

Co-ordination of Surge Arresters

Due to the awareness for the need to install lightning and overvoltage protection in equipment many manufacturers are now installing surge protection inside their equipment as standard practise

The protection level they choose is based on the SANS 10142-1:2003 Annex L section L.1.1.5. The impulse withstand levels are divided into categories as given in table L.1 with overvoltage limits listed for standard 230/400 V three-phase four-wire systems as in IEC 60664-1.

Table L.1 – Impulse withstand categories for overvoltage limits

1	2	3	4	5
Voltage line to neutral derived from nominal voltages a.c. or d.c. up to and including V	Rated impulse voltage			
	Overvoltage category			
	I	II	III	IV
50	330	500	800	1 500
100	500	800	1 500	2 500
150	800	1 500	2 500	4 000
300	1 500	2 500	4 000	6 000
600	2 500	4 000	6 000	8 000
1 000	4 000	6 000	8 000	12 000

The overvoltage categories given in this table are

category I	which includes equipment such as pluggable devices with electronic circuits,
category II	which includes equipment supplied from a fixed installation, such as pumps, motors and other appliances,
category III	which includes equipment in fixed installations, such as distribution boards and motor control centres, and
category IV	which includes equipment at the origin of the installation (point of control), such as electricity meters and primary overcurrent protection equipment.

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To comply with this specification of a withstand voltage of 1500V manufacturers are installing 250V and 275V metal oxide varistors between Live and Neutral on 220V supplies. These arresters are normally Class 3 arresters and are only rated to handle a maximum surge current of 5kA.



In addition, in terms of SANS 10142-1:2003 Annex L, electricians are installing 10kA to 40kA Class 2 arresters in the electrical distribution boards feeding this equipment. The surge arresters are installed as per the drawing which shows them fitted from each Phase to Earth as well as from Neutral to Earth.

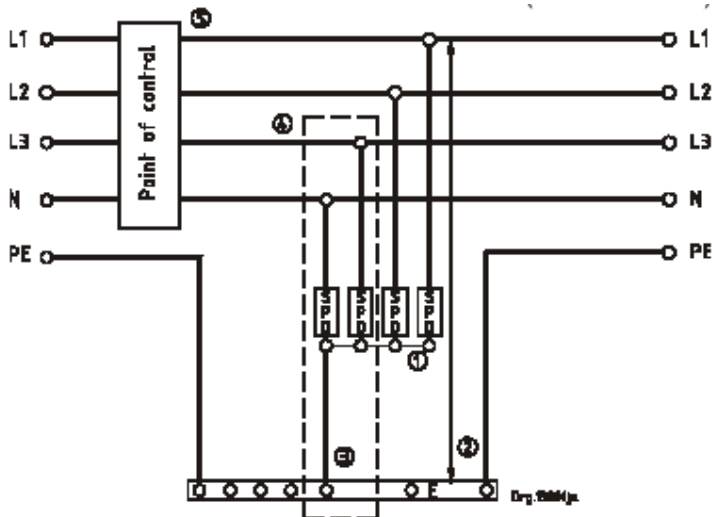
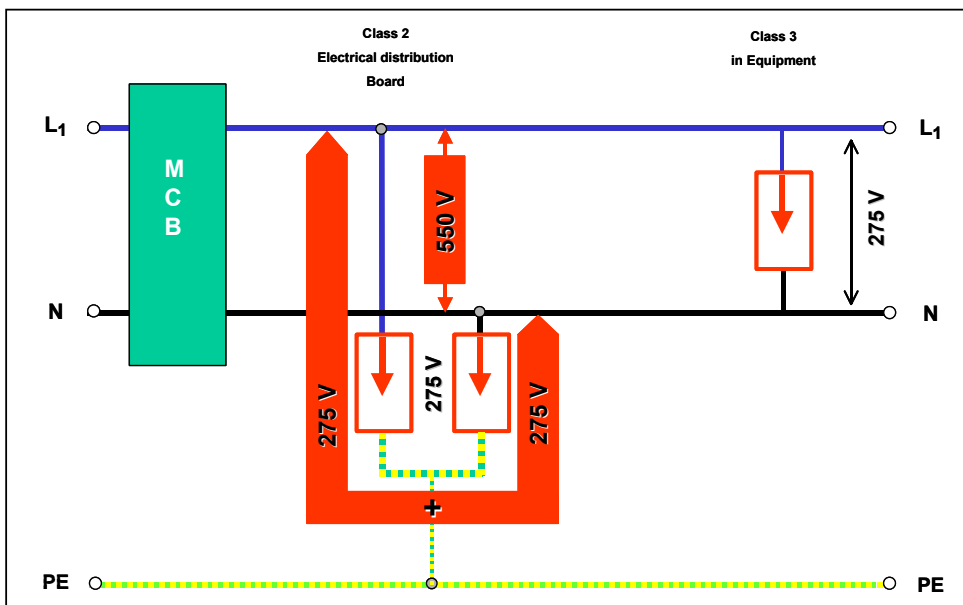
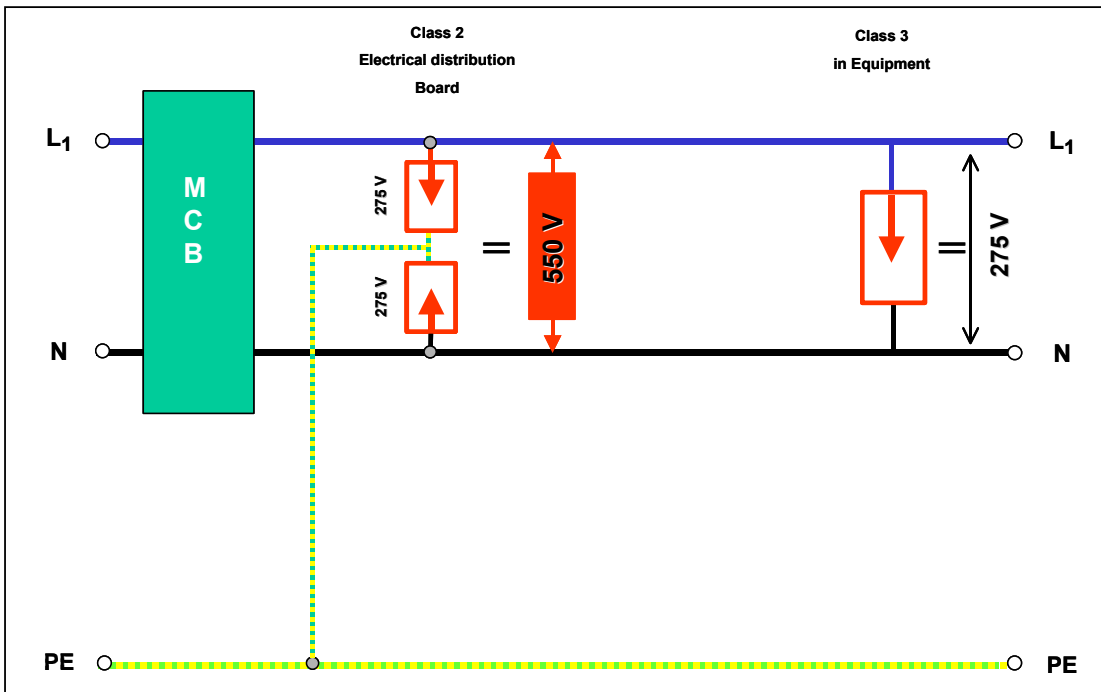


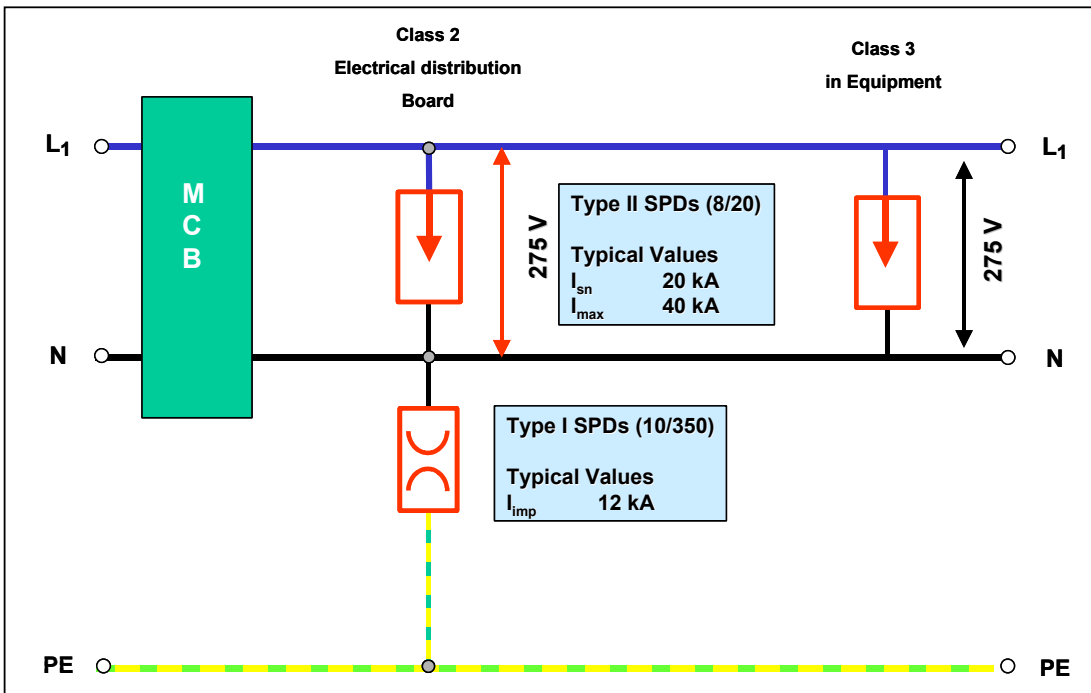
Figure L.2 – Installation of SPDs where the supply is a TN-S system earthing
Separate neutral and protective (earthing) conductors throughout the system earthing

For explanation purposes we will ignore the actual clamping voltage of the surge arresters and work on the rated voltages only. This means that if a typical 275V arrester are used you will have a minimum clamping voltage of 550V Phase to Neutral in the electrical distribution board and a clamping voltage of 275V in the equipment. (See attached diagram) This would mean that the Class 3 surge arresters installed in the equipment would operate first and be exposed to full surge current and as it has the lower operating voltage and the larger Class 2 arresters in the electrical distribution board will not operate as the voltage would be clamped to 275V Phase to Neutral and not reach the required 550V to cause the Class 2 arresters to operate. In most cases the Class 3 arresters installed inside the equipment are overstressed and damaged causing equipment failure.





To overcome this problem we recommend that the Class 2 arresters be installed as follows, from Phase to Neutral and then from Neutral to Earth. This now ensures co-ordination as you have a clamping voltage of 275V from Phase to Neutral (Class 2) in the electrical distribution board and 275V Phase to Neutral (Class 3) in the equipment.



The surge arrester used from Neutral to Earth must be specifically designed for this application as in the case of a 3-phase installation you can have 3 x 40kA surge arresters, total 120kA, trying to dissipate via this path to earth and a standard 40kA arrester will be overstressed.

We recommend a **DEHNgap C/T** for this application as the unit is rated at 12kA (10/350) which is the equivalent of a 300kA (8/20) arrester. This arrester meets Class 1 requirements and can easily handle the large common mode overvoltages experienced under surge conditions.

An added advantage of using this system of wiring is that it halves the clamping voltage Phase to neutral when compared with the standard SANS method of installation and the arresters installed from Phase to Neutral are less stressed due to the fact that they are only exposed to transverse mode overvoltages.

The same concept applies for Class 1 arresters and should be used right through the whole installation to ensure co-ordination of all the surge arresters.

