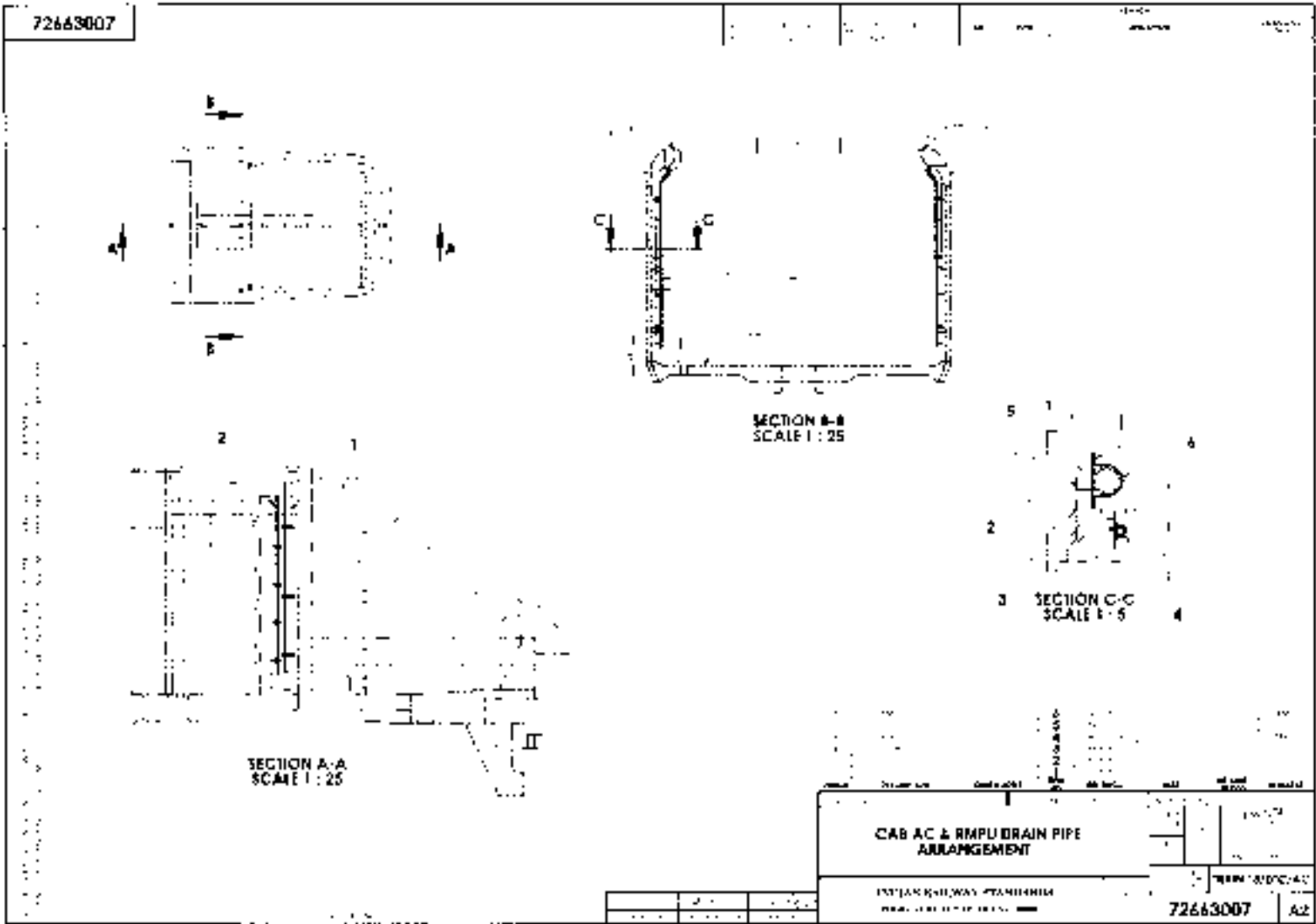


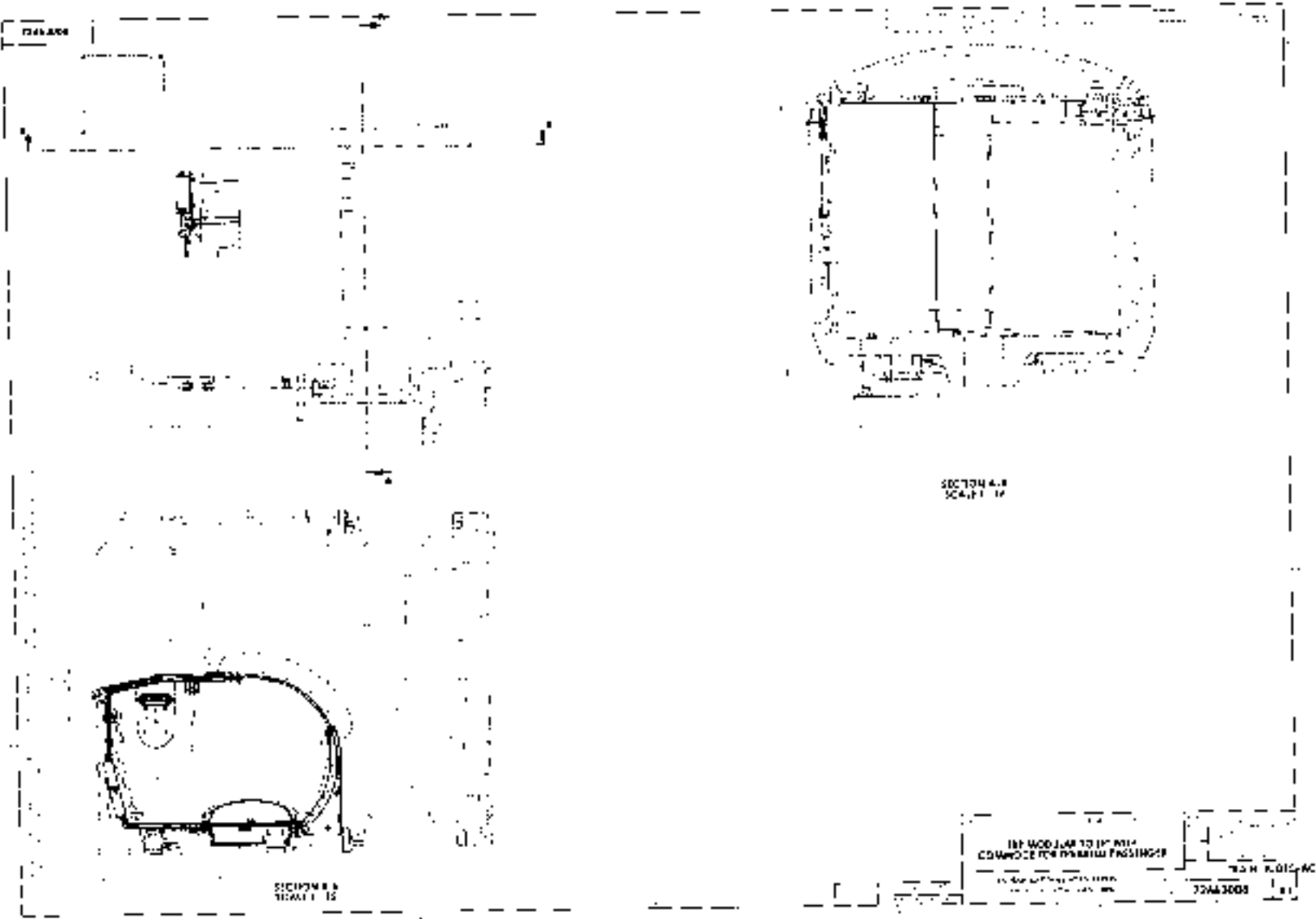


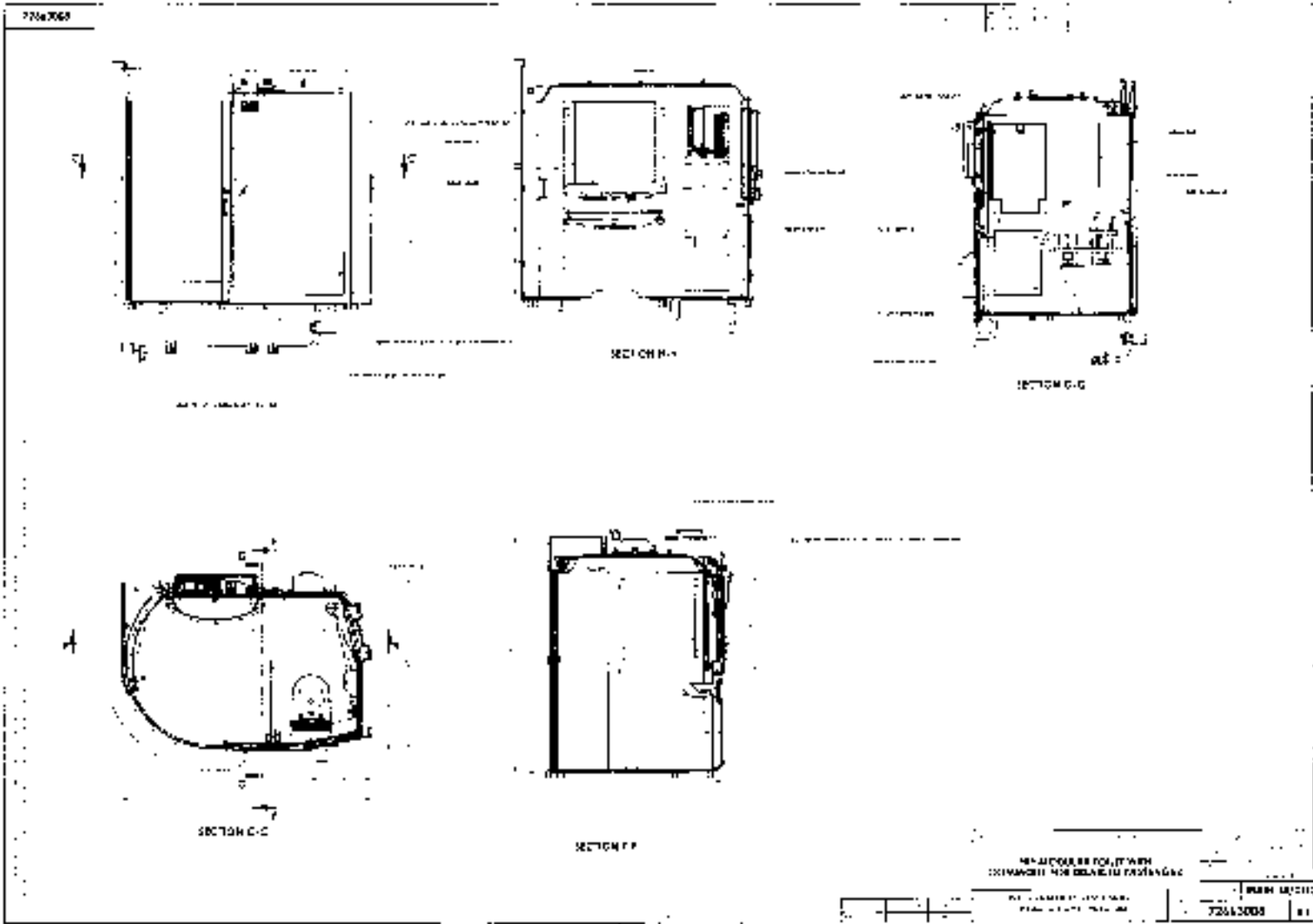


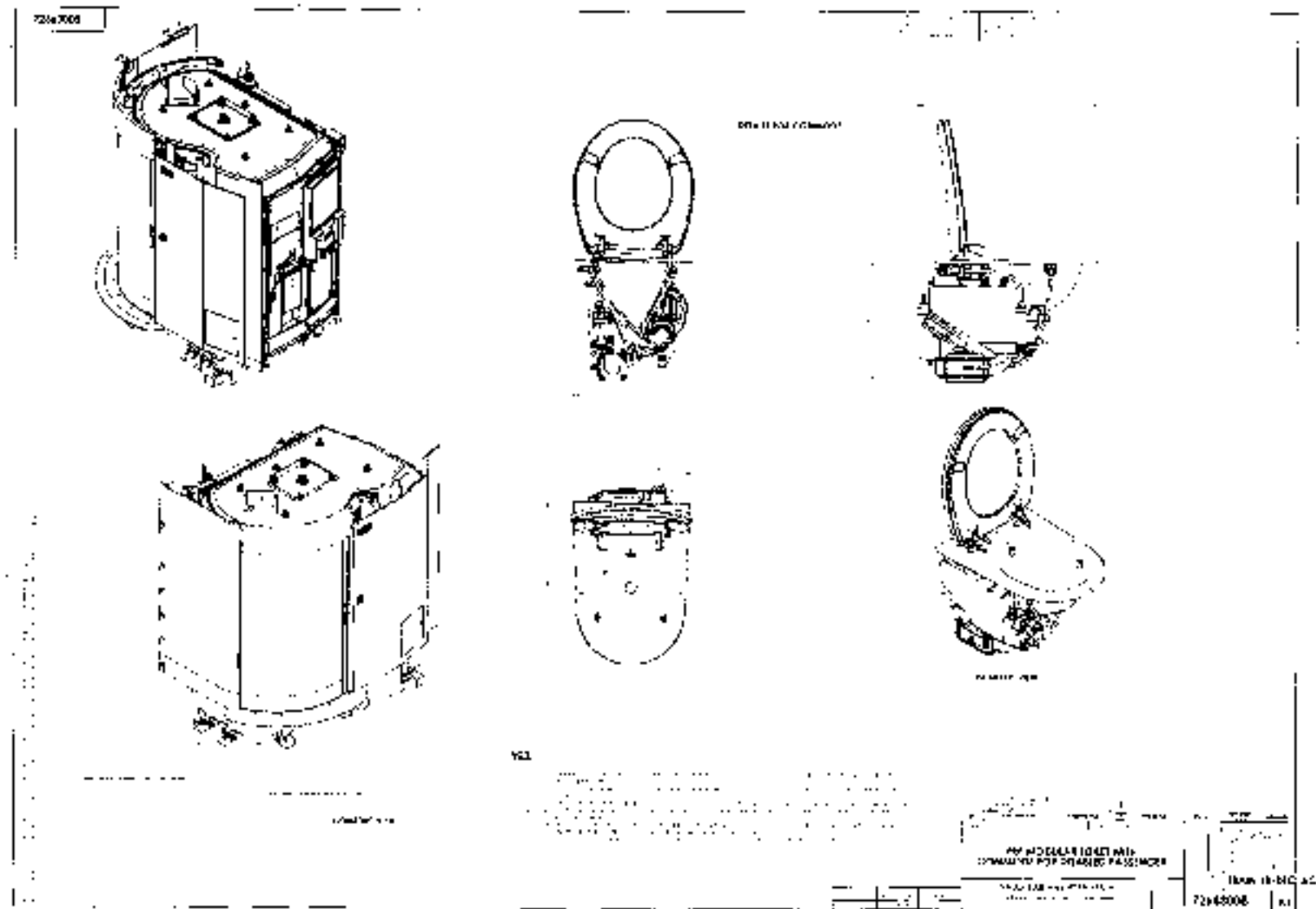


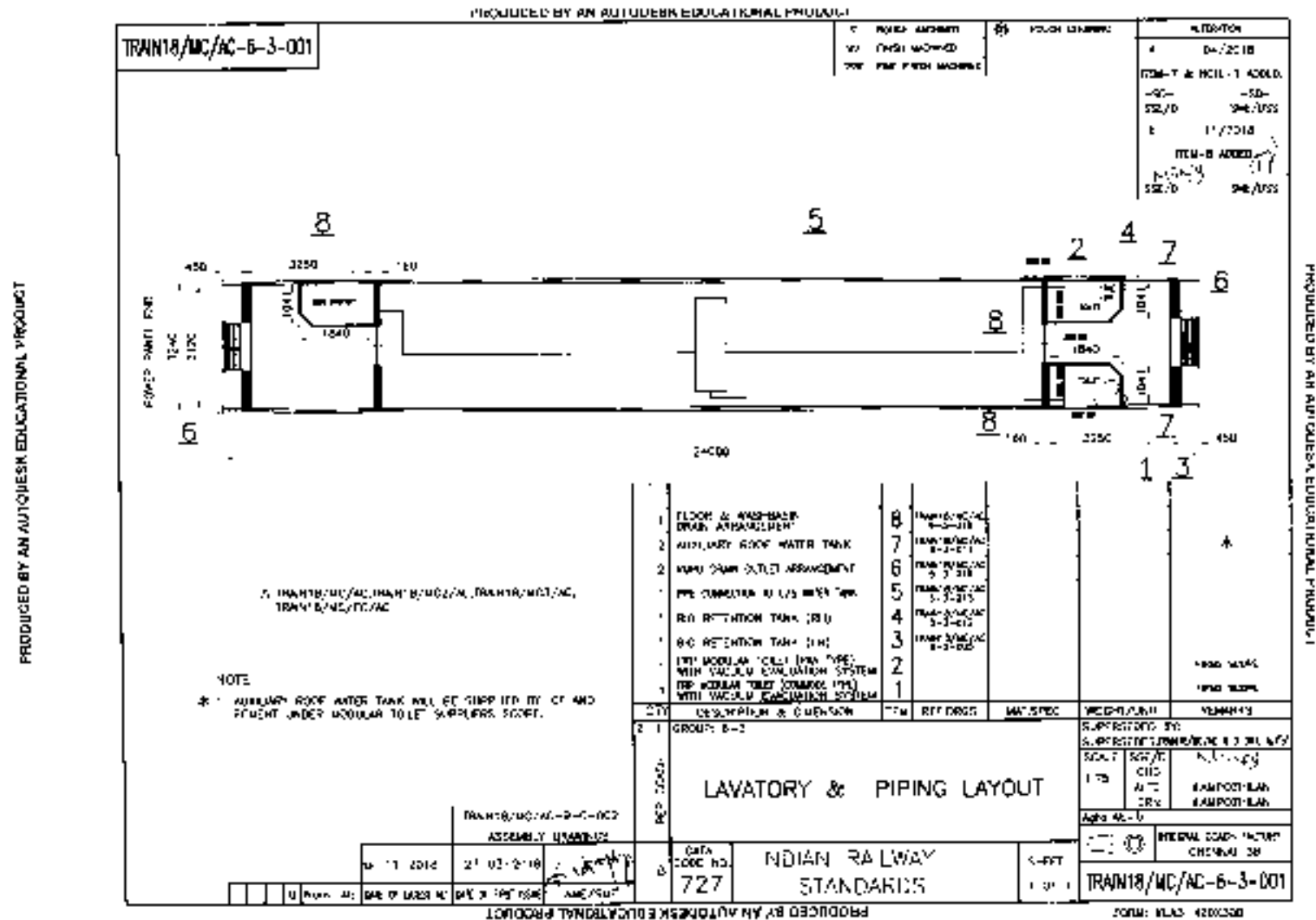


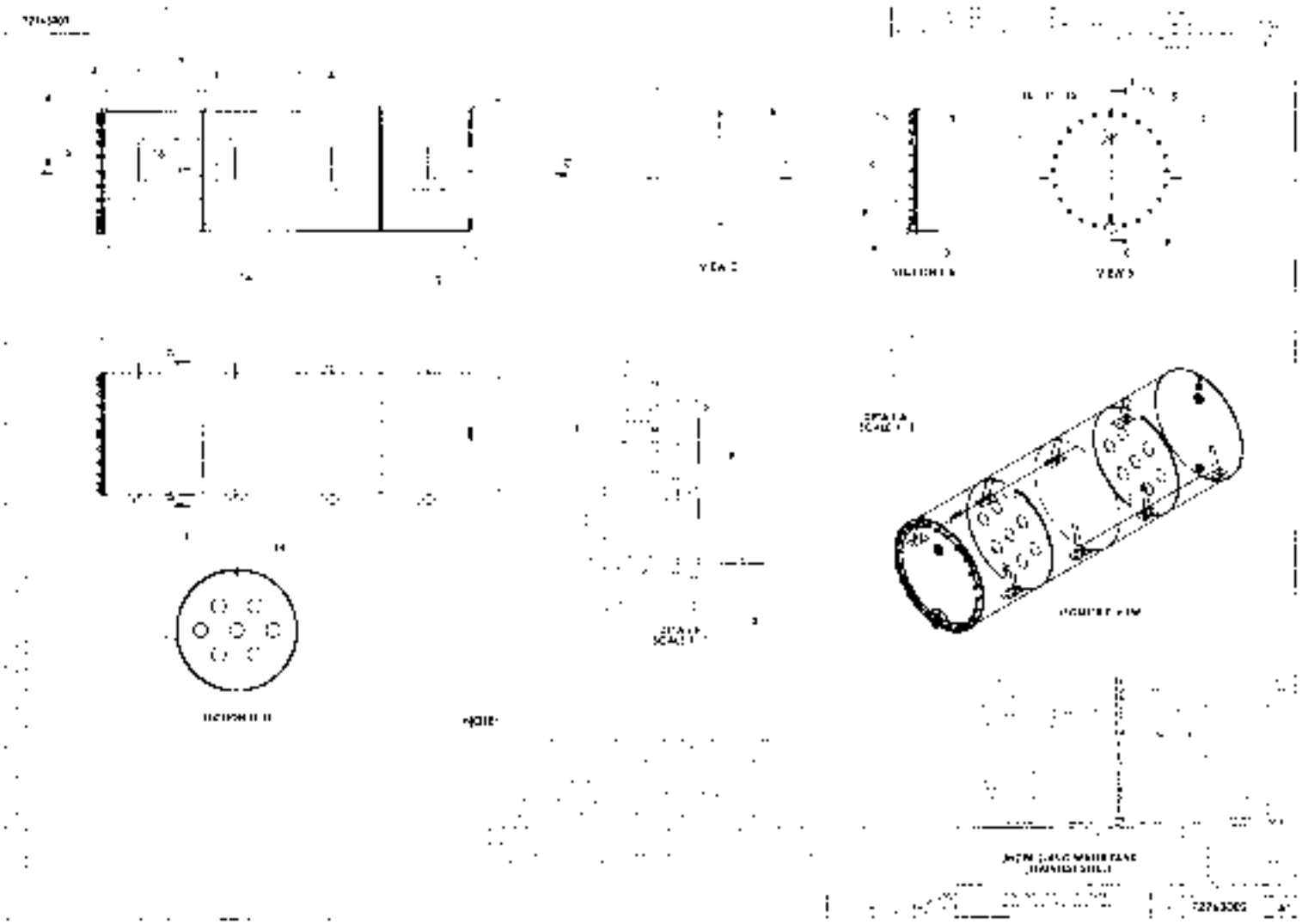


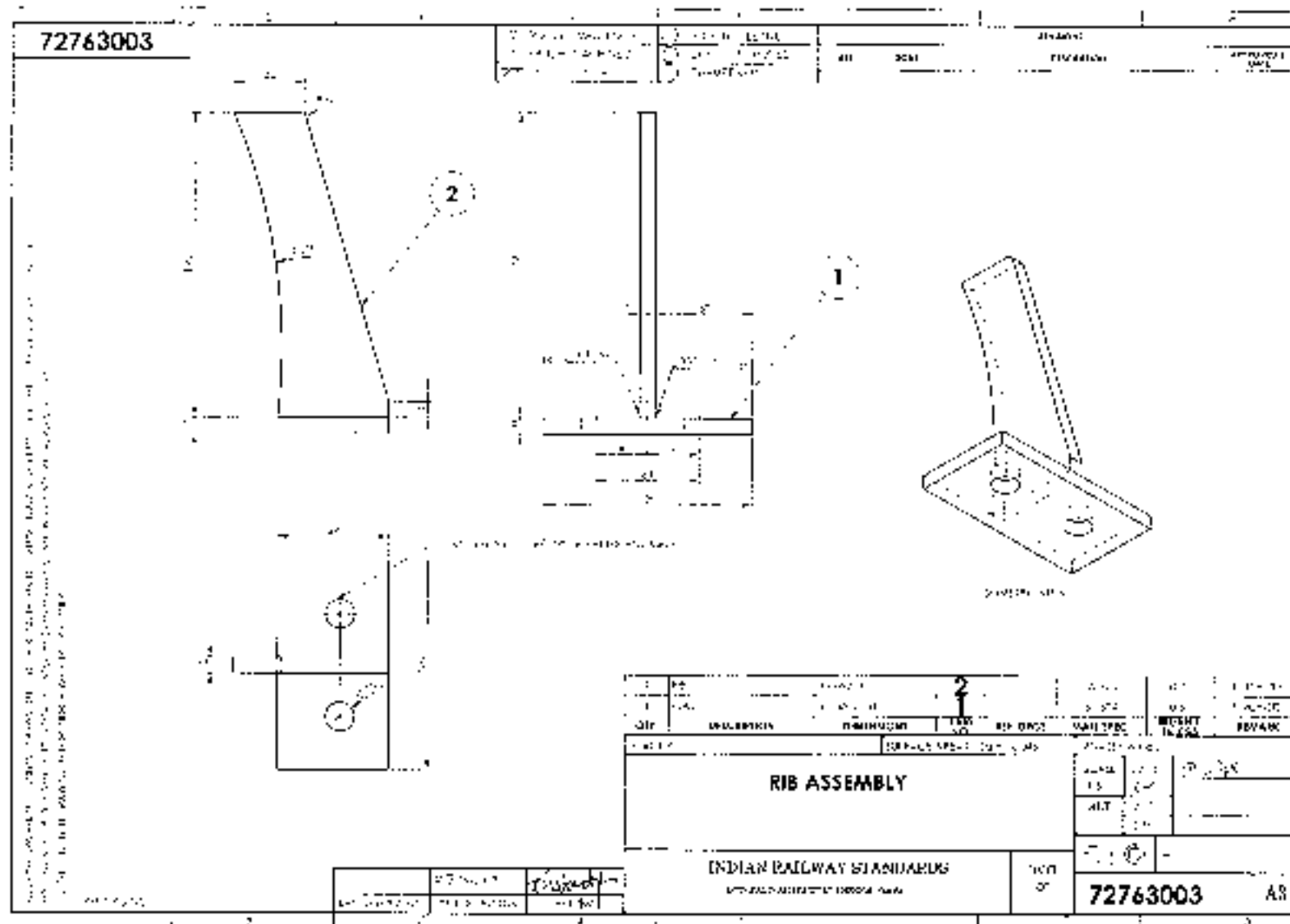


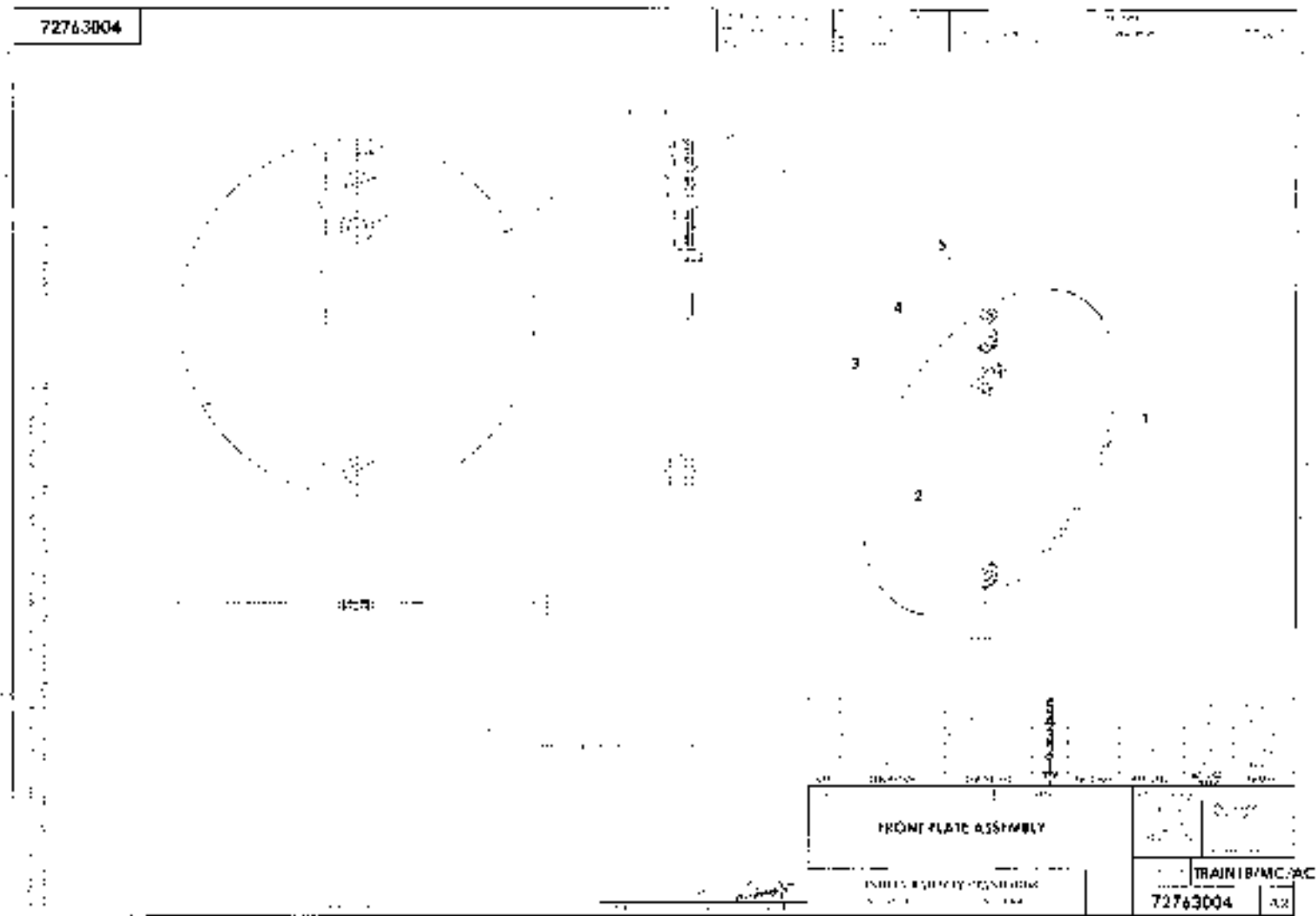


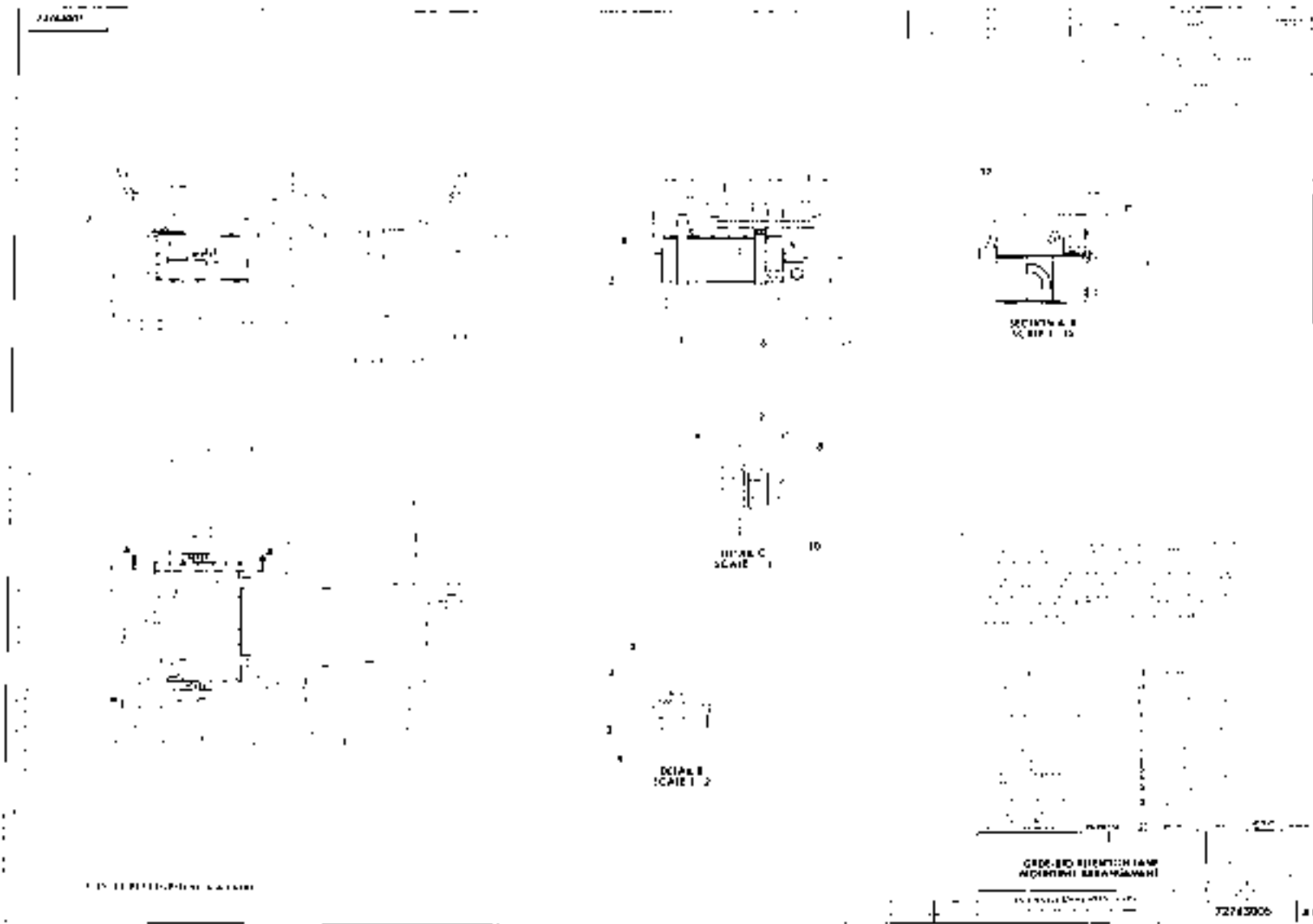


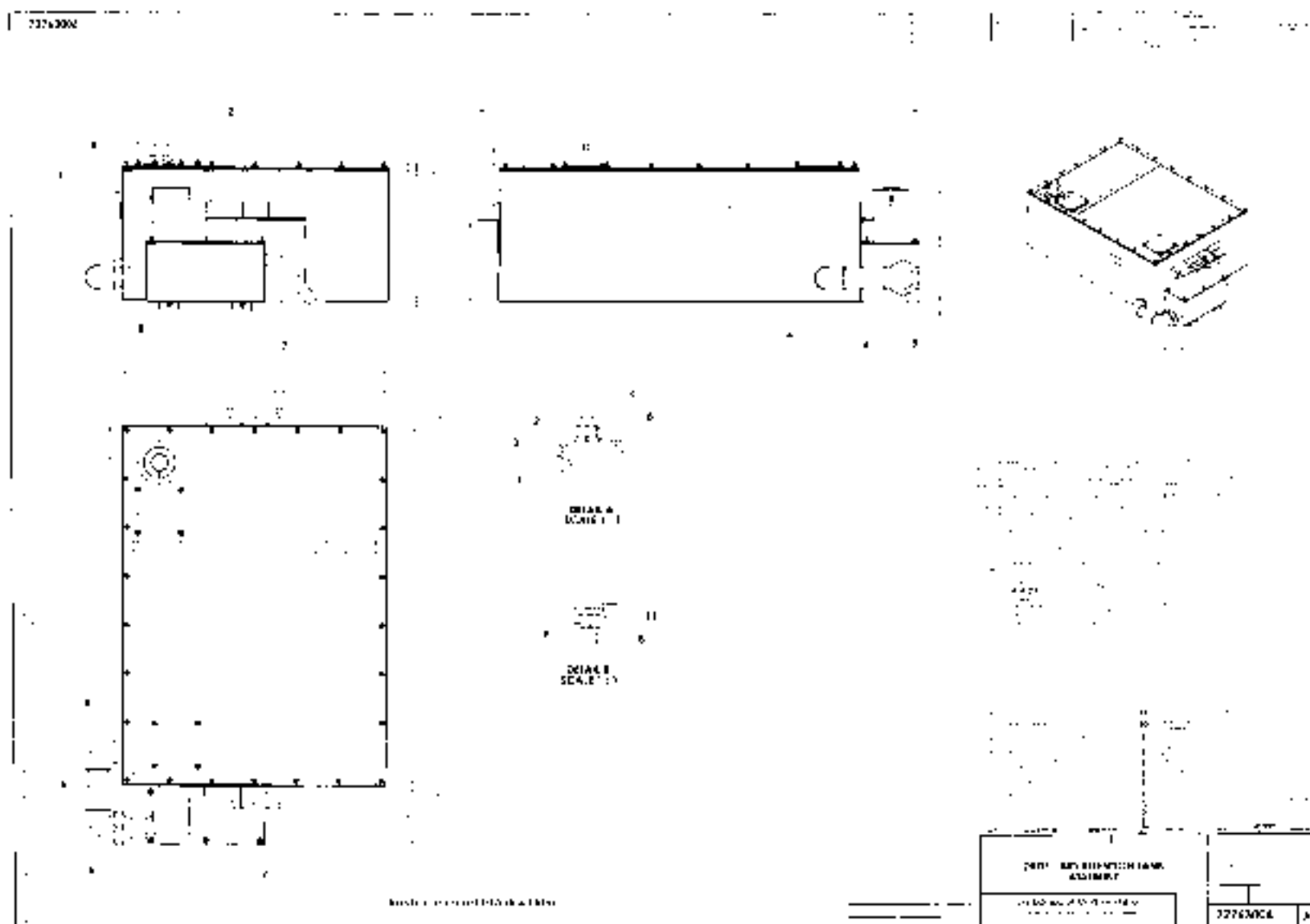


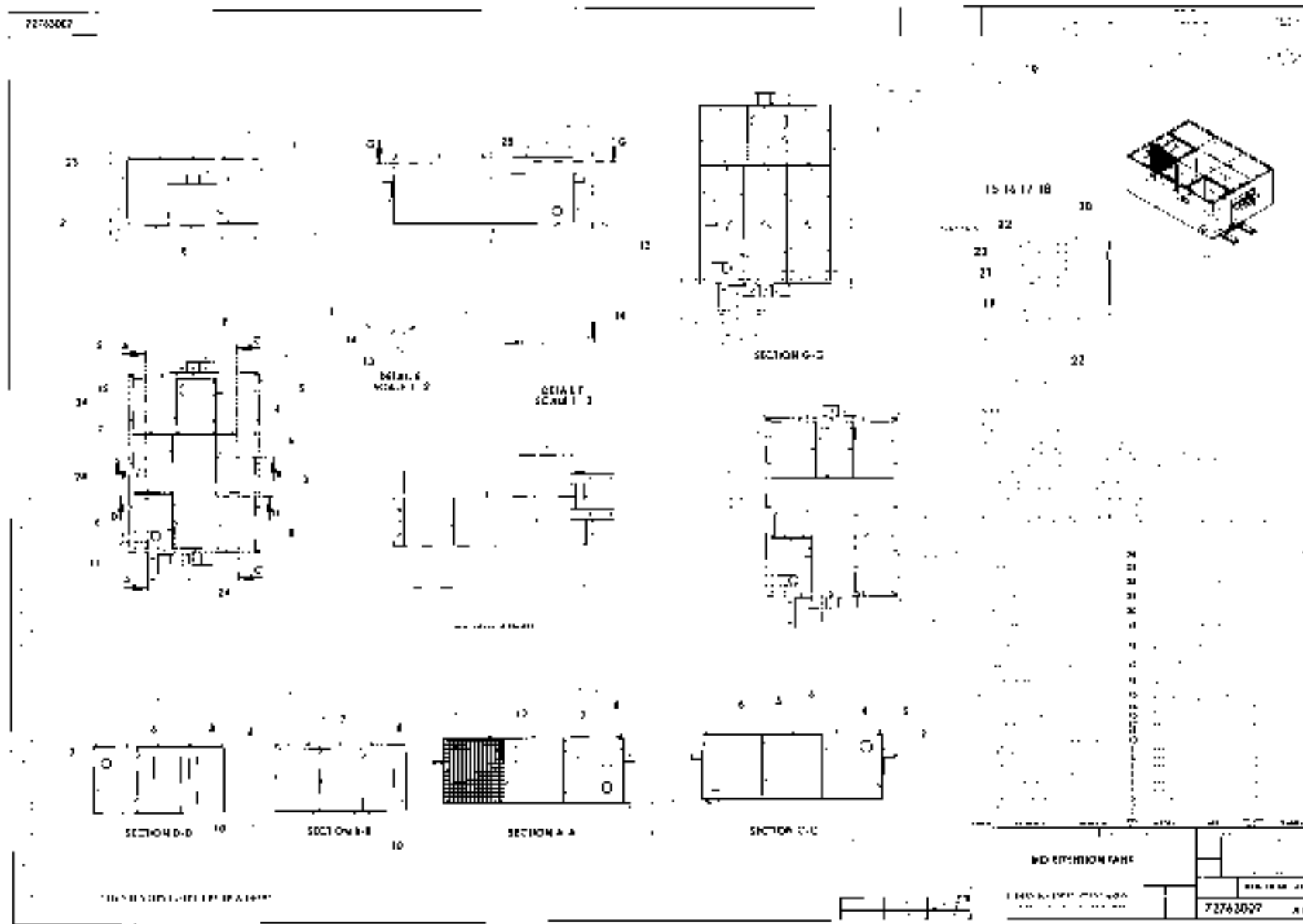


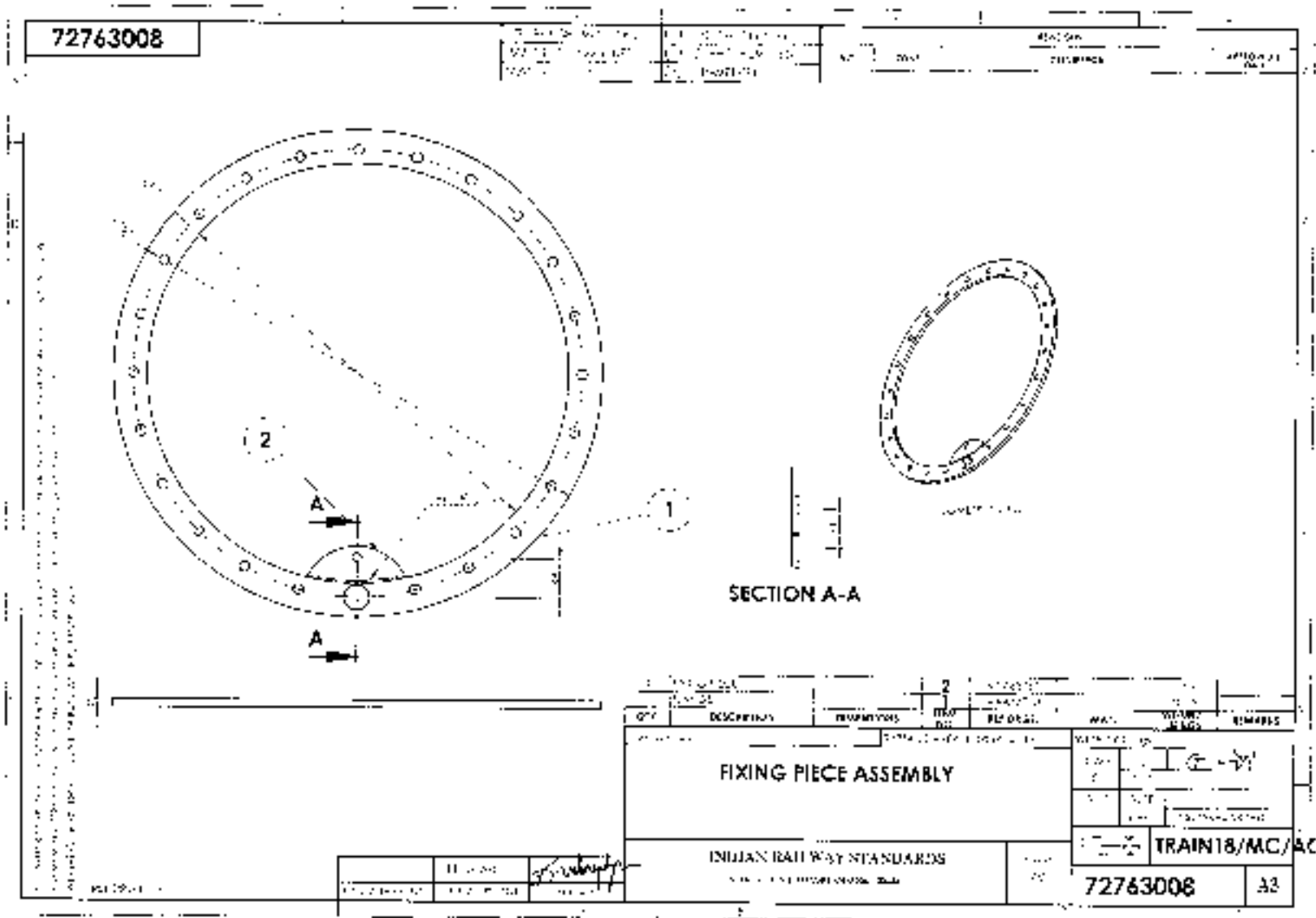


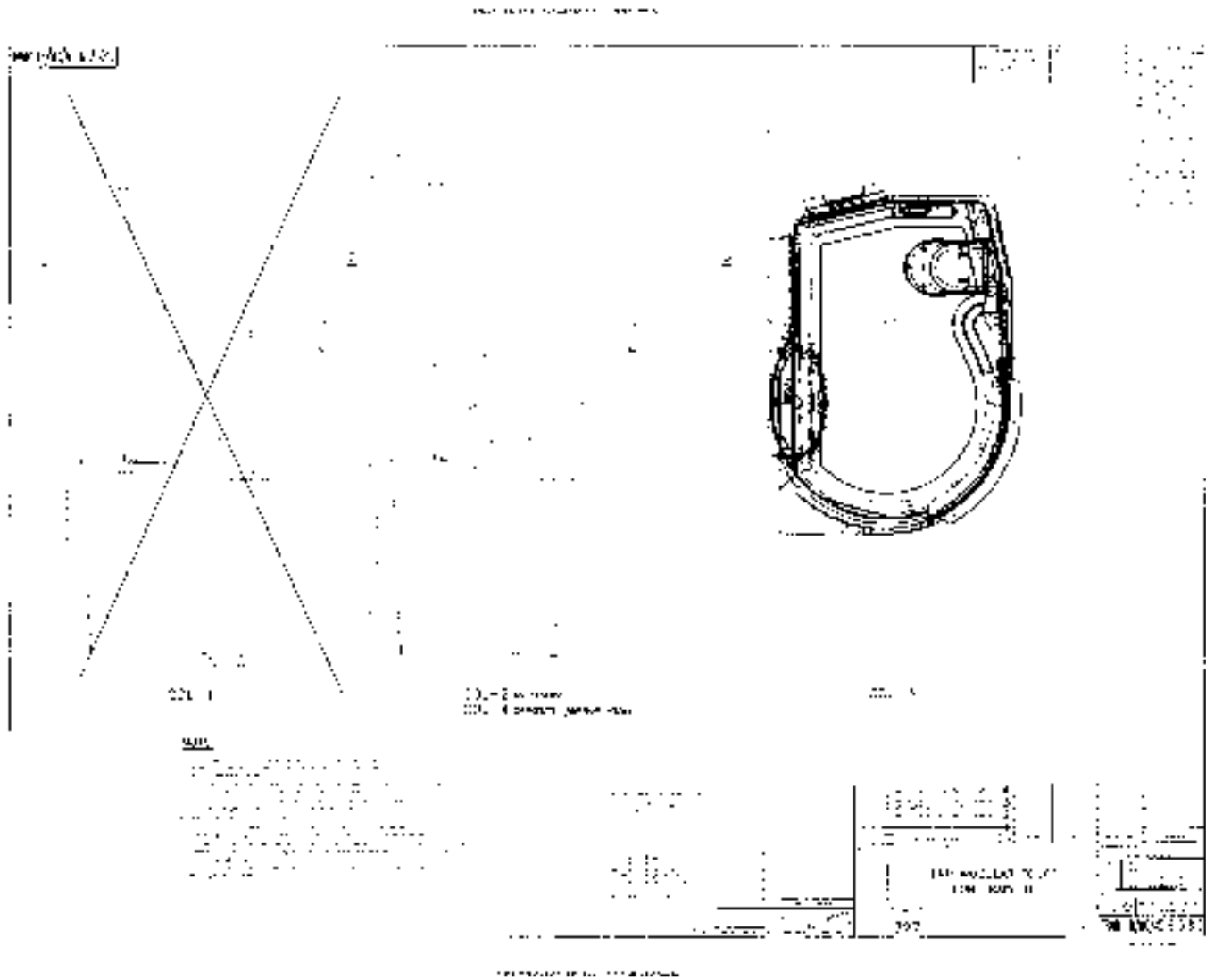


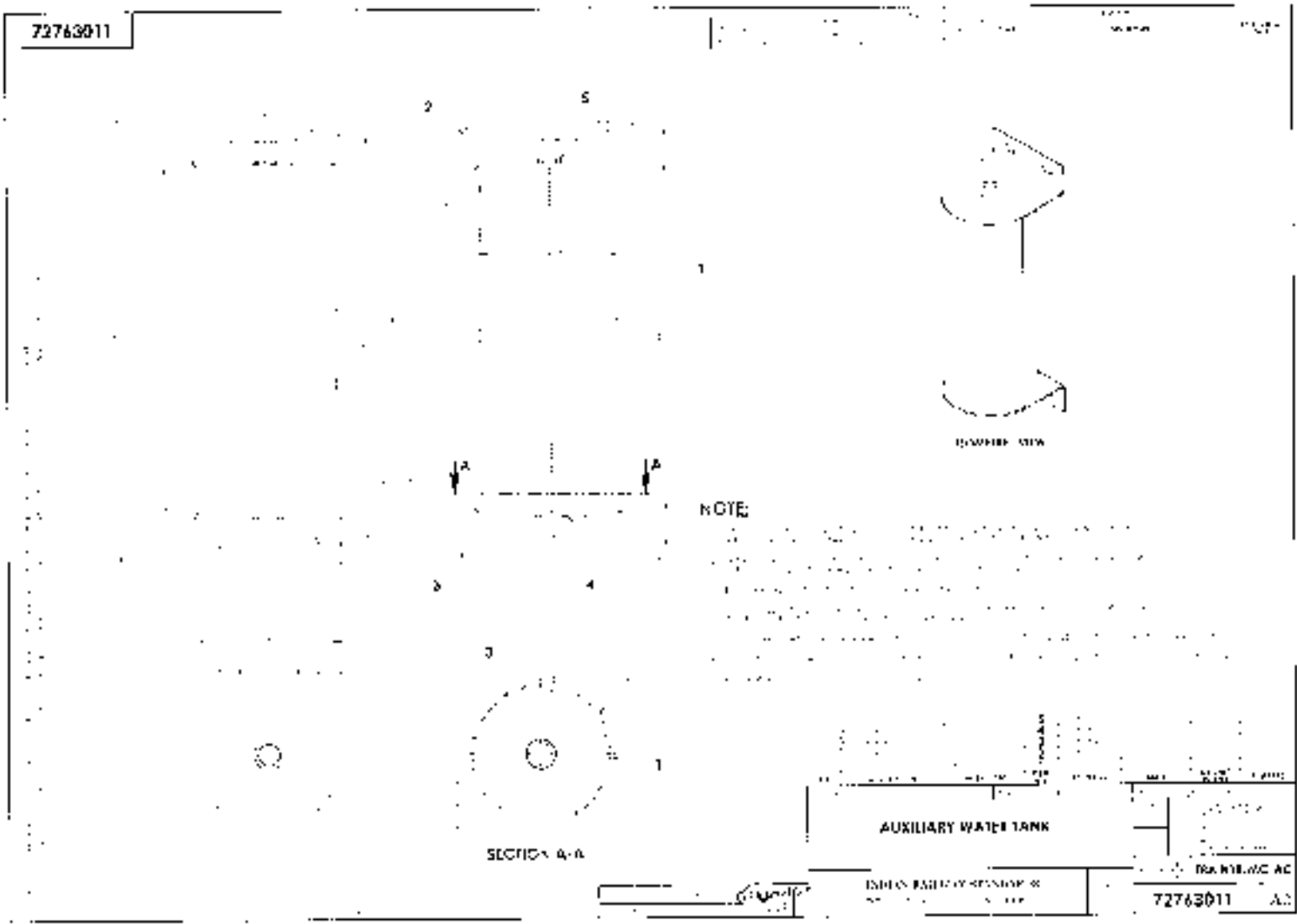


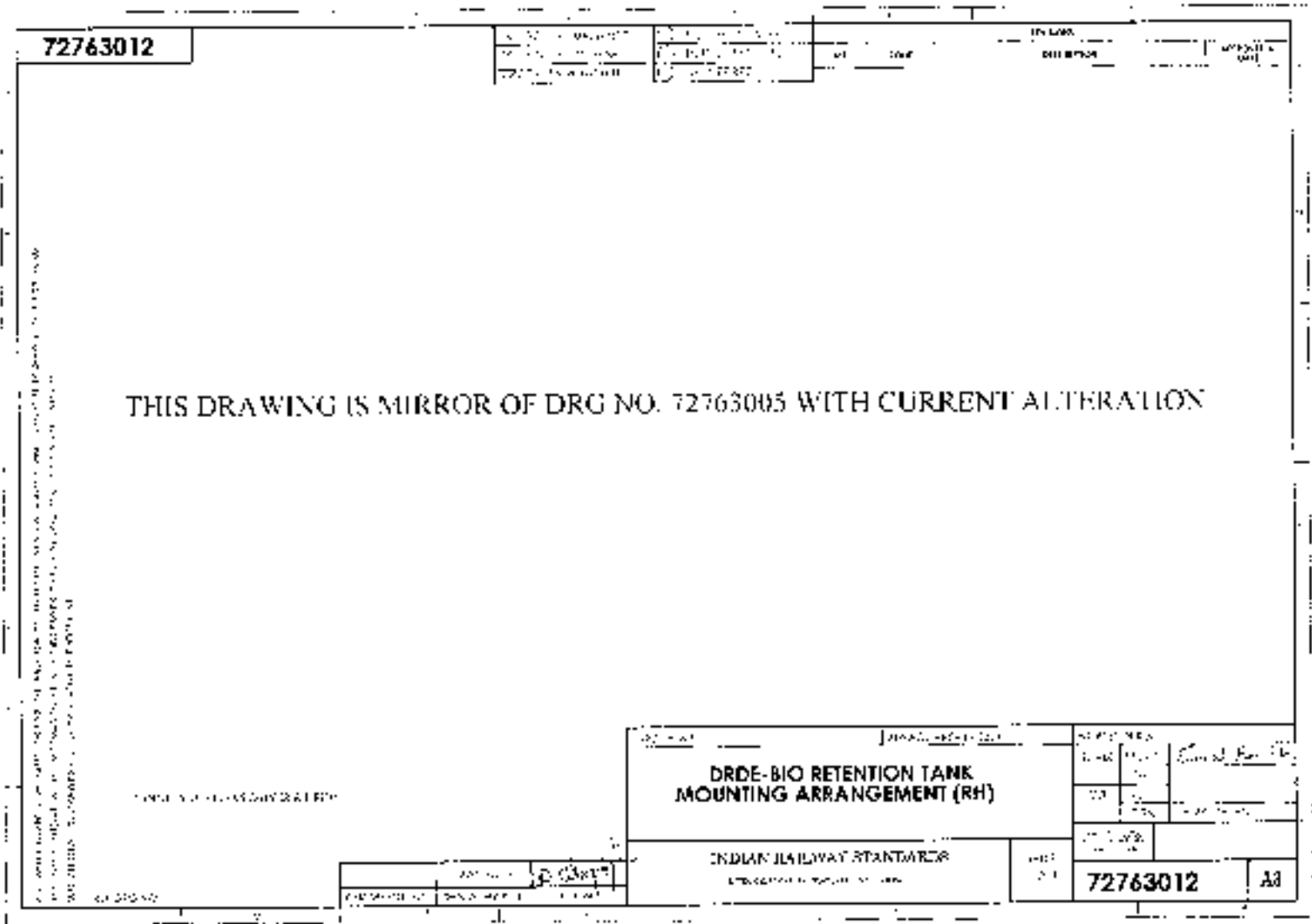


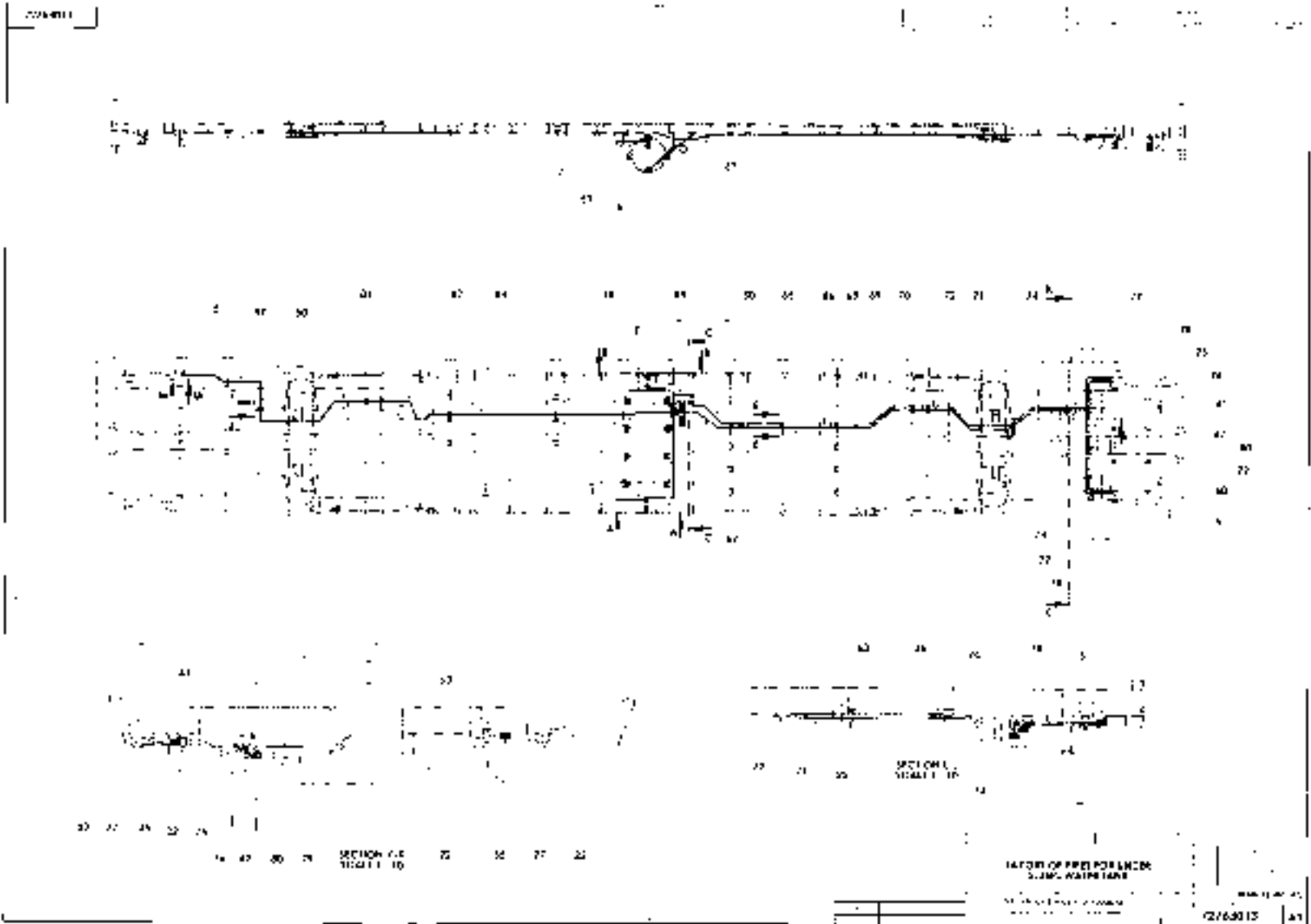


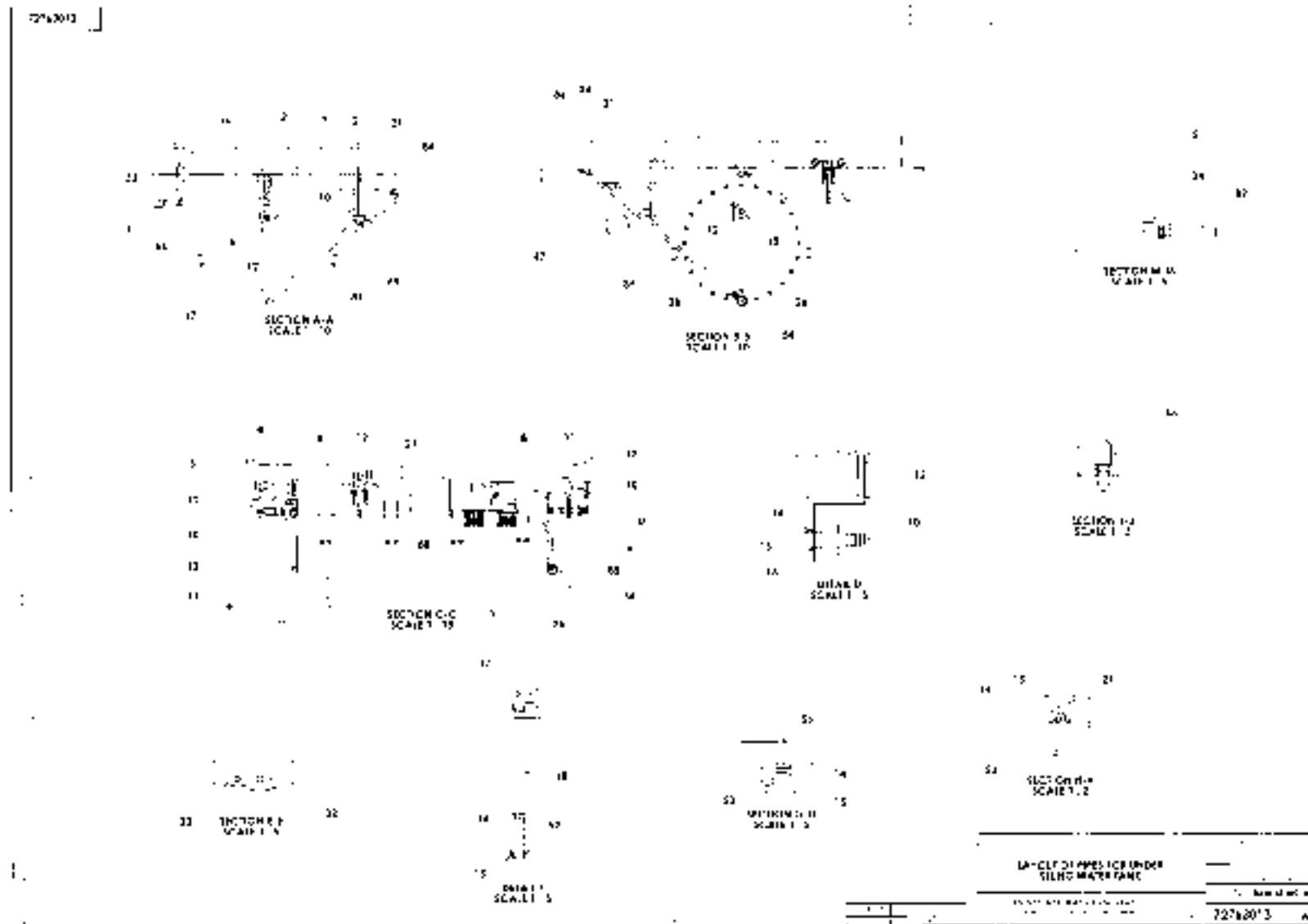


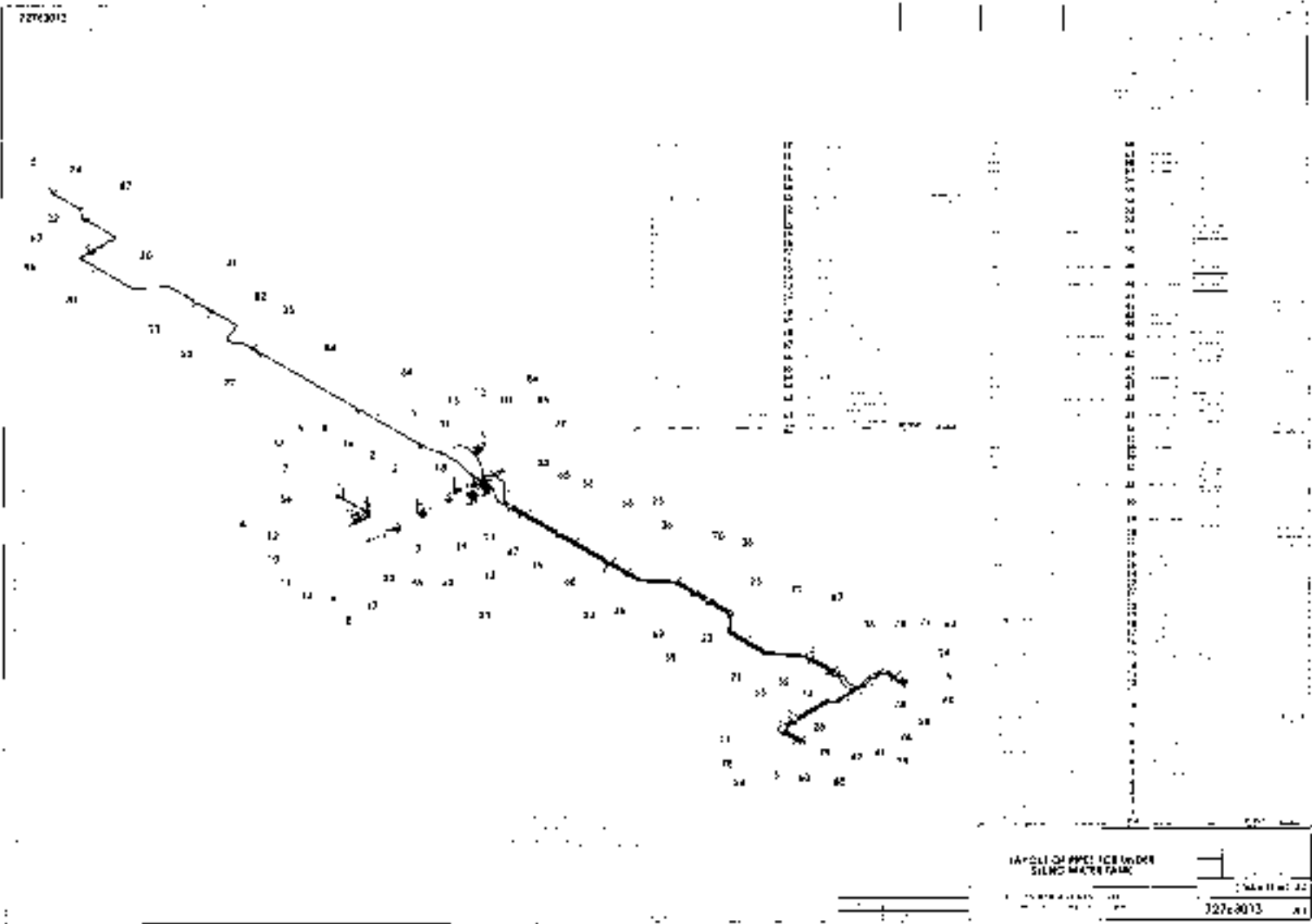


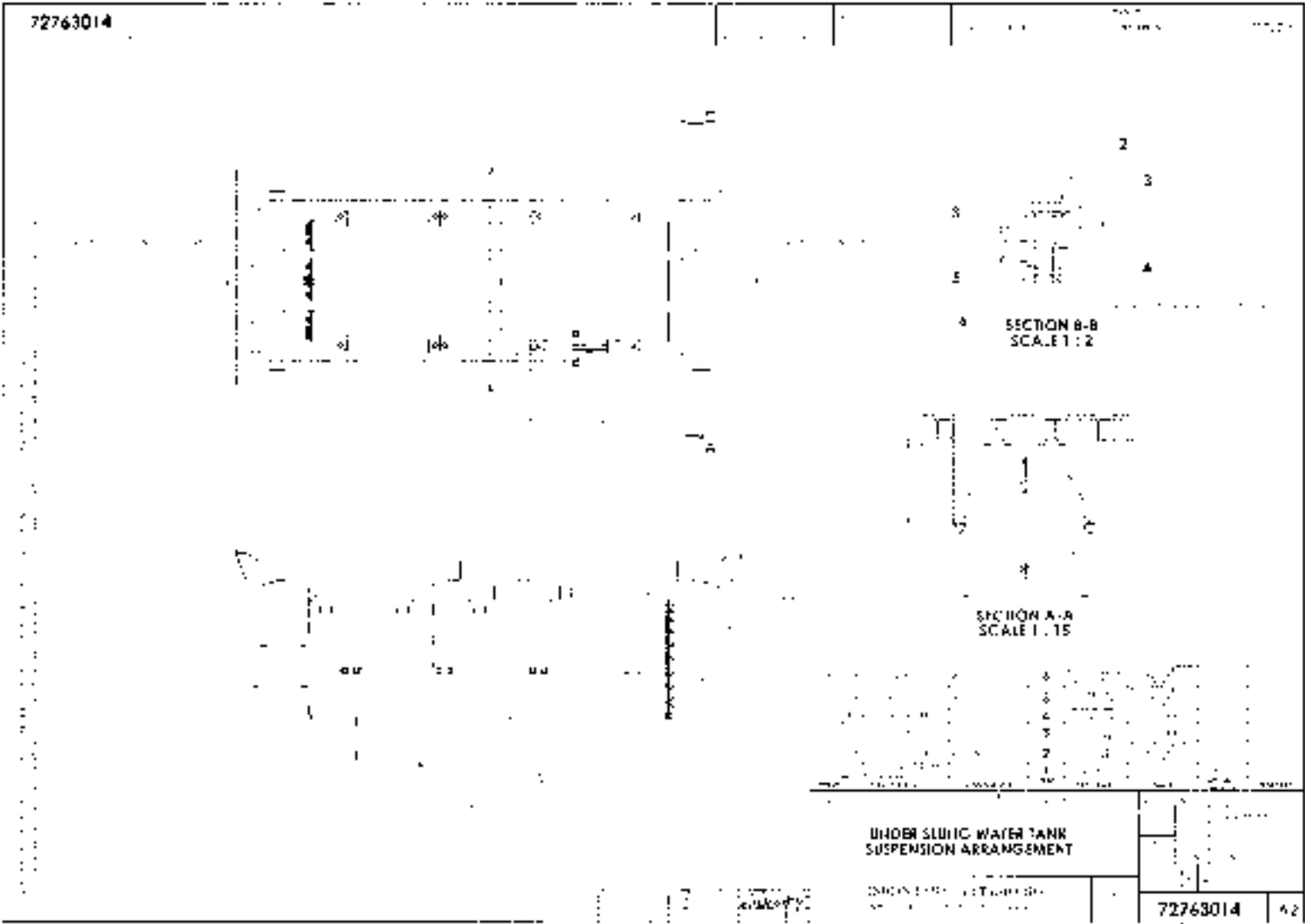


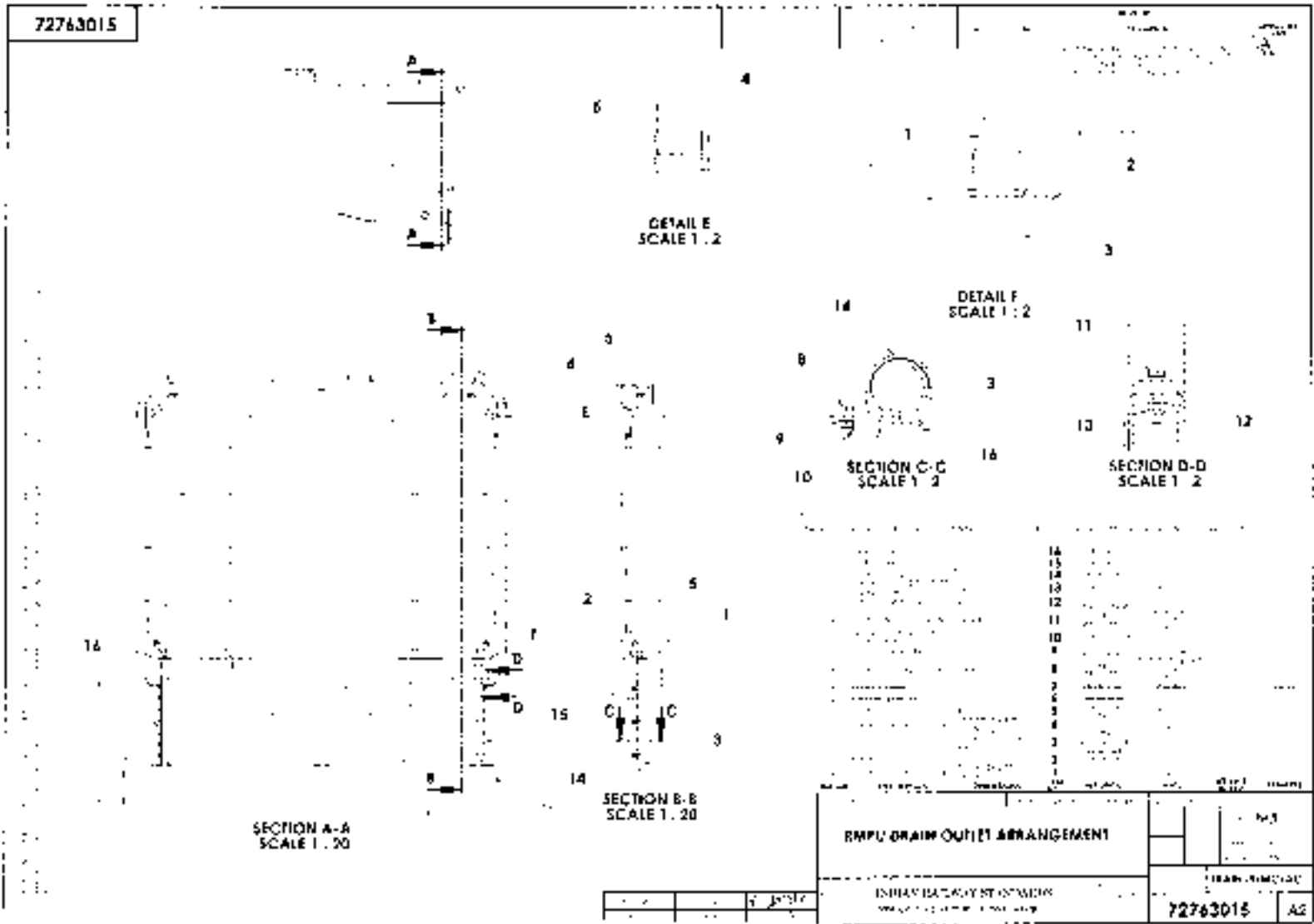


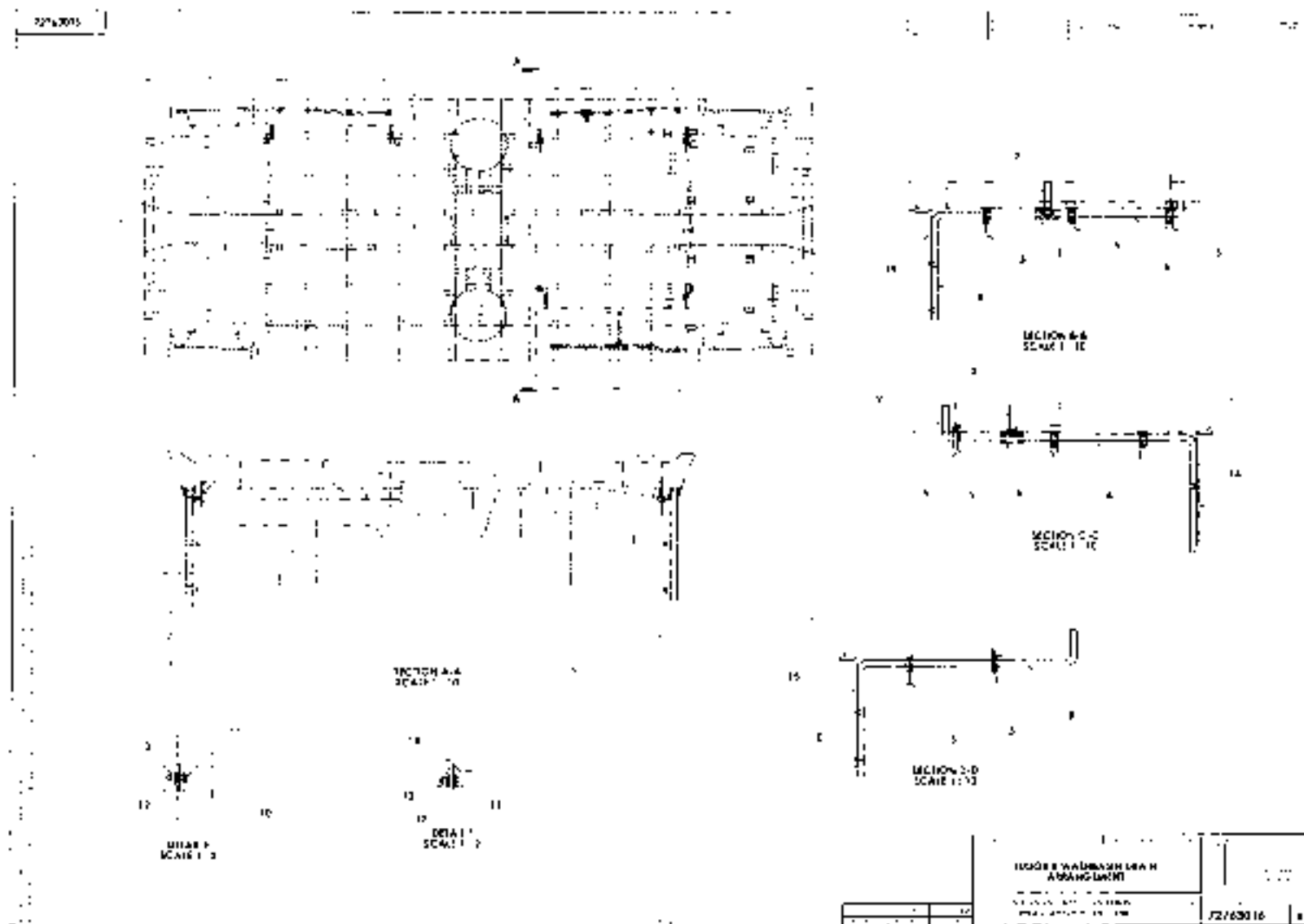


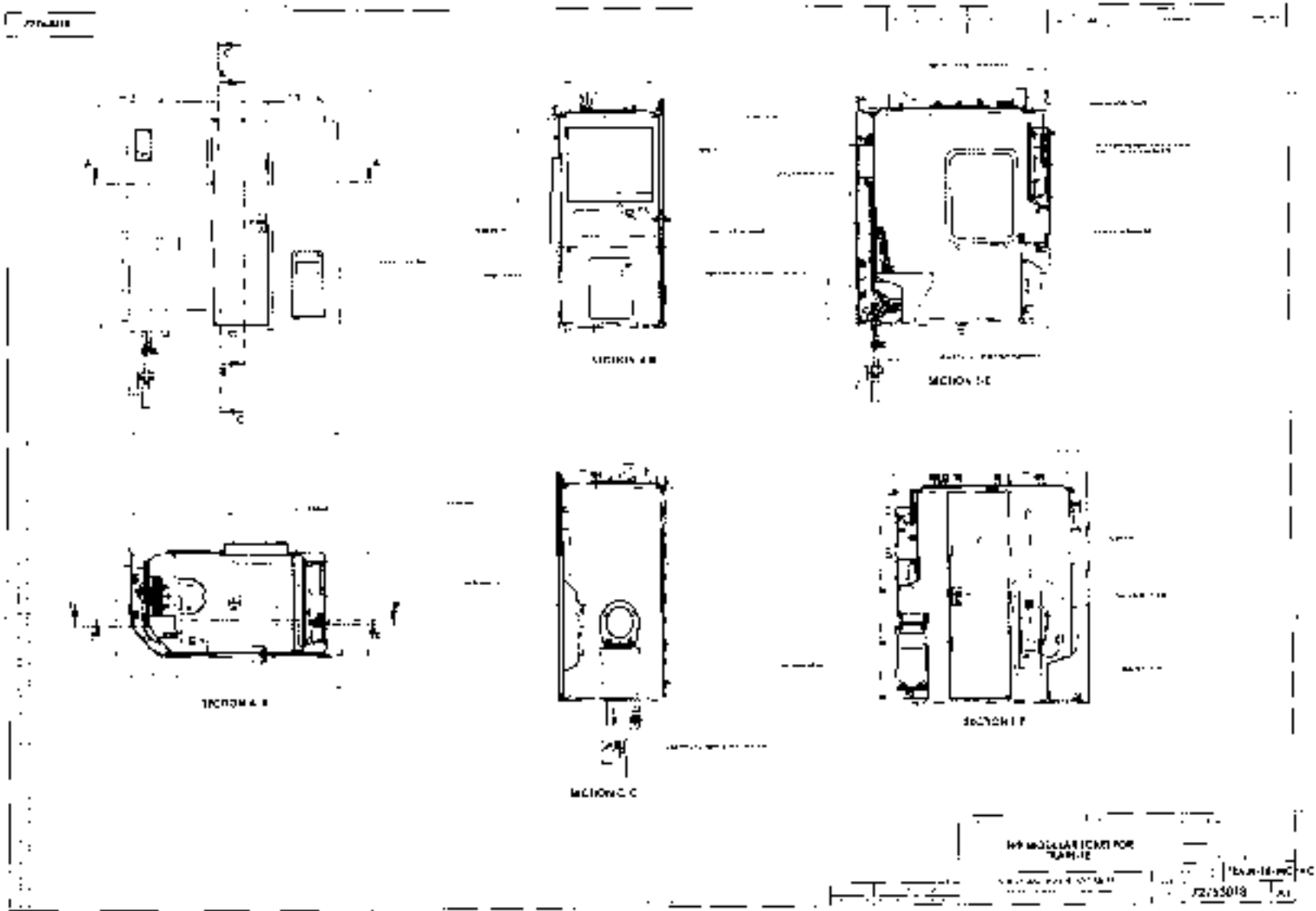


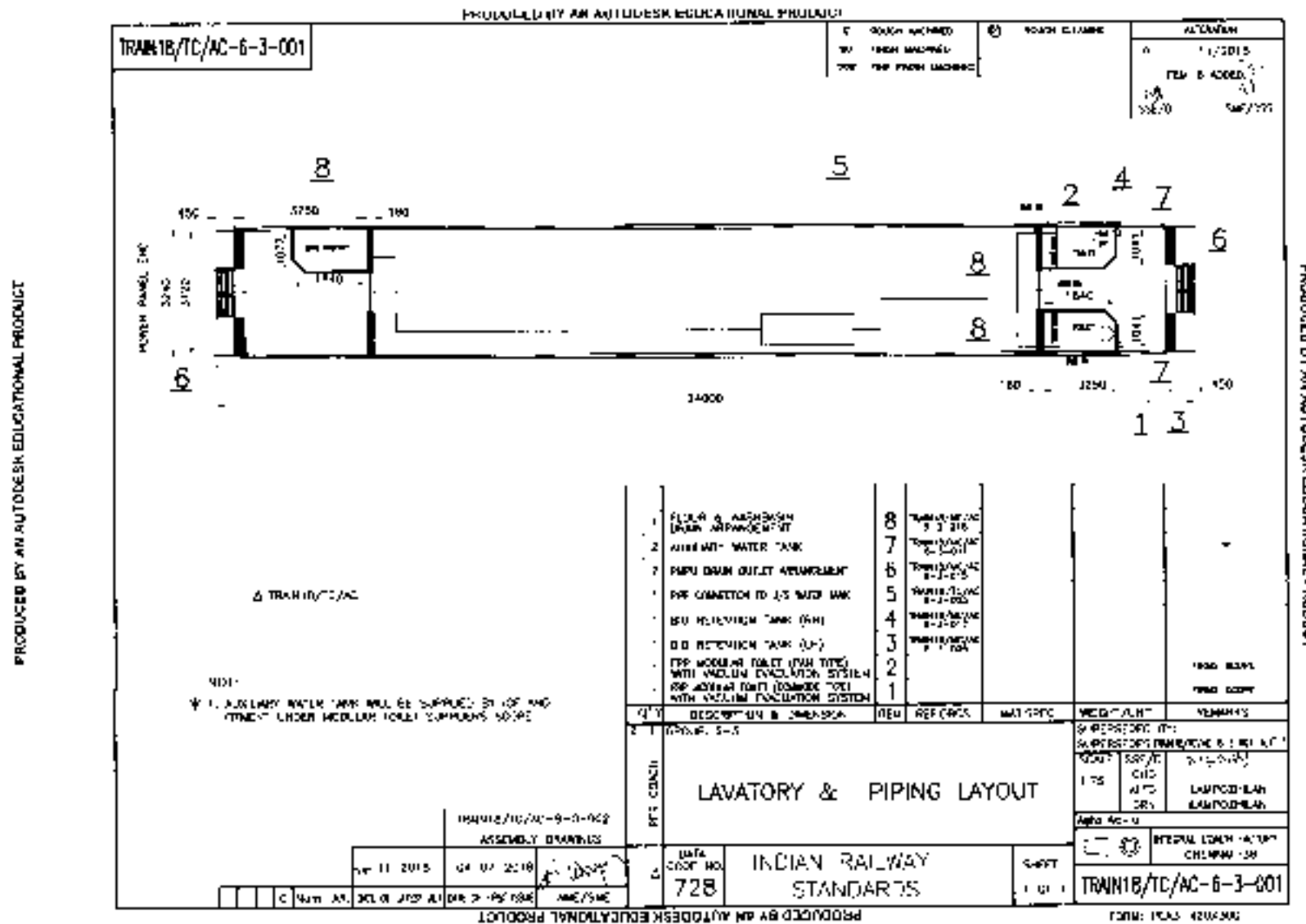


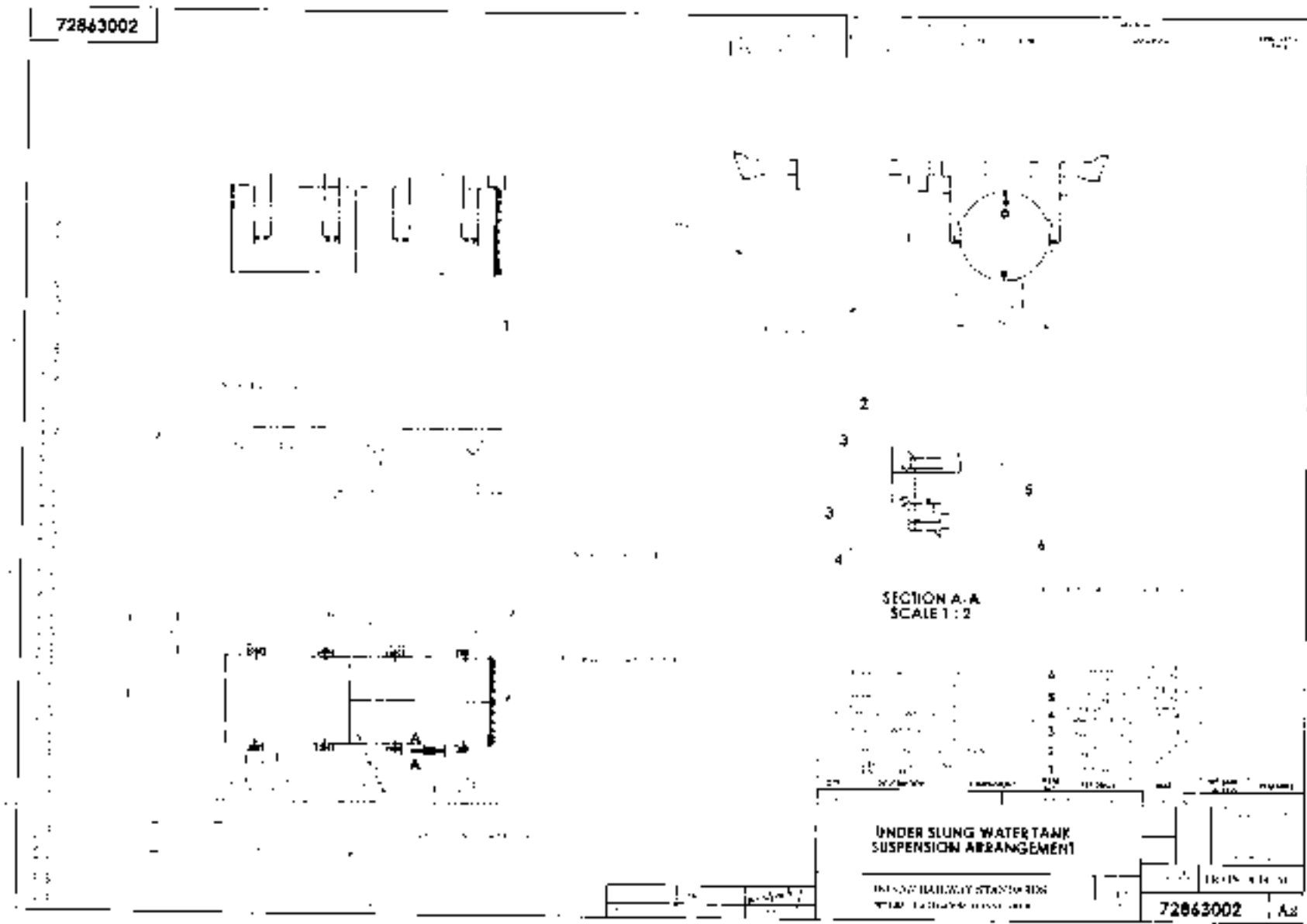


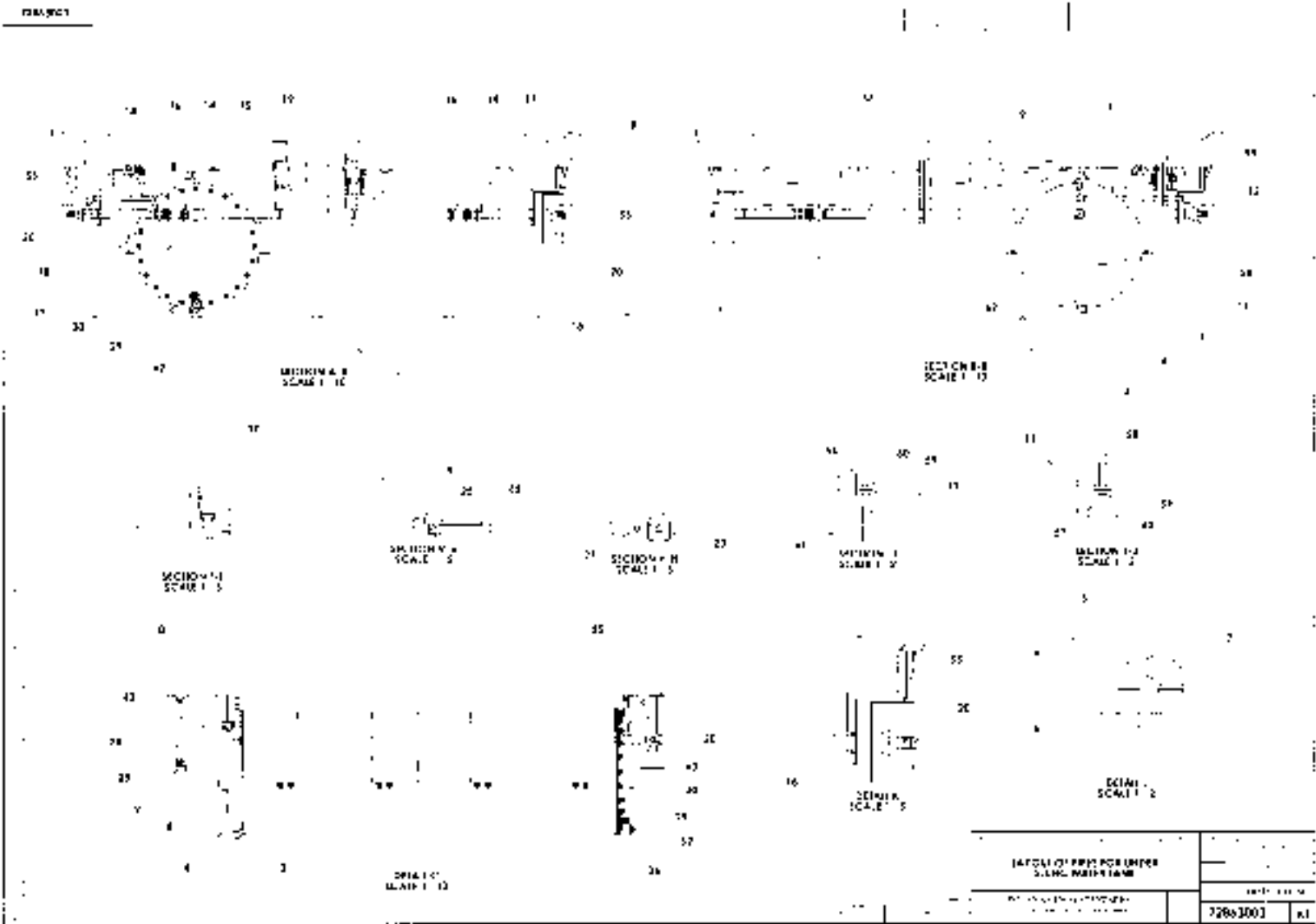




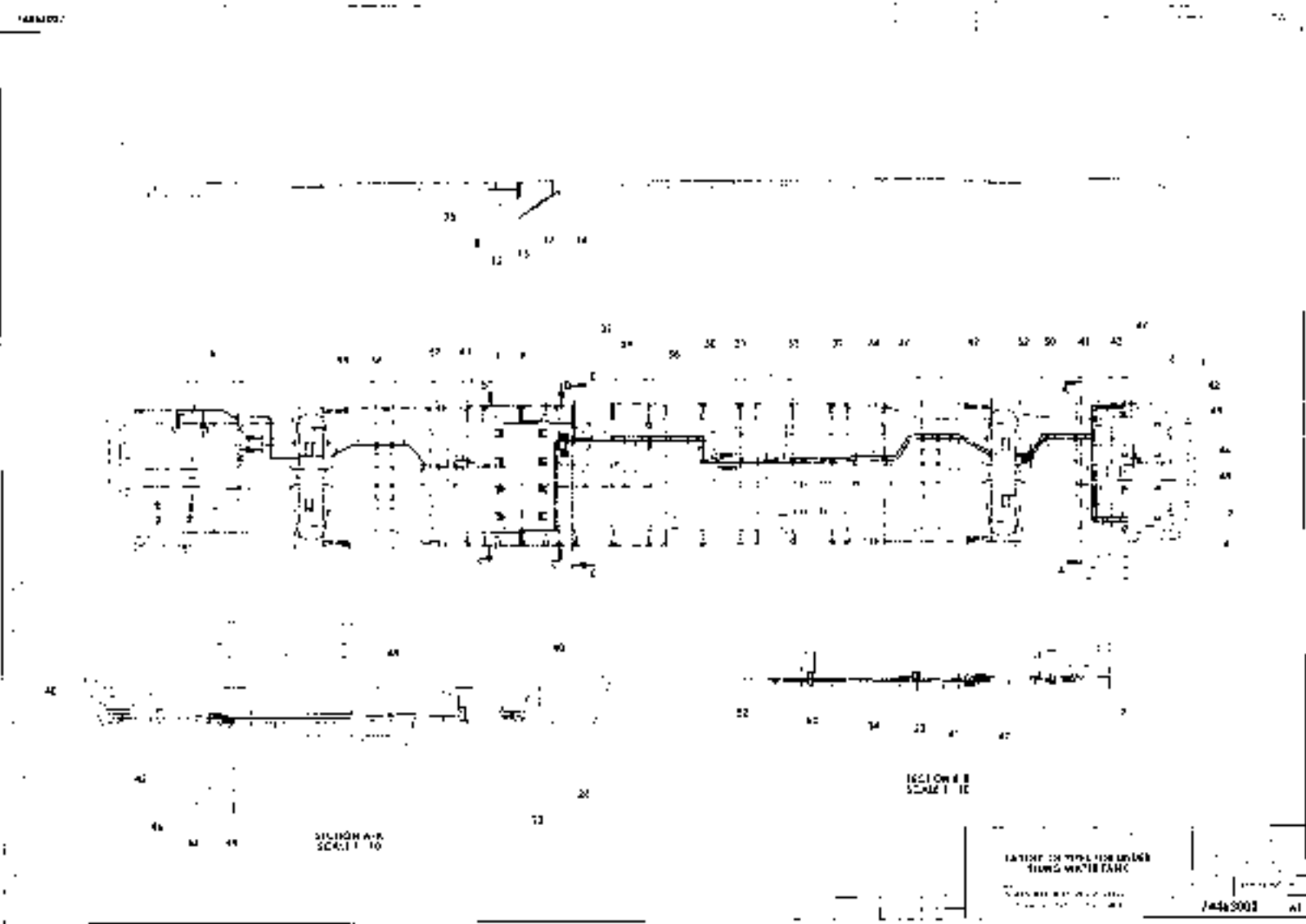


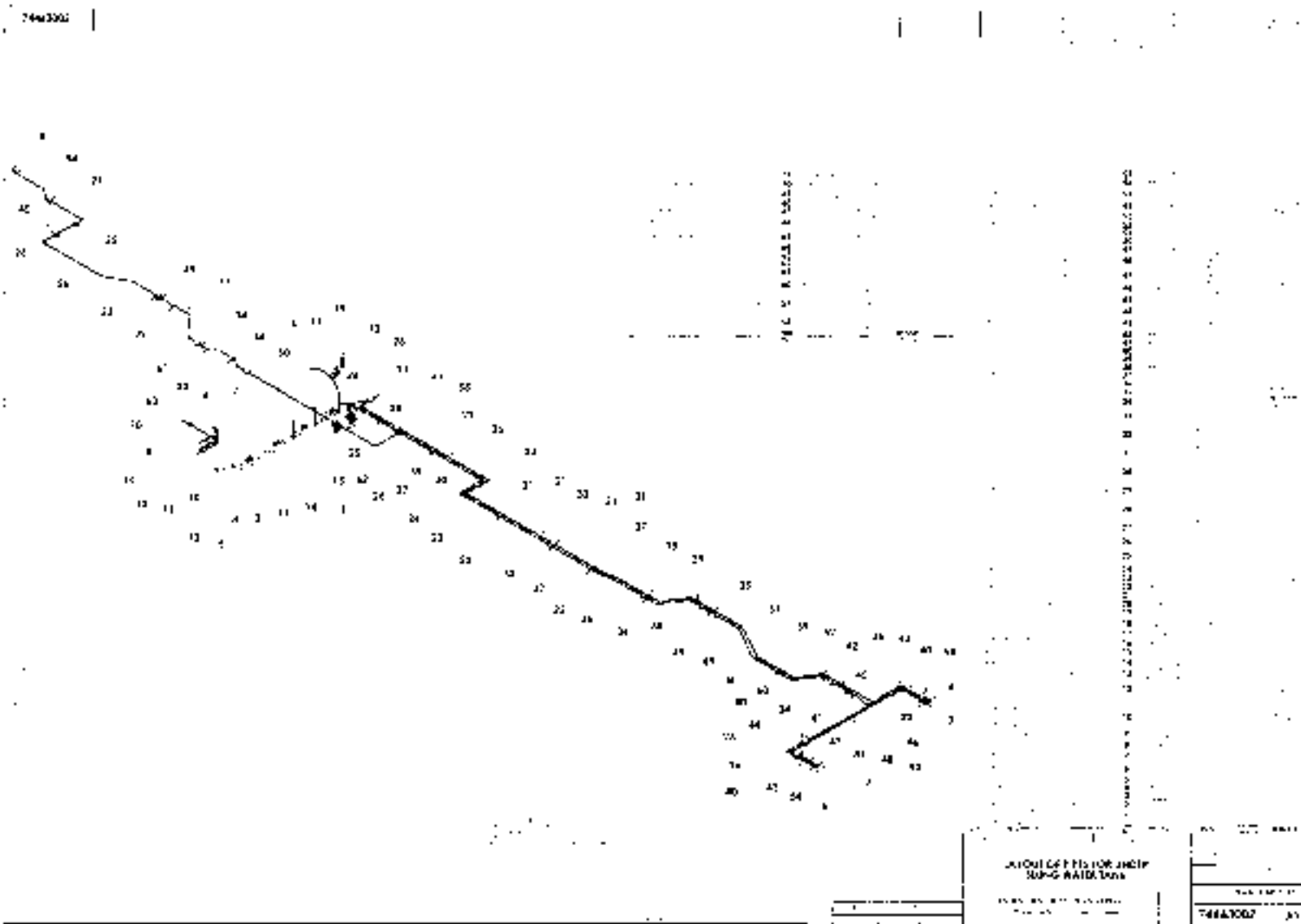


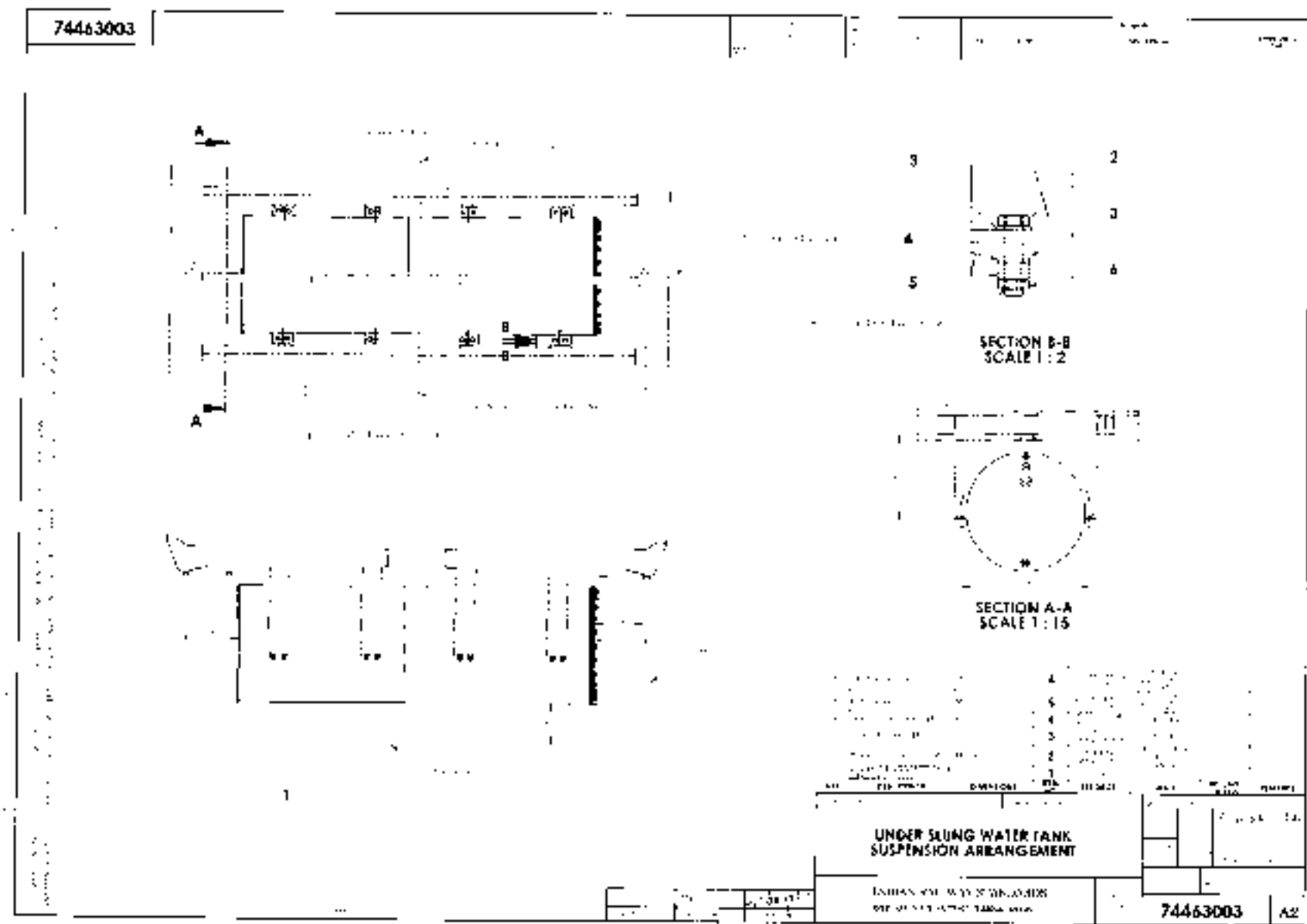


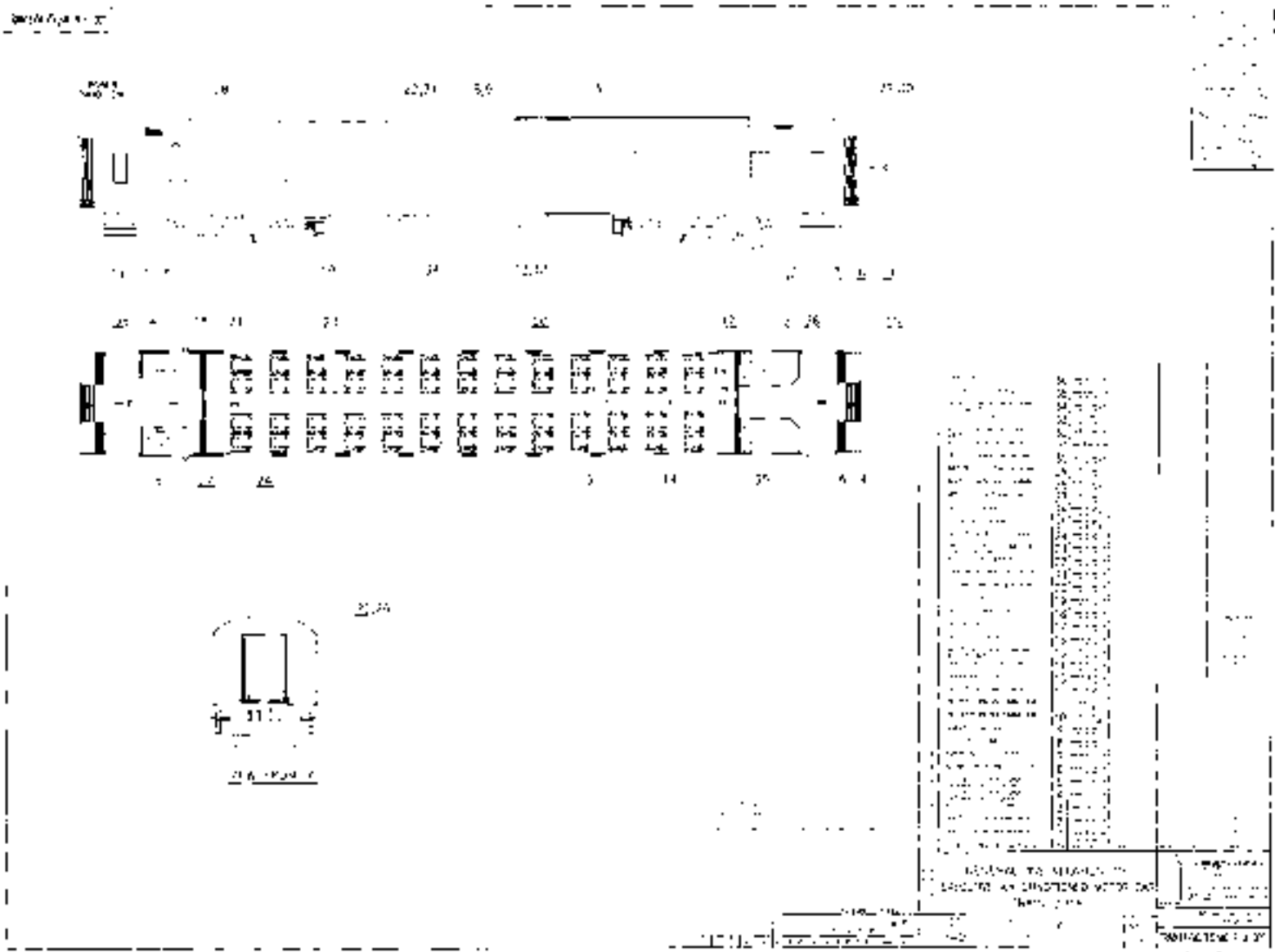




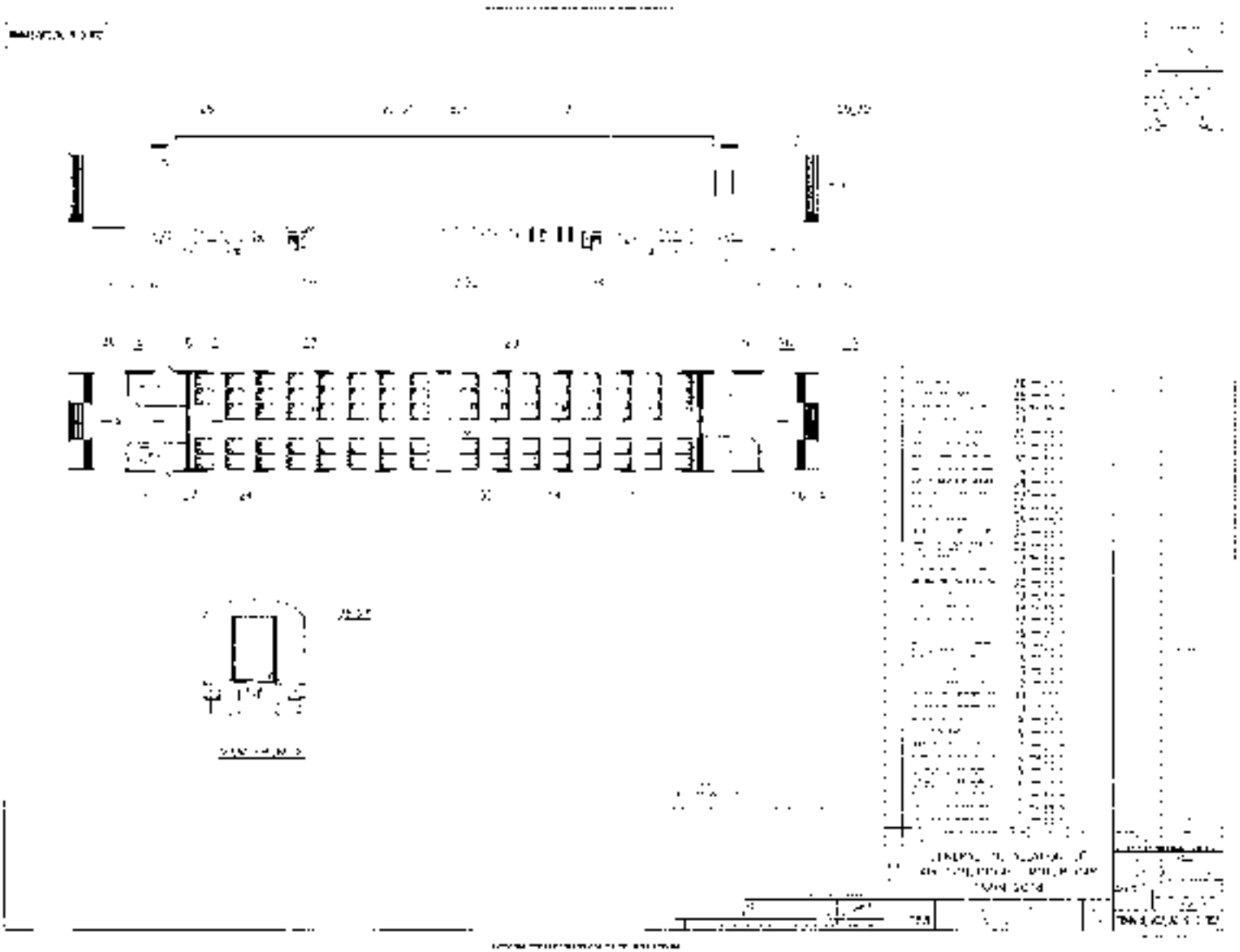


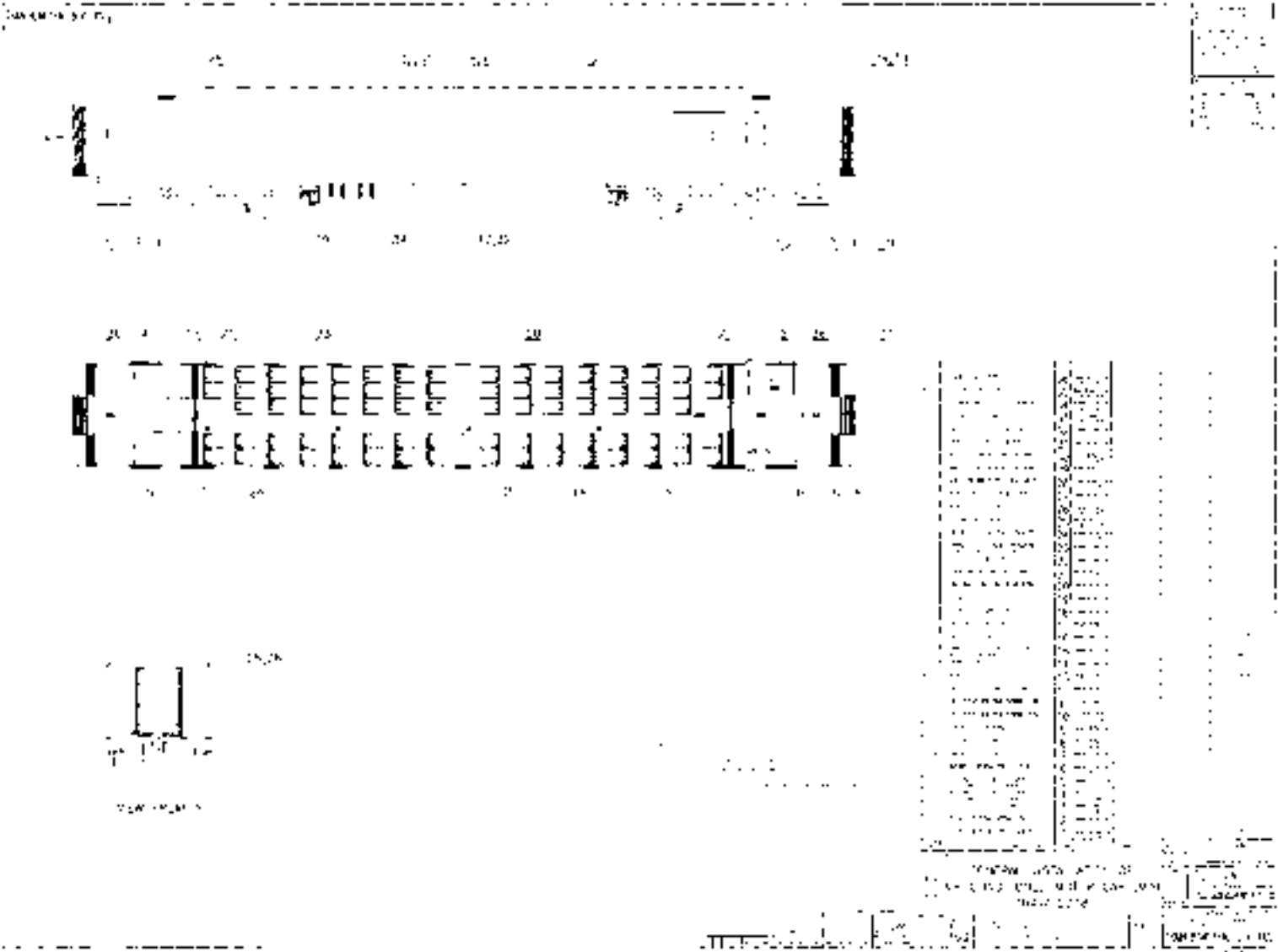












Note:

7. GENERAL INFORMATION

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1.00



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Amendment and Revisions

Version	Date	Corrections	Remarks
1.00	31/08/2020	First Release	--

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7.1. QUALITY OF COMPRESSED AIR

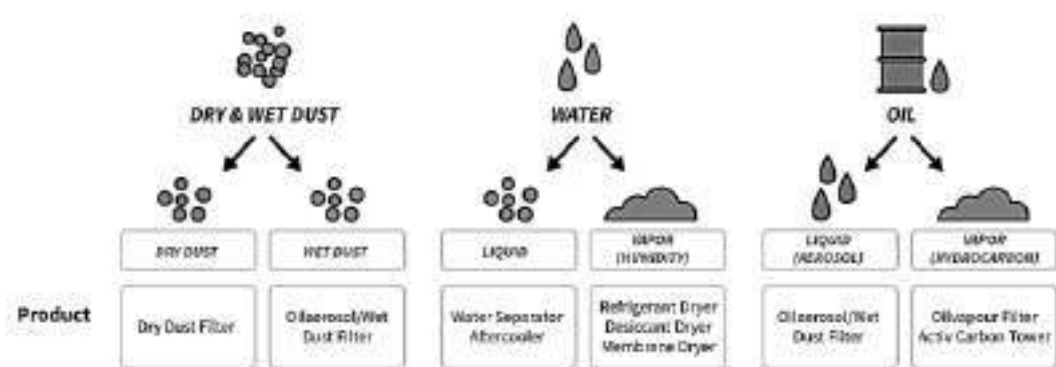
Quality of compressed air: ISO 8573-1

Definition for solids:	5 μm	Maximum particle size
	5 mg/m^3	Maximum concentration
Definition for water:	3°C	Maximum pressure dew point
Definition for oil:	1 mg/m^3	Maximum content
	~0,8 ppm	Maximum concentration

Illegal impurity: PAO-/Ester-oil, antifreeze, alcohol

Other impurity test on compatibility.

Contaminants in compressed air



Compressed air quality according to ISO 8573-1

	Definition for solids		Definition for water	Definition for oil	
ISO Class	Maximum particle size [μm]	Maximum concentration [mg/m^3]	Maximum pressure dew point [$^{\circ}\text{C}$]	Maximum Content [mg/m^3]	Maximum Concentration [ppm]
1	0,1	0,1	-70	0,01	~0,01
2	1	1	-40	0,1	~0,1
3	5	5	-20	1	~0,8
4	15	8	3	5	~4
5	40	10	7	25	~20
6	--	--	10	--	--

The values are defined at pressure = 0 bar, 20 °C, 60 % rel. humidity.

7.2. QUALITY OF WATER

- Low degree of hardness
- Part of bacteria as minimum as possible

7.3. LOCAL MAIN SUPPLY

- Demands of local mains supply Voltage: AC 415V (Power supply socket junction box for external power supply)

7.4. TRANSPORTATION CODE

S.No	Coach Name	Unique Transportation Code	Lay-Out Drawing Number
1	Driving Trailor Coach (DTC)	TS-18/DTC/AC	Train 18 /DTC/AC-9-0-001
2	Motor Coach (MC)	TS-18/MC/AC	Train 18 /MC/AC-9-0-001
3	Trailor Coach (TC)	TS-18/TC/AC	Train 18 /TC/AC-9-0-001
4	Non Driving Trailor Coach (NDTC)	TS-18/NDTC/AC	Train 18 /NDTC/AC-9-0-001
5	Motor Coach - Executive Class (MC2/EC)	TS-18/MC/EC/AC	Train 18 /MC/EC/AC-9-0-001
6	Non Driving Trailor Coach - Executive Class (NDTC/EC)	TS-18/NDTC/EC/AC	Train 18 /NDTC/EC/AC-9-0-001
7	Motor Coach (MC2)	TS-18/MC2/AC	Train 18 /MC2/AC-9-0-001

7.5. LIST OF ABBREVIATIONS

Acronym	Description
AC	Alternating Current
ACU	Auxiliary converter Unit
ADC	Analog to Digital Converter
AIP	Analog Input
AWS	Auxiliary warning system
BC	Brake Cylinder
BCP	Brake Cylinder Pressure
BE	Braking effort
BP	Brake Pipe
CAN	Controlled Area Network
CBC	Center Buffer Coupler
CCTV	Closed-Circuit Television
CCU	Coach Control Unit.
CRW	Cab Rear Wall (Panel)
DC	Direct Current
DCS	Key Driver control Switch Key
DDU	Driver Display Unit
DE	Driving End
DIP	Digital Input
DOP	Digital Output
DPRAM	Dual Port Random Access Memory
DSP	Digital Signal Processor
DTC	Driving trailer coach

EBCU	Electronic Brake Control Unit
EBL	Emergency Brake Loop
ECC	Electrical Control Cabinet
ECN	Ethernet Consist Network
ED	Electro Dynamic
EEPROM	Electrically Erasable and Programmable Read Only Memory
EMU	Electrical Multiple Unit
EOL	Emergency Off Loop
EP	Electro Pneumatic
EPCC	Enhanced Passenger comfort computer
EPCU	Enhanced Passenger comfort unit
ERCU	Earth Return Current Unit
EWP	End Wall Panels.
FDP	Fault Data Pack
FRP	Fibre-Reinforced Plastic
GCRW	Guard Cab Rear Wall (Panel)
GPS	Global Positioning System
HS	High Speed
HSCB	High Speed Circuit Breaker
HVAC	Heating, Ventilation and Air Conditioning
HWTl	Hard Wired Train Line
ICF	Integral Coach Factory, Chennai
IV	Inter-Vehicular
LED	Light Emitting Diode
LRMS	Locomotive Remote Monitoring System
LS	Low Speed
LTC	Line and Traction Converter
LTCU	Line and Traction Converter Computer
LTMS	Locomotive and Train Management System
MC	Motor Coach
MCB	Miniature Circuit Breaker
MCU	Main Control Unit
MMI	Man-Machine Interface
MPCB	Motor Protection Circuit Breaker
MR	Main Reservoir
MS	Motor Side
MVB	Multifunction Vehicle Bus
NDE	Non Driving End
NDTC	Non Driving Trailer Coach
NVR	Network Video Recorders
PA	PIS Passenger Announcement and Passenger Information System
PCC	Passenger comfort computer
RDM	Rescue Drive Mode
PVC	Ply Vinyl Chloride
RDSO	Research Development and Standards

	Organization
PCB	Printed Circuit Board
PCU	Pneumatic Control Unit
PS	Power Supply
PWM	Pulse Width Modulation
RMPU	Roof Mounted Packaged Unit
TB	Terminal Board
TC	Trailer Coach
TCMS	Train Control and Management System
TCN	Train communication network
TE	Tractive Effort
TFT	Thin Film Transistor
TIC	Traction Inverter Computer
TM	Traction Motor
TPWS	Train Protection and Warning System
TSA	Traction System Austria
USB	Universal Serial Bus
VOC	Volatile Organic Compounds
VCB	Vacuum Circuit Breaker
VCD	Vigilance Control Device
WS	Wheel Side
WTB	Wire train bus

7.6. PRECAUTIONS WHILE WORKING ON TRAIN-18

7.6.1. GENERAL PRECAUTIONS

- Death, severe injury and considerable damage to property and environmental damage may result if the safety instructions are not followed.
- Provide “**Man at Work**” board at both side of the train set.
- Set the display card “**Work in progress**” on the vehicle.
- Put the proper wheel skids on both end wheels of train set.
- Before commencing work on the vehicle, ensure that all voltages are disconnected.
- Be careful and vigilant.
- Always wear helmets, boots and personal protective equipment as per requirement of work.
- Insulated tools, insulating protective clothing, protective devices, safety belts, equipment and other auxiliary material must be preserved in good order and condition.
- Before every use, the user must inspect the insulating protective clothing for apparent damage.
- Damage to the insulating protective clothing must be rectified by technically qualified workshops only.
- However, gloves should not be repaired and should be replaced.
- At specific time intervals, the insulating gloves and shoes must also be inspected electrically for their protectiveness.
- The personnel should not have loose long hair, loose clothes or jewellery, including rings. There is risk of injury e.g. by getting caught or drawn in.

- Always, discharge the meggered circuit to ground with the help of flexible insulated wire after meggering.
- Working on electrical equipment must only be carried out by a qualified electrician/technician or by instructed persons under the leadership and supervision of a qualified electrician/technician.
- Use appropriate Personal Protective Equipment (PPE) when working with hot components and dusty environment.
- Always wear a dust mask when working in dusty environment.
- Ensure the adequate cooling time has been allowed, if train has recently been running.
- No one shall be allowed underneath the equipment while being transported by a crane or other means.
- Individual components and bigger components should be carefully fastened and secured to the hoisting devices during replacement.
- Only use suitable and technically perfect hoisting devices as well as load carrying equipment with adequate load carrying capacity.
- Only experienced people should be entrusted with fastening of loads and instructing the crane operators. The concerned staff must remain within the range of vision of the operator or they must be able to speak to each other.
- Do not stand or work under suspended loads.
- Take care when dealing with hot consumables and auxiliary materials (burn or scalding hazard).
- During cleaning work with compressed air, pay attention to suitable extraction and personal safety measures (safety gloves, safety goggles, respiration filter etc.).
- The chemical products used for cleaning must be kept in clearly visible and recognizable designated areas or cabinets, and always away from areas provided for food preparation.
- Aggressive cleaning agents should not be touched with hand.
- Wash off immediately with a large volume of water if touched with hand.
- Do not drink or inhale the vapors.
- A doctor's assistance should be sought immediately if the cleaning agent has been drunk inadvertently.
- Use heat resistant gloves when heating up parts.
- Before commencing any work on the vehicle the personnel shall always, set the vehicle to the correct operating position for the task to be performed.
- Study the necessary safety precautions within the documentation and on the Vehicle.
- Count all the tools after completion of work and keep them in a proper tool bag.
- Do not drop oil/ grease on pits as staff may slip and get injured.
- Do not leave released hardware on shop floor and inside the pits.
- Do not leave any tool, cotton waste or any other foreign material after completion of work.

7.6.2. SAFETY PRECAUTIONS WHILE ACCESSING THE ROOF

- Switch off OHE supply by opening the controlling isolator and provide pad lock in OHE isolated condition in supervision of maintenance gang in-charge.
- Earth OHE by providing earth discharge rods on both ends.
- The sequence of fixing discharge rod should be- first connect clamp to earth and then connect to OHE.

- Staff will further provide individual pad lock in controlling isolator in OHE isolated condition and retain key with him till such time the work is completed.
- Ground the Train set by operating roof earthing switch before accessing to the roof.
- Always use ladder for accessing to the roof.
- Clean the hands and sole of the shoes to avoid slipping before climbing on the ladder.
- Use a suspended bag to hand tools or parts to workers.
- After completion of every repair or maintenance, ensure that no tools or other are left on top of the vehicle roof.
- After completion of the work, the concerned supervisor, after satisfying himself that all staff, tools, ladder etc. and the discharge-rods provided on OHE have been removed, may re-energize the OHE.

7.6.3. PROCEDURE TO OPERATE DCLINK EARTHING SWITCH

- During maintenance of Line and Traction Converter (LTC) unit or DC link earthing switch, entire rake OHE power is switched OFF and power circuit in the Basic Unit (BU) is safely connected to earth from the pantograph to traction transformer and then to LTC unit. To properly ensure all these things, a safety interlock system with lock and key is provided in the system.
- For any maintenance activities related to LTC unit and DC link earthing switch user need to be ensured and also secured that the DC link voltage shall be at zero volts. To avoid charging of DC link capacitor from stray charging, it is recommended to short the DC link positive and negative terminals of LTC unit. This can be done by operating the DC link earthing switch.
- Each motor coach consists one DC link earthing switch box, which has one 4-pole DC link earthing switch. Both the LTC unit positive and negative terminals in the same MC are connected to 4-poles of DC link earthing switch.

To operate DC link earthing switch, follow the following procedure:

- Down the pantograph of Basic Unit and release the pantograph blue color key. After removing the blue color key, pneumatic pressure does not build up, even if command comes from the system, due to any reason and pantograph will not raise.
- Insert blue key in 25 kV roof earthing switch and operate its handle to earth position.
- Two Yellow color keys gets released and blue key will be locked in the panel. Remove any one of the yellow color key and insert it into the DC link earthing switch box in the under-frame and operate it. With this, all the positive and negative terminals of two LTC units in the same Motor coach shall be shorted and are connected to earth and provides safe condition for maintenance activities.
- Yellow color key will be locked in the DC link earthing switch panel. Release green color key from the DC link earthing switch panel.
- To know the status of the DC link earthing switch, NO/ NC feedback signals are connected to MCC unit. But the MCC reads the signal feedback when its control supply is in ON state only.

To restore to actual conditions, follow the same steps from last to first:

- Insert green color key into the DC link earthing switch and rotate the handle to normal working mode. Then green color key will gets locked and yellow key is released from the DC link earthing switch.

- Insert yellow key in 25 kV AC roof earthing switch and move the earthing switch handle to working conditions. Then two yellow keys get locked and blue color key will be released from the 25 kV AC roof earthing switch.
- Insert blue key into pantograph and rotate the key into its normal slot. With this, pantograph does not raise automatically. If command comes from the system, pantograph raises.

7.6.4. BEFORE STARTING MAINTENANCE OF LINE AND TRACTION CONVERTER UNIT

Before doing any maintenance activity related to Line and Traction Converter unit or any activity in the under frame, the following sequence of steps to be followed for human safety against dangerous high voltages:

- Make sure that the all the pantographs are in down conditions in the rake. If not down the pantographs and open all the VCBs in the system. Wait for 10 minutes from the instant the VCBs are open.
- Take out the blue key from all the pantographs in the rake. This gives guarantee that the pantographs will not be raised in the rake during maintenance periods.
- Follow the procedure as mentioned earlier to remove Green colour key from the DC link Earthing switch. By using the Green key LTC converter unit door can be opened.
- After completion of maintenance work follow the opposite sequence to restore the normal conditions. Otherwise the system will not get the OHE power supply.

7.6.5. BEFORE STARTING MAINTENANCE AUXILLIARY CONVERTER UNIT, BATTERY CHARGER

- Put the train in duty position.
- Verify that there is no voltage remaining between DC+ and DC- by measuring with a voltmeter.
- The propulsion equipment is secured by the key interlock system. It ensures that the high voltage supply is always earthed before it is possible to get in contact with the equipment.
 - I. Open the isolation switch guard cover by unscrewing the knob.
 - II. Place the key-A in to the isolation switch and rotate clockwise for accessing key-B. Rotate the key-B anti-clockwise and remove it. With Key-B Main door lock to be opened.

7.6.6. BRAKE CHOPPER RESISTOR

- Before starting any maintenance operations, make sure that VCB is opened and Manual DC Link discharge switch is operated in that basic unit and the resistor cannot be energized.
- It is necessary to wait for 30 minutes after power cut off to allow the resistor active parts and the frame to cool.

7.6.7. MAIN TRANSFORMER

Deadly voltages are present inside the transformer and all electrical connection points, creating a risk of electric shock. Before working on the electrical connections, it is mandatory to:

- Before working in an electrical box, carry out an analysis of potential risks and take adequate and appropriate measures.

- Before working on the device, turn off the train supply and secure the electrical installations by earthing and short circuit as well as equi-potential bonding.
- Before any maintenance operation, operating personnel must leave the time to the equipment to cool down to avoid injury.
- Verify that there is no voltage left in any bushing (LV and HV) by measuring with a voltmeter.
- OIL System may be under pressure, and may cause skin irritations and damage to eyes from escaping fluids.
- Switch off the cooling unit and relieve pressure from the system before disconnecting the hoses for cleaning and maintenance.

7.6.8. TRACTION MOTOR AND GEAR BOX

- Carry out maintenance and repair work only when the traction motor is switched off and secured against inadvertent restarting.
- In the case of any intervention, the power supply to the traction motor should be disconnected.
- Before welding, burning and grinding, the traction motor and its surroundings should be cleaned of dust and combustible materials and must make sure there is enough ventilation (explosion hazard).
- Never operate the traction motor without safety devices and an open junction box.
- For measurements of Insulation resistance with megger, the motor should be isolated from all cable connections.
- For all work on the gearbox in which the drive is installed in the bogie or is connected to another power supply, it must be ensured that the drive and all connections are switched off and secured against being switched ON again.

7.6.9. ECC, CRW AND GCRW UNIT

- CRW, GCRW and ECC contain electrical equipment, which uses/ carries high voltage. This can be highly dangerous.
- Any maintenance/ installation work is to be carried out by trained staff with appropriate precaution only.
- Before commencing work, ensure all voltages are disconnected.
- Lock the switches, isolators, fuses, etc. where possible.

7.6.10. WIPER

- Always disconnect the power, when servicing the Windscreen Wiper System, or on any ancillary components. Serious damage to the Equipment and/or Personal Injury may occur if the power is not disconnected.

7.6.11. ROOF MOUNTED PACKAGE (AIR CONDITIONER) UNIT

Air conditioners are charged with the refrigerant R-407C. R-407C is colorless with a faint ether-like odor.

- Pressurized, liquid refrigerant escaping from the system may cause cold burn and blindness. If there is a risk of contact with liquid R-407C, suitable protective equipment must be worn (goggles or face-shield, insulation gloves, clothes and footwear).
- R-407C is not flammable but toxic and/or corrosive gases may be produced when R-407C is involved in a fire. Never use direct flame (e.g. a brazing torch) in the presence of R-407C.

- R-407C vapor is heavier than air and may accumulate in confined spaces, particularly at or below ground level.
- High concentrations, R-407C may cause asphyxiation. Symptoms may include loss of mobility/consciousness. Victims may not be aware of asphyxiation.
- In low concentrations may cause narcotic effects. Symptoms may include dizziness, headache, nausea and loss of co-ordination. Keep workplace well ventilated.
- The refrigerant circulates through the air conditioner under high pressure. Make sure that the refrigerant charge is removed with suitable equipment before carrying out any repairs of the refrigeration system. An explosion may occur when excessive heat (e.g. a gas flame) is applied to the charged system.

7.6.12. HIGH TENSION (AC AND DC) TESTING

- After isolating OHE as described earlier, check the roof of the train set for any foreign material.
- Ensure that no one is working on the train set.
- Make sure that all switches are in normal position.
- After safety Inspection and energizing the overhead supply line.
- Before taking traction, check the brake power and ensure that the brakes are effective.
- Follow all safety norms and speed restrictions during testing and shunting in the depot.

8. TROUBLE SHOOTING

Version :

1.00



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Amendment and Revisions

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1.00	31/08/2020	First Release	--

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8.1. FAULT DISPLAY ON DRIVER DISPLAY UNIT (DDU)

DDU provides information for the Train Computer Management System (TCMS) system to support motor man in operating rake while normal operation, as well as in case of malfunction of a subsystem.

DDU supports the maintenance staff in setting basic system parameters and fault finding. In case of failure of TCMS DDU, train can still be operated. There is one DDU installed in each DTC cab.

It provides an interface to control train functions

- Display operational status of train functions
- Display diagnostic events

For details, kindly refer - Troubleshooting Manual for 25 KV AC Three Phase Propulsion & Other Equipment for Train 18 by MEDHA Document No- IM-292 rev 0

8.2. TROUBLESHOOTING OF CENTER BUFFER COUPLER

The following are the typical trouble shooting points occurring in couplers

- Tell-tale recess obstructed
- Coupling height disturbed from rail level.
- Manual Uncoupling Device Lever not in position

For details, kindly refer -Descriptive and Maintenance Manual for High Tensile Centre Buffer Couplers with AAR 'H' Type Head and Balanced Draft Gear. Document no CBC-001. Rv.005

8.3. TROUBLESHOOTING OF SEMI PERMANENT COUPLER

Fault	Possible Cause	Operator Intervention
Will not couple/uncouple	Foreign material obstructing coupling/uncoupling.	Manually remove foreign material.
	Coupling details worn/rusty.	Check socket joint kit. Replace as required
	Flanges will not catch, excessive height difference	Lift coupler half a bit more
Slack when coupled	Rear nut loose	Check rear nut. Replace as required.
	Rubber springs broken or exhausted	Check rubber springs. Replace as required.
Cannot absorb the draft and buff loads.	Exhausted or broken Rubber springs	Draft gear requires repair

For details, kindly refer – Operating Instruction Semi-Permanent Coupler by DELLNER – Rev.00 31/01/2018

8.4. TROUBLESHOOTING OF PLUG DOOR

For details, kindly refer –Door Diagnostic Description Document - DDSTE11071E13 Rev.00 27/07/2018

8.5. TROUBLE SHOOTING VACUUM BIO TOILET**Flush button is pushed but toilet does not flush**

Cause	Action
No power	Supply power
No fresh water	Check water supply
Bio-digester full	Empty Bio-digester
No compressed air	Provide compressed air
Flush button defective	Check cable, check flush button, replace if necessary

Water flows into toilet bowl

Cause	Action
Water Inlet valve clogged	Remove blockage
Pinch valve defective	Replace pinch valve
Quick exhaust valve blocked due to frost	Defrost quick exhaust valve
Quick exhaust valve blocked due to pollution	Clean quick exhaust valve
Water filter clogged	Clean filter
Liquid level guard in flush water tank defective	Contact EVAC service Remove flush water tank

Toilet bowl is not flushed sufficiently

Cause	Action
Flush nozzles polluted	Clean flush nozzles
Flush nozzles calcified	Decalcify flush nozzles
Flush nozzles swivelled out of optimal position	Adjust flush nozzles

Error Routine

Code	Cause
Code 01	WWT (Bio-digester) full
Code 02	Pressure rise
Code 03	Pressure Vacuum
Code 04	Pressure detected
Code 05	Bowl full
Code 06	No water
Code 09	Inlet can't close
Code 10	Inlet can't open
Code 20	Flush Button Error

For details, kindly refer – Operation Manual Vacuum Toilet System by EVAC Train Rev.: 01 – 2018-08

8.6. TROUBLESHOOTING BRAKE YSYTEM AND AIR SUPPLY

Micromesh oil filter(OEF 1-5)

kindly refer – Descriptive Manual Micromesh oil filter Doc. no.: B-LE70.21(Rev.15-en).

Check valves with damping (G1; G1 1 / 2 ; G3/ 4)

kindly refer – Descriptive Manual Check valves with damping Doc. no.: B-OF11.21 (Rev.06-en).

Safety valves(SV1809, SV1810, SV1811, SV1812)

kindly refer – Descriptive Manual Safety valves Doc. no.: B-OS10.29 (Rev.00-en).

Drain valve(EW6)

kindly refer – Descriptive Manual Drain valve Doc. no.: B-MB20.21 (Rev.01-en).

Silencers(NW6, NW12)

kindly refer – Descriptive Manual Silencers Doc. no.: B-TB10.21 (Rev.02-en).

Test fitting(T2-TS)

kindly refer – Descriptive Manual Test fitting Doc. no.: B-VC40.29 (Rev.03-en).

Test fitting(K1-ES)

kindly refer – Descriptive Manual Test fitting Doc. no.: B-VC10.22 (Rev.01-en).

Pressure Governor(MCS4, MCS11, MCSN11)

kindly refer – Descriptive Manual Pressure Governor Doc. no.: B-EN20.22 (Rev.05-en).

Ball cocks with a switch module and with or without an exhaust (SK-DN-SM)

kindly refer – Descriptive Manual Ball cocks with a switch module and with or without an exhaust Doc. no.: B-OJ41.21 (Rev.09-en).

Pressure sensors with a current output(DG10, DG10-B, DG10-S)

kindly refer – Descriptive Manual Pressure sensors with a current output Doc. no.: B-IS30.24 (Rev.07-en).

General Servicing Instructions

kindly refer – Descriptive Manual General Servicing Instructions Doc. no.: B-IE21.175 (Rev.12-en).

Check valve(RV19-T)

kindly refer – Descriptive Manual Check valve Doc. no.: B-GF10.21 (Rev.05-en).

Check valve(RV7-T)

kindly refer – Descriptive Manual Check valve Doc. no.: B-GF10.29 (Rev.05-en).

Ball cock with an exhaust and a switch module (SK-T-DN.E-SM, SK-T-DN.E-SM-K)

kindly refer – Descriptive Manual Ball cock with an exhaust and a switch module Doc. no.: B-GJ20.23 (Rev.02-en).

Impulse valve (WIMHV5-NT)

kindly refer – Descriptive Manual Impulse valve Doc. no.: B-GD80.24 (Rev.00-en).

Double check valve(DRV7-T)

kindly refer – Descriptive Manual Double check valve Doc. no.: B-GF20.27 (Rev.06-en).

Filter (FIL100)

kindly refer – Descriptive Manual Filter Doc. no.: B-GQ10.22 (Rev.04-en).

Ball cock with an exhaust (SK-T-DN.E, SK-T-DN.E-K)

kindly refer – Descriptive Manual Ball cock with an exhaust Doc. no.: B-GJ10.22 (Rev.01-en).

Pressure reducing valve (DMV15/T)

kindly refer – Descriptive Manual Pressure reducing valve Doc. no.: B-GE50.25 (Rev.04-en).

Distributor valve (STV200)

kindly refer – Descriptive Manual Distributor valve Doc. no.: B-EC90.22 (Rev.00-en).

Mean pressure valve (MDV1, MDV1-T)

kindly refer – Descriptive Manual Mean pressure valve Doc. no.: B-KF20.22 (Rev.05-en).

Brake calliper units (RZTS, RZTM)

kindly refer – Descriptive Manual Brake calliper units Doc. no.: B-CT60.26 (Rev.02-en).

Wheel-mounted brake disc with keyed plug centring

kindly refer – Descriptive Manual Wheel-mounted brake disc with keyed plug centring Doc. no.: B-CM00.22 (Rev.10-en).

Magnet valves (WMV-01/1NZG)

kindly refer – Descriptive Manual **Magnet valves** Doc. no.: B-OG20.31 (Rev.00-en).

Magnet valves (WMV1-ZES, WMV1-ZEST)

kindly refer – Descriptive Manual **Magnet valves** Doc. no.: B-GG21.41 (Rev.06-en).

Magnet valves (WMV-20/2ZG, WMV-20/2ZE, WMV-20/2ZES)

kindly refer – Descriptive Manual Magnet valves Doc. no.: B-OG21.24(Rev.03-en).

Anti-skid valve (GV12-3, GV12-3S)

kindly refer – Descriptive Manual Anti-skid valve Doc. no.: B-HE10.40 (Rev.03-en).

Air Filter (LF7-T; LF7-TF; LF7-TFF)

kindly refer – Descriptive Manual Air Filter Doc. no.: B-GQ10.21 (Rev.03-en).

Overflow valve without reflux (DR07-T)

kindly refer – Descriptive Manual Overflow valve without reflux Doc. no.: B-TD20.28 (Rev.02-en).

Double check valve (DRV7-T)

kindly refer – Descriptive Manual Double check valve Doc. no.: B-GF20.27 (Rev.06-en).

Piston valve (WKV1-T)

kindly refer – Descriptive Manual Piston valve Doc. no.: B-GD71.23 (Rev.04-en).

Tyfon (MKT)

kindly refer – Descriptive Manual Tyfon Doc. no.: B-VE20.23(Rev.06-en).

Drain valve (EE1104)

kindly refer – Descriptive Manual Drain valve Doc. no.: B-MB20.25 (Rev.00-en).

8.7. TROUBLESHOOTING PANTOGRAPH

Defect	Reason(s)	Correction
Pantograph does not Raise or Lower.	Air bellow damaged.	Check air bellow, exchange broken air bellow. (also see defect: Bellow drive defective).
	Cable torn	Replace cable. (also see defect: Cable torn)
	Pneumatic control unit defective.	Exchange pneumatic control.
	Pneumatic tube defect.	Replace pneumatic tube.
	Shock absorber between base frame and lower frame defect.	Replace shock absorber.
	Inner friction of panto is too high.	Check pantograph for damages, and eliminate damages. Replace defective bearings
	Auto drop device activated adjusted.	Check auto drop device, especially carbon strips for air leakage or damage. Change defective parts
Frequent interruption of current transmittal (strong arcing).	Contact pressure is poorly adjusted.	Check contact pressure and adjust.
	Inner friction of panto is too high.	Check pantograph for damages, and eliminate damages. Replace defect bearings.
Frequent interruption of current transmittal (strong arcing).	Carbon strips show strong breakage.	Replace carbon strips.
	Pan head springs are slow motion..	Clean bearings, replace defect bearings.
	Carbon strip parallelism is not correct adjusted.	Adjust carbon strip to parallel to catenary.
	Parallel guide bar is poorly adjusted (pan head doesn't turn freely from horizontal position).	Adjust turning capacity of pan head.
Uneven wear of carbon strips.	Parallel guide bar is poorly adjusted	Adjust turning capacity of pan head.
Current flashover from pantograph to vehicle roof	Insulators between base frame and vehicle roof are dirty	Clean insulators between base frame and vehicle.

Cable torn.	Cables are not greased	Replace cable and grease in area of cam disk with non-water soluble grease.
	Bellow drive is improper adjusted; bellow does not expand straight-lined.	Replace cable, adjust bellow to achieve straight expanding line.
Bellow drive defective.	Screws are loose.	Tighten screws.
	Hose line leaking.	Exchange leaking hose with new hose line.
	Bellow cylinder leaking.	Exchange bellow cylinder; find reason for leakage and check bellow joints.
Excessive air leakage.	Pressure-regulator defective (normal air leakage of pressure regulator = 0,5 l / min.).	Exchange pressure regulator.
Increase of contact pressure without previous adjustment of pressure regulator.	Pressure regulator defective.	Exchange pressure regulator.

For details, kindly refer – Description Maintenance and Operating Manual FOR Single Arm Pantograph by SCHUNK Metal & Carbon (India) Pvt. Ltd. Document No 4 -14062-22.03 (Rev.2)

8.8. TROUBLESHOOTING MAIN TRANSFORMER

Event / Fault	Immediate action	Diagnostic / Action
Pressure relief device tripping	<ul style="list-style-type: none"> • Stop transformer / Do not reenergize transformer. • Visual checking of pressure relief device, bushings, and tank. • Check circuit breaker tripping. • Check oil level. • Perform electrical measurements. • Perform dissolved gas analysis. • Do not reenergize without full diagnostic. • Contact main transformer manufacturer. 	<ul style="list-style-type: none"> • Check if air dryer is not blocked (disassemble it) • Electrical measurements (ratio, winding resistances, insulation resistances). • Visual checking of pressure relief device, bushings, and tank. • Perform dissolved gas analysis. • Analyse train parameters records.
Circuit breaker tripping	<ul style="list-style-type: none"> • Check pressure relief device tripping, visual checking of pressure relief device, bushings, and tank. • Check oil level. • Do not reenergize transformer if some anomaly is detected during above checks. 	<ul style="list-style-type: none"> • Electrical measurements (ratio, winding resistances, insulation resistances). • Visual checking of pressure relief device, bushings, and tank. • Perform dissolved gas analysis.

	<ul style="list-style-type: none"> • Perform electrical measurements • Perform dissolved gas analysis • Contact main transformer manufacturer. 	<ul style="list-style-type: none"> • Analyse train parameters records.
Current Transformer over current	<ul style="list-style-type: none"> • Check pressure relief device tripping, visual checking of pressure relief device, bushings, and tank. • Check oil level. • Do not reenergize transformer if some anomaly is detected during above checks. • Perform electrical measurements. • Perform dissolved gas analysis. • Contact main transformer manufacturer. 	<ul style="list-style-type: none"> • Electrical measurements (ratio, winding resistances, insulation resistances) • Visual checking of pressure relief device, bushings, and tank • Perform dissolved gas analysis • Analyse train parameters records
Over temperature tripping (temp. sensor or thermostat)	<ul style="list-style-type: none"> • Reduce power, if not sufficient stop transformer. • Check pressure relief device tripping, visual checking of pressure relief device, bushings, and tank. • Check oil level. • Do not reenergize transformer if some anomaly is detected during above checks. • Contact main transformer manufacturer. 	<ul style="list-style-type: none"> • Check load and other train parameters records. • Check cooling system : oil flow, air flow, and radiator cleaning. • Check temperature sensors. • Check for any oil presence in air dryer.
Different reading from temp. sensors or Tripping of one thermostat without tripping of lower range thermostat	Check temperature sensor / thermostat and change device if necessary.	--
Visual oil level too low	<ul style="list-style-type: none"> • Check for any leakage. • Add dry and filtered oil. 	<ul style="list-style-type: none"> • Look for any leakage including tank, pipe, gasket assembly, air plug, cracks • Clean suspected area, and check if oil appear again (preferably with hot oil). • When located repair leakage.
Low oil level sensor tripping	<ul style="list-style-type: none"> • Check for any leakage. • Add dry and filtered oil. 	<ul style="list-style-type: none"> • Look for any leakage including tank, pipe, gasket

		assembly, air plug, cracks • Clean suspected area, and check oil appear again (preferably with hot oil). • When located repair leakage
Very low oil level sensor tripping	• Stop transformer. • Check visual oil level. • Check for any leakage. • Check for consistency of sensors : low oil sensor tripping before very low level.	• Check recorded load and oil temperature(train parameters). • Perform dissolved gas analysis. • Look for any leakage including tank, pipe, gasket assembly, air plug, cracks • Clean suspected area, and check if oil appear again (preferably with hot oil). • When located repair leakage.
Oil leakage	• Check Oil level. • If very low oil level stop transformer. • Look also for other train equipment in the vicinity.	• Look for any leakage including tank, pipe, gasket assembly, air plug, cracks • If gaskets are mounted with Vaseline lubrication and transformer being heated, it could be sometime misinterpreted as leakage. • Clean suspected area, and check if oil appear again (preferably with hot oil). • When located repair leakage.
Oil flow stop tripping	• Stop transformer. • Check oil level. • Check if pump is running. • Check for every valves position.	If pump is running and valves are ok, check oil flow switch contactor, if necessary change oil flow switch. if not, check pump supply and windings, if necessary change pump.
Air dryer change of colour start on opposite site of air entrance	• Check oil water content, if below limit oil needs to be dried. • Change gasket or air dryer.	Check for any crack on air dryer.
Bushing colour change	• Look for any loosening of connection, and correct it • Look for any crack, if any stop transformer and advise manufacturer	Check possible overheating from loosening connection or possible damage creating electrical ageing
Bushing crack	Check for any leakage. Advise	--

	manufacturer.	
Abnormal noise	Try to locate area involved: <ul style="list-style-type: none"> • pump • hydraulic noise • fans • main tank • some losing equipment • other train component 	<ul style="list-style-type: none"> • Check there isn't any loosed equipment and correct immediately if necessary • Pump: check rotation and if necessary correct phases supply. • Check bearings and replace if necessary. • Hydraulic: try to evacuate air by air drain plugs • Fans : looks for some friction or any external part blocking fan rotation. • Check rotation and if necessary correct phases supply. • Check bearings and replace if necessary. • Main tank : advise manufacturer
Paint damage or corrosion	Paint repair	According to maintenance manual
Shocks	<ul style="list-style-type: none"> • on bushings: replace • on accessories: replace • on main tank: advice manufacturer • on flexible pipe: replace • on auxiliary connectors : replace 	Check for any leakage
Physical properties of oil (water content, breakdown voltage)	Refer to maintenance manual	Check air dryer
DGA indicating fault	Consult expert to decide	Expert diagnostic and sampling interval

For details, kindly refer –Maintenance Manual Main Transformer by JST Transformers

8.9. TROUBLESHOOTING TRACTION MOTOR

Distinctive feature	Possible reason	Corrective measure
Motor vibrates	Motor suspension defect	<ul style="list-style-type: none"> • Do visual check of motor suspension. • Renew motor suspension if necessary.
	Loose screws	<ul style="list-style-type: none"> • Do check of screws check if correct tightening torque is applied. • Replace broken or damaged screws.

	Unbalanced rotor	<ul style="list-style-type: none"> Disassemble rotor and check balance. If necessary do new balancing of rotor.
	Bearing damage	Replace bearings.
Unusual motor noise	Rotor and rotor parts rubbing on stator	<ul style="list-style-type: none"> Replace rotor and check stator for damage. Renew damaged stator.
	Bearing damage	Replace bearings.
Temperature of the motor is too high	Ventilation grid is dirty (paper, plastic bag)	Clear ventilation grid.
	Ventilation holes are dirty	Clean ventilation holes
Smoke emission	Bearing damage	Replace bearings
	Damage of winding	<ul style="list-style-type: none"> Check winding visually and check insulation of winding. If necessary replace stator.

For details, kindly refer – Operating Manual for Traction Motor TME 49-35-4 by TSA Document - TSA018528 / 0 / EN

8.10. TROUBLESHOOTING GEAR DRIVE

Malfunction	Possible cause	Checks/corrective actions
Oil leaking off the labyrinth Seals of the shafts	Oil level in gearbox too high	Check oil volume on the oil level indicator and adjust if necessary
	Water has penetrated into the gearbox (e.g., while cleaning the wheel set gearbox)	Perform oil change
	Gearbox was tilted too much (with oil filling)	Disassemble, clean and assemble labyrinth seal parts.
Oil escaping on a locking bolt	Bolt not tightened according to specifications	Tighten bolt with specified torque
	Seals worn or defective	Replace affected seal
Wheelset gearbox gets too hot	Oil level in gearbox too high or too low	Check oil volume on the oil level indicator and adjust if necessary
Loud noises	Damage to toothing or bearings	Check the toothing and the bearings
Vibration or knocking when load changes	Retaining bolts of the gearbox mounting are loose or spherolastic bearing is	Check whether retaining bolts are seated firmly on the gear box mounting and

	defective	retighten if necessary. Inspect spherolastic bearing visually; replace if necessary.
	Gear coupling defective	Check and replace the gear coupling according to operating manuals of the coupling KWN31426 of KWD

For details, kindly refer – Operating Manual for Traction Gearbox *GKD 1-52-372A* by TSA Document - TSA017120 / 0 / EN

8.11. TROUBLESHOOTING CCTV SYSTEM

For details, kindly refer – Maintenance manual for 25 KV AC Three Phase Propulsion & Other Equipment for Train 18 by MEDHA. Document No: IM-291 rev 0

8.12. TROUBLESHOOTING RMPU

For details, kindly refer – Maintenance manual for Roof Mounted Air Conditioner RCAC-2400EF by SIDWAL. Document No: SID-T18- 5 Rev. 0

8.13. TROUBLESHOOTING CABIN AIR CONDITIONER UNIT

Trouble	Cause	Remedy/Check
MCB Switched on but AC unit does not start	No input voltage	<ul style="list-style-type: none"> • Check main supply connector tightness • Check voltage at MCB input • Check phase sequence (RYB)
Condenser/Blower fan does not start	A) No voltage applied to motor B) Motor defective	A) Check voltage at input terminal of condenser motor B) Check winding continuity, if broken, change motor
Compressor does not start	A) No voltage applied to motor B) Compressor Motor defective	A) Check voltage at input terminal of condenser motor B) Check winding continuity, if broken, change motor
Compressor starts but stops before set temp is achieved	A) Suction pressure too low B) Discharge pressure too high	<ul style="list-style-type: none"> • Refrigerant shortage • Clogged filter • Blower rotation in reverse direction • Check liquid line, evaporator and TXV. • Condenser contaminated/clogged • Defective condenser coil