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**Low Voltage Distribution Earthing**

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## **Note:**

Personnel responsibilities referred to in this document will be altered in due course to reflect the ARTC organisational structure.

## **About This Standard**

This document sets out the earthing requirements for the low voltage equipment on the supply side of the consumers' terminals for all electrical installations which are owned and operated by ARTC as an Electricity Distributor. It sets out the common requirements for the Distributor's supply earth but does not include the earthing requirements of the actual installation being supplied. Refer to Specification PDS 08 - "Low Voltage Installations" for further information on these aspects.

## Document History

**Primary Source** – RIC Standard EP 12 10 00 20 SP Version 2.0

### List of Amendments –

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## 1 Supply from ARTC High Voltage Network

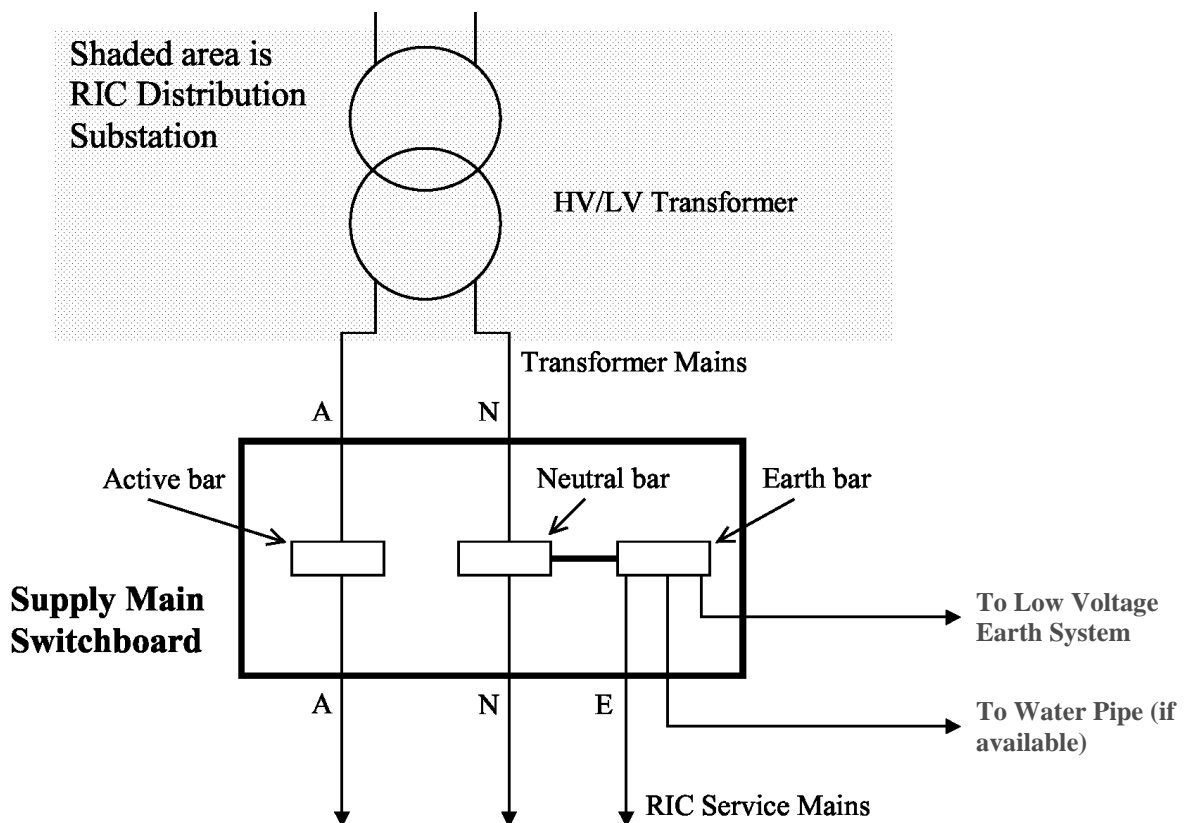
The low voltage earth grid is provided by electrodes located at the Distribution Substation; refer to Specification PDS 05 - "Distribution Substation Earthing" contained in Volume 1.

The supply main switchboard which may be located at the Distribution Substation or at the installation, eg railway station, will have the earth bar and neutral bar connected together. This connection must be the only earth-neutral connection for the whole electrical installation supplied from this substation. Refer to figure 1 below. The transformer mains active and neutral conductors shall be a minimum of 25 mm<sup>2</sup> copper of single core double insulated (SDI, 0.6/1.0 kV) construction from the Distribution Substation to the supply main switchboard. If the active and neutral conductors are to be switched then all conductors must be switched simultaneously.

If there is a substantial metallic water pipe nearby then the earth bar of the supply main switchboard is to be bonded to it with a conductor of the same size as the main earth conductor, but need not be larger than 70 mm<sup>2</sup> copper. The bond conductor is to be effectively protected from mechanical damage as detailed in Specification PDS 08 - "Low Voltage Installations Earthing". The supply main switchboard shall be clearly labelled with the location of the water pipe connection and the appropriate earth link shall be clearly labelled "water pipe bond".

Note: A 2 m distance shall be maintained between any low voltage earthed equipment and overhead wire structures which are not bonded to the low voltage earthing system.

Fig 1. Supply from ARTC High Voltage Network



## **2 Supply from Local Electricity Distributor's Network**

### **2.1 General**

The MEN system of a local Electricity Distributor must not be allowed to pick up appreciable dc leakage current. The recognised method of achieving this is to ensure the earth and neutral of the MEN supply is physically isolated from any part of the supplied installation, including earthed metalwork (such as pipes, fences, overhead earth wires or troughing).

This document is based on the use of an isolating transformer to separate the local Electricity Distributor's MEN earth and neutral from the ARTC distribution systems direct earthing system. Refer to figure 2 below. Where the local Electricity Distributor supply is from a dedicated substation with separate high and low voltage earthing systems and with no MEN connections then there shall be no requirement for an isolating transformer.

### **2.2 The Local Electricity Distributor's Point of Supply**

The supply from the service line shall be taken at a point as close as practicable to the boundary of the 'railway corridor' maintaining a clearance of 2 m from the boundary fence or any other earthed metalwork. This may be by the use of a non-metallic meter board, which will negate the need for earthing the meter board, or one of the methods contained in Specification PSD 08 - "Low Voltage Installations Earthing".

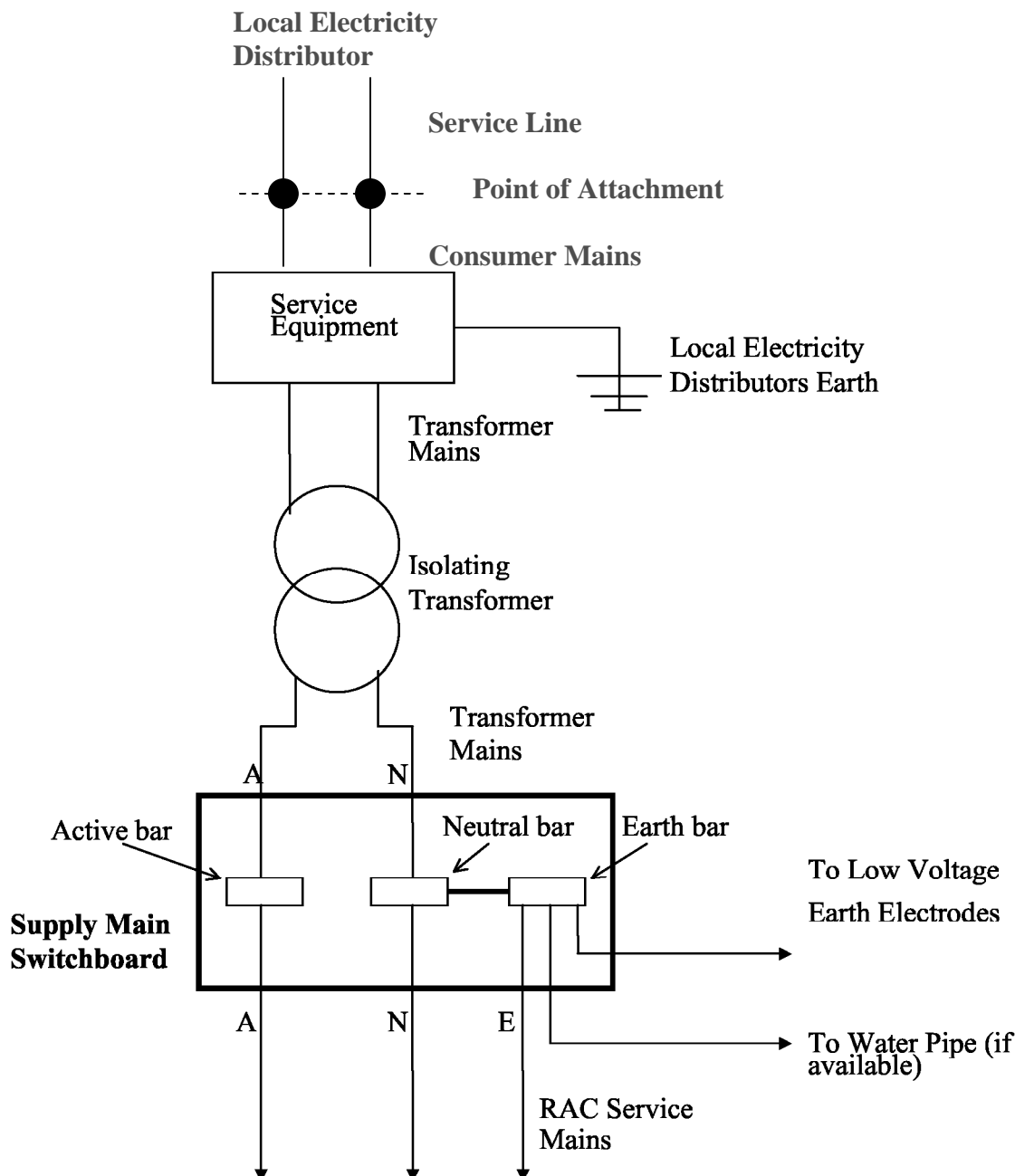
The consumers mains and the service equipment, including the earthing of the meter board and the neutral, shall be as prescribed by the local Electricity Distributor. The local Electricity Distributor's earth electrode shall be located as far as practicable but in any case not closer than 3m from the closest electrified rail and any other metalwork associated with the installation, such as an overhead wire structure footing, fence or signal cable troughing.

### **2.3 Isolating Transformer**

An isolating transformer shall be connected between the local Electricity Distributor's service equipment and the supply main switchboard to physically isolate the earth and neutral of the MEN supply from any part of the ARTC distribution system, including earthed metalwork (such as pipes, fences, overhead earth wires or troughing).

The isolating transformer shall comply with SRA Specification A-844. The transformer shall be installed with a sign prominently displayed on its case stating that it is double insulated and conforms to AS 3108.

The transformer mains active and neutral shall be a minimum size of 25 mm<sup>2</sup> copper of single core double insulated (SDI, 0.6/1.0 kV) construction up until the neutral-earth connection for the ARTC distribution system at the supply main switchboard. If the active and neutral conductors are to be switched before the neutral-earth connection then all conductors must be switched simultaneously.



**Fig. 2 Supply from Local Electricity Distributors Network**

In the situation described above no connection shall be made to the isolating transformer screen.

The case of the transformer is not to be earthed.

### CAUTION

For 120 V signalling supplies the neutral of the isolating transformer secondary winding is not directly connected to earth and the isolating transformer screen must be connected to the supply earth (and neutral). This connection is required to provide a direct path to earth to ensure the operation of the primary side protection if the double insulation of the isolating transformer breaks down. Refer to Specification PDS 08 - "Low Voltage Installations Earthing".



## 2.4 Supply Main Switchboard

The supply main switchboard is the first switchboard after the isolating transformer terminals. The supply main switchboard is the location to establish the one and only connection between earth and neutral.

### CAUTION

**For 120 V signalling supplies there shall not be any connection between earth and neutral, except as authorised by the Engineer, Signal Standards. Refer to Specification PDS 08 - "Low Voltage Installations Earthing".**

In the situation where the local Electricity Distributor supply is a back-up to an ARTC supply the supply main switchboard is a part of the ARTC infrastructure. The local Electricity distributor's supply line shall connect through the isolating transformer directly to the change-over contactor. Refer to section 3.

## 2.5 Voltage Operated ELCB from a Local Electricity Distributor

This system is encountered only in the older installations built before 1988. No new voltage operated earth leakage circuit breaker installations are to be built. The arrangement is shown in Drawing E/3 8221.

## 3 Back-up Supply with Change-over Contactor

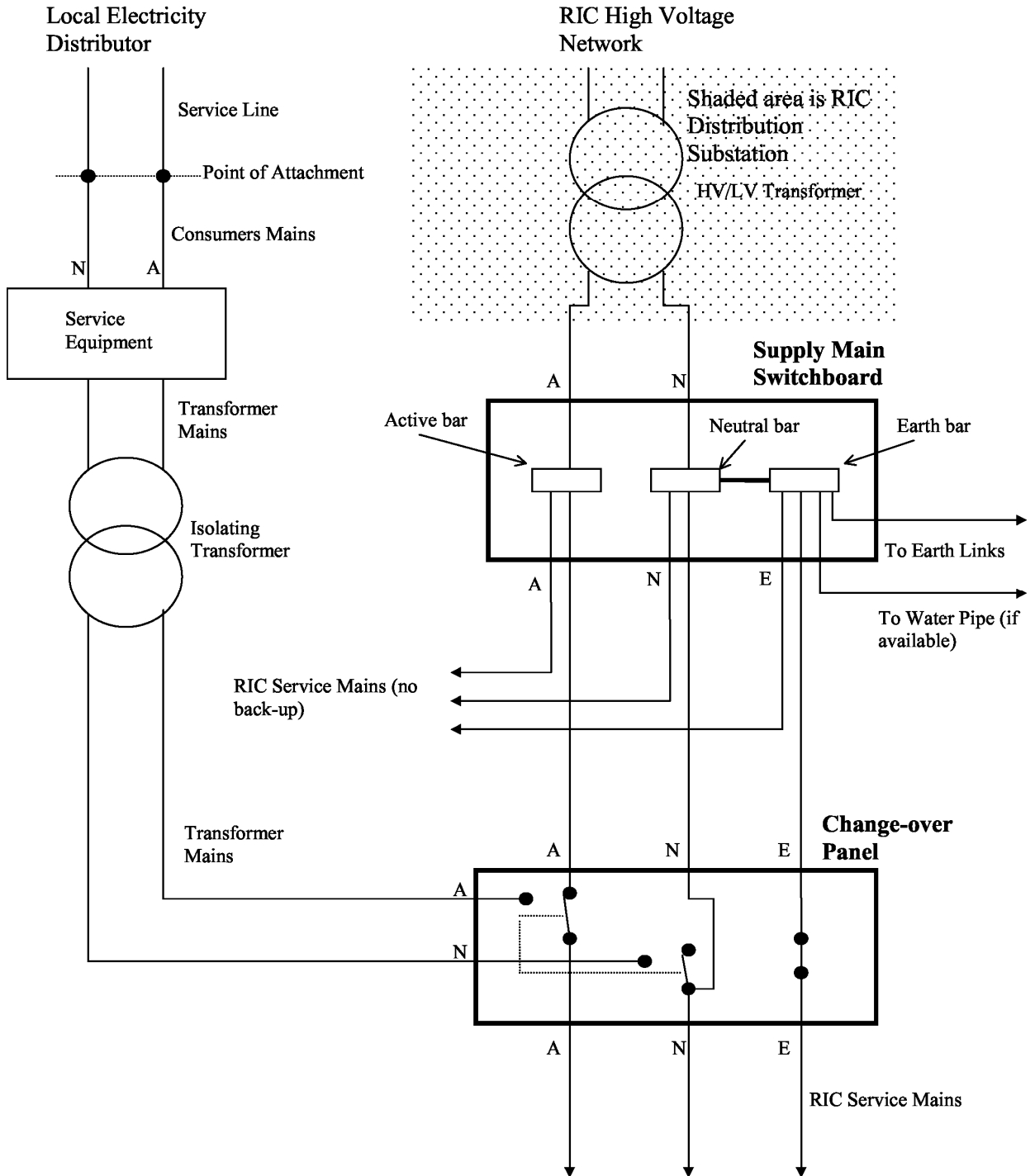
Critical installations usually have two sources of supply, a normal ARTC supply with a back-up from a local Electricity Distributor connected through an automatic change-over contactor. The ARTC supply shall be connected as described in section 1 with the automatic changeover contactor fed from the main supply switchboard. The local Electricity Distributor supply shall be connected as described in section 2, but will not have a supply main switchboard. The transformer mains shall be connected directly from the isolating transformer to the change-over panel. Refer to figure 3 below.

It is essential at these locations that the following points are taken into account when designing the earthing for the automatic changeover panel.

- There must be only one earth-neutral connection which is to be located on the ARTC supply main switchboard. This connection must not be broken unless both supplies are disconnected.
- There must be a solid neutral and solid earth connection to the ARTC supply main switchboard at all times. The change-over panel should not break these conductors during operation.
- The local Electricity Distributors active and neutral conductors shall be connected and disconnected (switched) simultaneously either at the service equipment or at the changeover panel.
- A back-feed must not be possible when one supply is out of service for maintenance.

Note: there are some signal locations where the normal supply is from a local Electricity Distributor with a back-up supply, through an automatic change-

over contactor, from a diesel generator. In this situation the normal supply shall be as described in section 2, including the supply main switchboard, and the diesel generator shall be as described in Specification PDS 08 - "Low Voltage Installations Earthing".



**Fig. 3 Back-up Supply with Change-over Contactor**