



TECHNOLOGY MANAGEMENT  
SPECIFICATION

ONBOARD OPERATIONAL SYSTEM  
INTERFACE SPECIFICATION

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# 1 Scope

This document specifies the physical interface requirements applicable to both the locomotive and the operational systems.

The operational systems are defined as those systems required by the train driver and his assistant to facilitate, authorise, monitor and protect the safe movement of the locomotive or train. This thus includes amongst others train authorisation systems, voice and data communication systems as well as condition monitoring systems.

## 2 Applicable documents

BBC 1790: Transnet Freight Rail Locomotive Antenna Bulkhead and Cable Distribution

BBC 4204: Triton Data Communication Protocol

IEC 60297: Dimensions of Mechanical Structures of the 482.6 mm (19 in) Series Part 1: Panels and Racks, IEC standard

DC Axial Fans Datasheet for series 4300

## 3 Requirements

### 3.1 Electronic system cubicle

Operational systems consist, of electronic modules such as processors, interfacing circuitry, Human Machine Interfaces, Power Supplies, radios, antennas etc. Placements of these modules in the locomotives are cumbersome and where possible provision will be made to install these systems in a common space.

#### 3.1.1 Physical Space

The designs of all new locomotives shall make provision for physical space allocated to electronic operational equipment. The provided space shall be adequate to install a 19" electronic equipment rack with minimum dimensions 1500(H) X 600(W) X 600(D). The rack shall be located as close as possible to the drivers' console.

In the case where the available space inside the locomotives cannot satisfy the stipulated requirements (above), a proposal may be submitted to Transnet Freight Rail Technology Management for approval. Upon approval, the 19" cubicle dimensions may be adjusted accordingly to allow it to fit in the available space. Approved Locomotive specific equipment cubicle specifications are specified in the Addendum.

### 3.1.2 Electronic Equipment Rack

Transnet Freight Rail has embarked on a modular design philosophy for Traffic Management Systems on its locomotives and will, wherever possible, allocate space for the electronic modules of these systems. On all new locomotives (and some of the existing locomotives fleet) a 19" equipment rack shall be provided.

Where these racks are installed it shall be in accordance with IEC standard IEC 60297 and further information provided in this specification. The rack shall be fitted with a door and a locking mechanism, which shall accommodate a Padlock issued by Transnet Freight Rail, any alternative locking methods shall be submitted to TFR Technology Management for approval. The 19" cabinet shall however be removable to allow the addition of operational systems and installation of the required wiring. Adequate space shall be provided for cable slack at the back of the cabinet to facilitate outward movement of the units without disconnection of cable connectors.

A minimum distance of 100mm shall be allowed between the front vertical rail and the cabinet door to allow space for cable connections on the front of 19" rack units.

### 3.1.3 Electronic Units

In order to align with this design philosophy the electronic units (Processors, Data Acquisition Units, etc.) shall be designed in such a way as to be compatible with the 19" rack mount.

The height of the units supplied shall be an integral number of "U" dimensions. The depth of the units shall not be more than 500 mm.

The units shall be securely bolted to the 19" frame at the front and the rear of the unit. Since access to the rear of the cabinet is restricted in most locomotive installations, during normal operation, the rear securing

mechanism shall be accessible from the front of the unit or the module shall be mounted on a sliding tray or similar to allow easy removal of the unit.

Many older locomotives do not have a dedicated cabinet to allow for rack mounting. In order to cater for these locomotives the unit design shall be adaptable between 19" rack mount and mounting on a wall, roof, floor or a designated compartment.

### **3.1.4 Unit cable connections**

Cable connections to the electronic units shall preferably be at the rear of the cabinet. Enough slack shall be provided on the connecting cables to allow extraction of the unit in order to gain easy access to the connectors. Alternatively the unit design shall have a backplane to facilitate the easy removal of modules from the front of the cabinet.

Where cable entries to the units is to be done from the front the cabling shall be routed from the front to the rear of the cabinet in the same plane as the electronic unit and shall not take up more vertical space than the height of the unit it connects to.

A maximum distance of 100mm is allowed in front of the unit face plate (i.e. front vertical supports) for the connectors and cables. Space will be provided on the sides of the cabinet to accommodate the cable runs to the front of the units. In such a configuration it is however preferred to install the unit on a tray and accommodate the cabling on the side of the unit in the allocated rack space.

### **3.1.5 Ventilation**

Where 19" equipment racks are provided in the locomotive equipment compartment the cabinet shall be force ventilated with the locomotive equipment room air. The air flow through this space shall be 680m<sup>3</sup>/h. Multiple fans each generating air flow of 170m<sup>3</sup>/h as per EBMPAPST DC Axial 4300series data sheet (see Applicable documents list) or any compatible fan(s) may be used. In cases where equipment space is designated inside the driver cab, no ventilation is provided.

## **3.2 Power supply**

Electrical power shall be made available in the power cubicle space. The termination of this supply shall be such that it will be easy to connect the

Electronic Equipment Cubicle power supply to this termination. The positioning of this termination shall be such that it will be possible to remove the 19" Electronic Equipment Cubicle" without removing the termination itself.

The power supply configuration shall be as depicted in Figure 1.

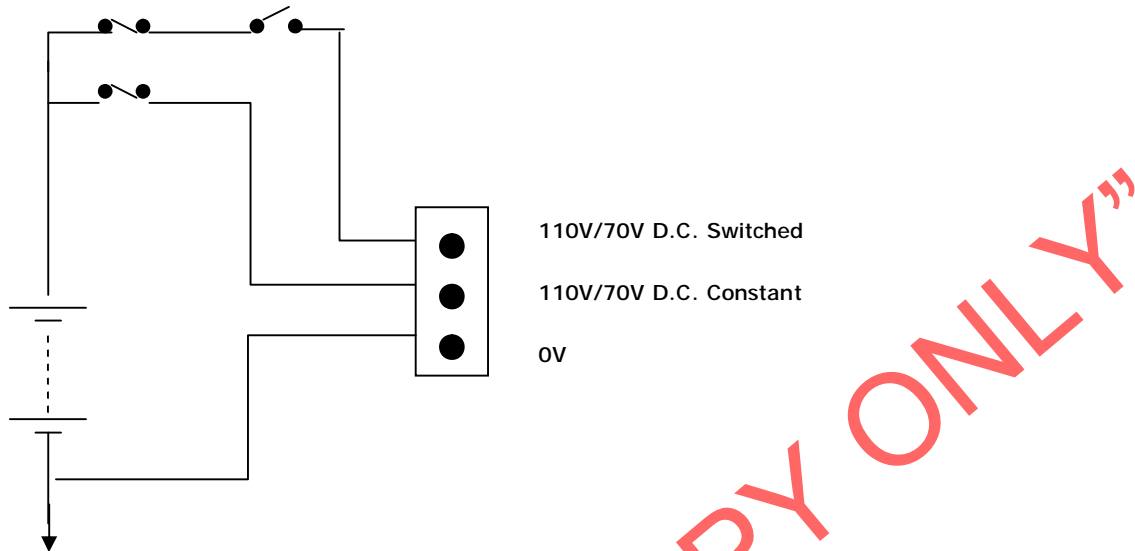


Figure 1. Power supply configuration.

The electrical power for the operational systems consists of two supply points. The source of these supply points shall be a battery (110V for electric loco and 70v for diesel loco). The two points will be sourced as follows from their respective battery:

- \* Direct from the battery (indicated as "Constant") and
- \* Additional 110V (70V) D.C. supply tapped from the switched locomotive control system supply as in shown in Figure 1.

This will allow systems to detect that the locomotive is being switched off and to keep essential services alive whilst drawing minimum power.

The current rating of these supplies shall be at least as specified in Table 2.

Supply	Current rating
110V (70V) Switched Supply	110V (70V) DC $\pm$ 20% unregulated power rated at 10 ampere.
110V (70) Constant Supply	110V (70) DC $\pm$ 20% unregulated power rated at 1 ampere.

Table 2 Power supply ratings

### 3.2.1 Power Supply Isolation

Operational systems obtaining their power from the locomotive DC supply shall not earth the positive or the negative rails of the locomotive supply to the locomotive chassis (earth). In cases where any of the supply rails are earthed deliberately, such as the RF coaxial feeds to antennas the operational system shall be fed via a galvanically isolated converter or power supply.

### 3.3 Cable Ducting

Cable ducting shall be installed to house the cabling of the operational systems in accordance with the requirements of Table 1. The ducting shall be separate from other power cable routes and used exclusively for the operational systems.

Ducting route	Size	Purpose
Driver Console to Electronic System Cubicle	2 X 50mm X 50mm or 1 X100mm X 50mm	Cabling between driver Machine Interface equipment and electronic modules.
Electronic System Cubicle to the Roof	50mm X 50 mm	Antenna cables between RF equipment and roof mount antennas.
From Electronic System Cubicle to below locomotive floor (on the cab end of the locomotive).	50mm X 50mm	For special bogie mounted equipment (i.e. transponder equipment & tachometers)
From Electronic System Cubicle to locomotive Control System.	20mm diameter	Interfaces to locomotive control circuitry such as vigilance.
From Electronic System Cubicle to bogie area (End of ducting must be sealed off).	20mm (dia)	Cabling for external mounted devices such as high integrity tachometers etc

Table 1. Operational system ducting requirements.

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## 4 Antennas and Connector Bulkhead

### 4.1 Antenna

On Board Operational systems require numerous antennas in different frequency bands. Currently these antennas has been integrated into two types, namely the Web Industries type TRD150G and type TRD450G. All operational system can be catered for through the installation of 3 antenna units, namely one TRD150G and two TRD450G. (Thus providing antenna elements as follows: 2 x UHF, 1 x VHF, 3 x GPS, and 3 x GSM / GPRS / WiFi.)

The wiring of the antennas shall be done in accordance with the requirements as set out in BBC 1790, as per written contract.

Positioning of the antennas relative to each other is a function of metal parts in the vicinity of the antennas as well as the shape and size of the locomotive roof. The final positioning shall thus be approved by the Transport Telecom department of Transnet Rail Freight.

### 4.2 Bulkhead

The antenna bulkhead and connector (as per BBC1790) shall be installed inside the Electronic Equipment cubicle space to allow easy access by the systems installed in the cubicle.

### 4.3 Antenna cabling

Antenna cabling shall be clearly marked at each end with durable marking. Antenna cables shall have a droop at the antenna side to allow water to dip from the cable in the unlikely event of a leak at the antenna.

## 5 Data Communication Interface

The Transnet Freight Rail operational systems installed onboard the locomotive incorporates a standardised data communication interface. The physical connection consists of Ethernet LAN ports on a network switch. The network switch is situated in the 19" Operational Systems cubicle. The system comes standard with 8 ports allocated by a TFR data communications committee. The data accepted on these ports can be routed to other devices on the same network or to the TFR land based WAN, through various radio



connections. The availability of the radio connections depends on the location of the locomotive and the selection of the active radio is seamlessly controlled by the operational system

The data communication protocols supported include UDP and TCP/IP. A special messaging service is also implemented on the ports. The protocol and usage of this messaging structure is governed by BBC4204. All users of this network shall apply to TFR for IP addresses and port allocation, and shall conform to the requirements specified in BBC4204.

The system has an external module that contains locomotive identification as well as train and driver identification information. This module is called a Train Definition Unit (TDU) and it is installed in the driver machine interface console as defined in 6.2. The TDU require input from the driver at the start and end of the train trip or driver shift.

## 6 Driver Machine Interface (DMI)

### 6.1 Multi Function Display

All the Onboard Operational systems will occupy a common Driver/machine interface space. This space will either be occupied by an open multifunction display or it will be occupied by the most dominant onboard system. The maximum dimensions of the required DMI interface space is characterised by the following (See Figure A.1 Appendix A):

- \* Max. cutout 300(w) x 212
- \* Max cutout depth 140 plus 60 for airflow and connectors, etc.
- \* Max. outside frame 345(w) x 227
- \* Protrusion of DMI will not exceed 20mm above the panel surface.

This space must be provided in such a position that the driver has full view of the display (to be provided separately) for the purpose of obtaining information for the safe movement of the train.

In addition to this the UHF Voice radio systems employed on the different lines will require a cut-out. The dimensions of this cut-out are dependant on the deployment of the locomotive and will be provided separately. However, 6.3 below describes the space requirements for 19E and 15E locomotives radio cab units.

## 6.2 Train Definition Unit (TDU)

The TDU will be installed in the locomotive cab where the driver has access to it at the start and end of a train trip or driver shift. The maximum dimensions of the required TDU installation space is characterised by the following (See Figure A.2 Appendix A for TDU enclosure diagram):

- \* Max. cutout 93(w) x 144
- \* Max cutout depth 50 plus 60 for airflow and connectors, etc.
- \* Max. bottom mounting frame 114(w) x 140
- \* Protrusion of TDU will not exceed 20mm above the panel surface.

This space must be provided in such a position that the driver has a clear view of the display and easy access to the keypad at the start and end of a train trip or driver shift.

## 6.3 Radio Cab Unit (19E and 15E)

Different UHF Voice radio systems are employed on the different TFR lines for operations and shunt purposes. The provision of a 19" Operational Systems cubicle in locomotives enables the possibility of split radio equipment implementation, where the power supply and radio components can be mounted in the equipment cubicle and only driver interface components require space in the driver console.

The maximum dimensions of the radio cab unit deployed on the 19E and 15E locomotives is characterised by the following (See Figure A.3 Appendix A for Radio Cab Unit enclosure diagram):

- \* Max. cutout TBD.
- \* Max cutout depth 50 plus 60 for airflow and connectors, etc.
- \* Max. outside frame 310(w) x 140
- \* Protrusion of Radio Cab Unit panel, excluding buttons and headset will not exceed 20mm above the panel surface.

This space must be provided in such a position that conforms to TFR operations and ergonomic requirements.

## 6.4 End of Train Cab Unit (EoT)

TFR locomotives are fitted with an End of Train system. Space is required in the driver console for the Cab Unit (CU) of the End of Train system. The maximum dimensions of space required for the CU is characterised by the following:

- Max. cutout 197 (w) x 67.5 +/- 0.25mm
- Max cutout depth 250 plus 60 for airflow and connectors, etc.
- Max. outside frame TBD.

## 6.5 Radio Cab Unit

The protrusion of Radio Cab Unit panel, excluding buttons and headset will not exceed 20mm above the panel surface.

This space must be provided in such a position that conforms to TFR operations and ergonomic requirements.

## 7 Control System Interface

Detailed brake interface information shall be provided in order to facilitate interfacing of the Signalling/Authorisation System to the locomotive for the purpose of the initiation of a braking application by the onboard Signalling/Authorisation System.

## 8 Addendum

### 8.1 39-200 (50 like new) Diesel Locomotives

In the case of the 50-like new locomotives; the available space is restricted to the dimensions 594.4mm (H) X550mm (W) X500.8mm (D). This is due to the high voltage cables that run through the area where the cubicle shall be positioned as well as the air-conditioner pipes, the toilet walling and the water tank for the toilet basin. TFR Technology Management has acknowledged these restrictions and has subsequently designed a 19" equipment cubicle with the above stated dimensions.

## 9 APPENDIX A

### 9.1 Multifunction display.

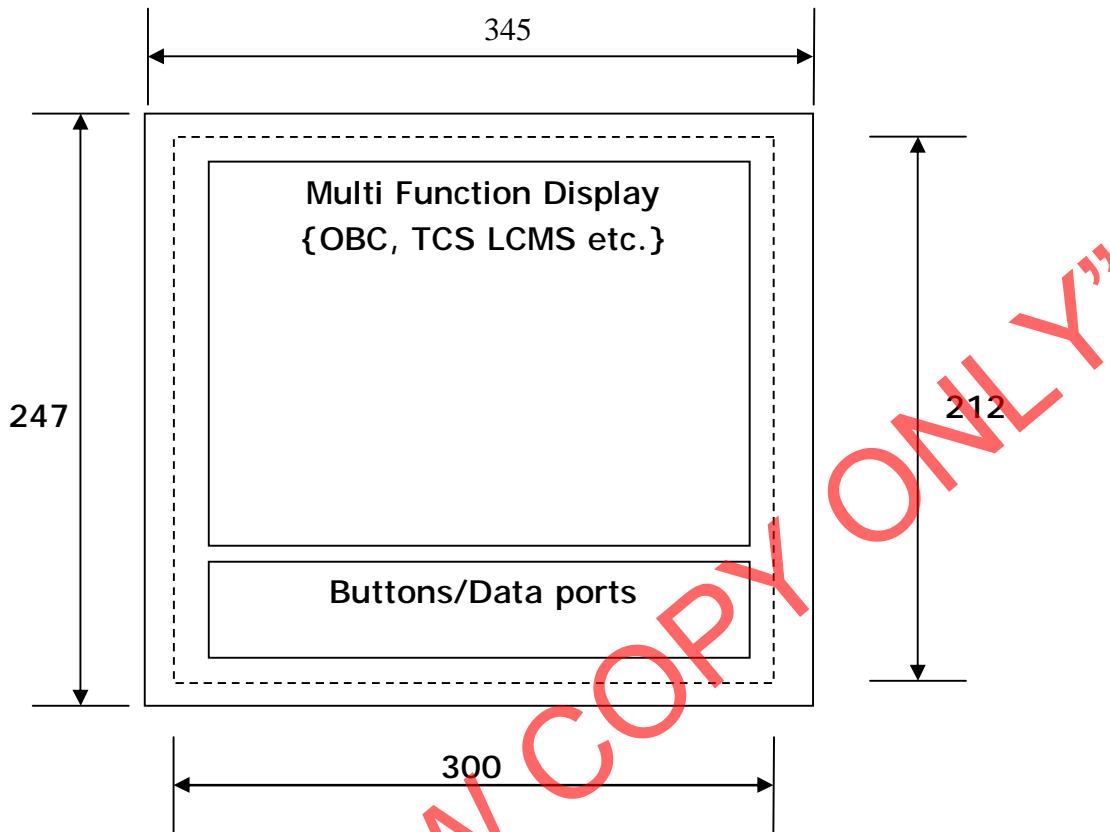


Figure A.1 Multifunction Display Dimensional requirements on the Driver Console.

### 9.2 Train Definition Unit (TDU)

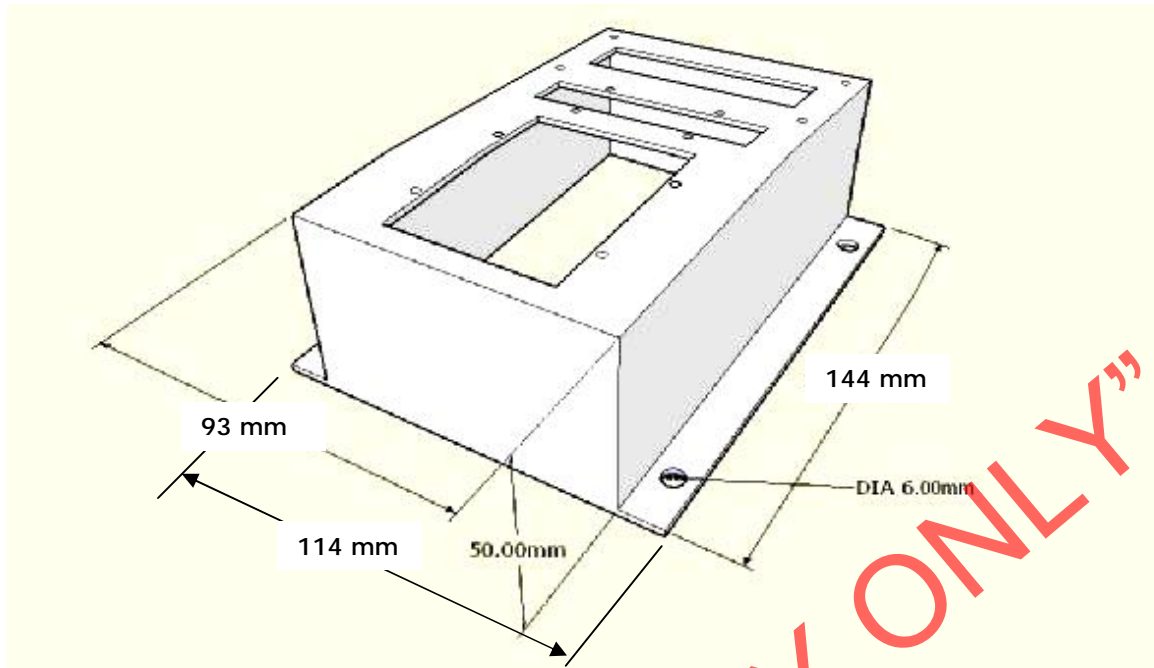


Figure A.2 TDU Enclosure Dimensional requirements on the Driver Console/ Locomotive cab.

### 9.3 Radio Cab Unit (19E and 15E locomotives)

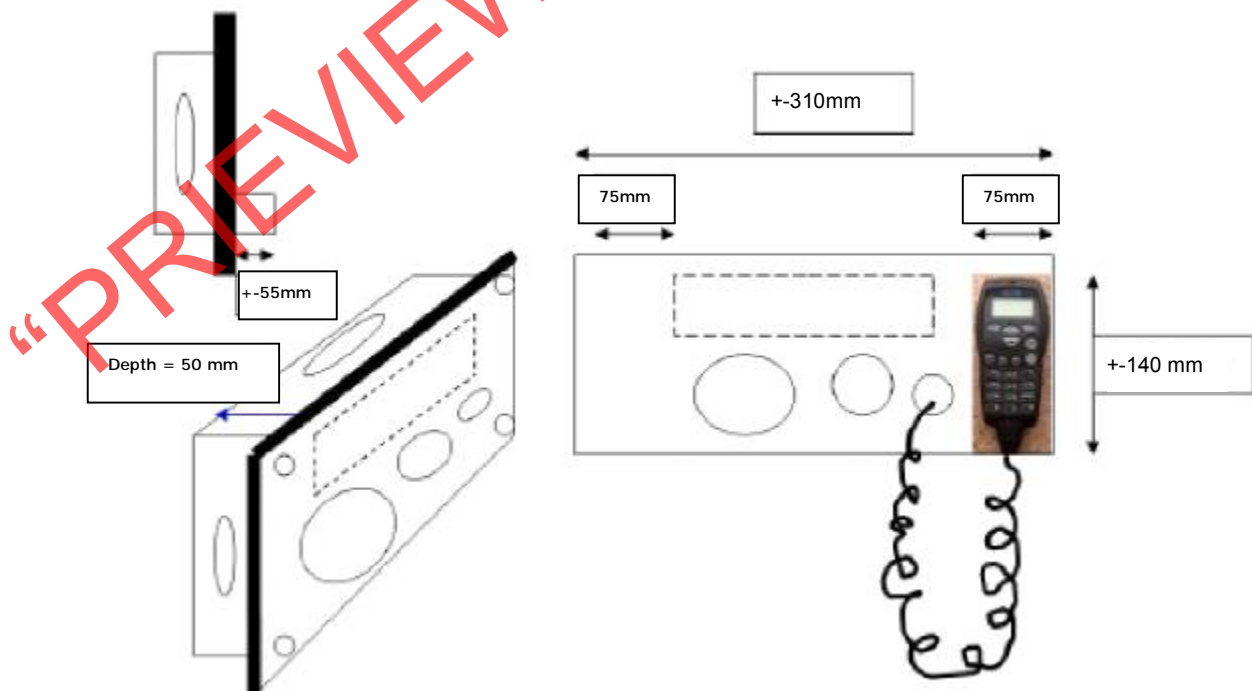


Figure A.2 Radio Cab Unit Dimensional requirements on the Driver Console.

9.4 19" Equipment Cubicle for 39-200 Class Locomotive

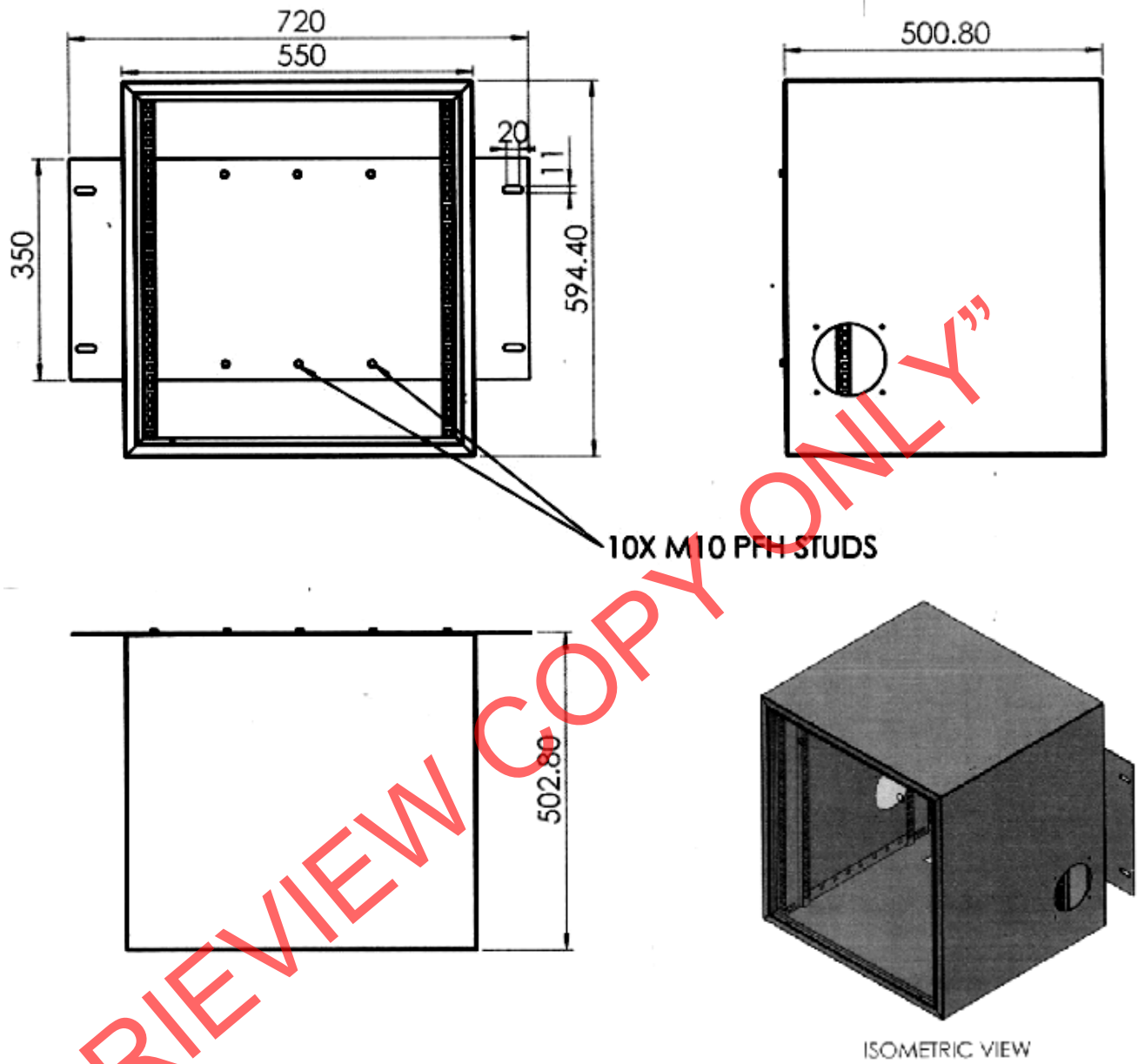


Figure A.3 19" Equipment Cubicle for 39-200 Class Locomotive.