



## USE OF HEMP FILTERS CONNECTED IN PARALLEL

MPE do not recommend connecting power filters in parallel if it can be avoided. This applies to all power filters and not just HEMP filters

This is due to the following reasons

1. Slight mismatch in the resistance of filters will cause an imbalance in current though filters connected in parallel
2. As an example, even a 10% difference in resistance of filters will result in 10% current overload in the filter with the lower resistance
3. The situation is actually much worse than this would indicate as the 10% current overload represents a power overload of 21% because the power dissipated is based on  $I^2R$ .
4. This will cause significant overheating in the low resistance filter unless it has a significant safety margin in terms of temperature rise.
5. Hence, just 10% mismatch in resistance will cause a 21% increase in heat dissipation and that may cause the filter to get too hot and fail.
6. It does not matter how many filters are connected in parallel, the one with the lowest resistance will fail first.
7. Once the first filter fails then the full current will be shared by the remaining filters so they could all potentially fail in cascade.
8. If protection methods such as fuses are included on each line, they could protect an individual line from overheating and failing, but as soon as the fuse blows on one line, it instantly puts an increased load on the remaining filters, again potentially causing a cascade failure.
9. The only really safe method of protection would be to monitor the temperature of each filter in parallel, and to shut everything down in the event of any individual filter overheating. However, in a strategic infrastructure project, it is not usually acceptable to have a complete power shutdown.



If there is no alternative to connecting filters in parallel, eg where there may not be a filter of high enough current rating available, then the resistances of each paralleled filter must be very closely matched including the resistances of the paralleling links. Calculations must be carried out to establish the degree of matching required. The filters should also be derated to allow for an amount of current imbalance.

In the case of HEMP filters which need to meet the residual current requirements of Mil-Std-188-125, it is well known that it is more difficult to achieve the 10A residual current requirement both because of the difficulty in achieving high inductance values within a practical size, and also because of the requirement to use a lower value of load resistor for filters of higher current rating.

As an example, a 200A filter running on a 440/250V supply will need to be tested with a load resistor of  $V/I = 250/200 = 1.25\Omega$ , and will probably meet the residual current requirement of less than 10A.

If, for example, 5 of these 200A filters are connected in parallel for a 1000A requirement then the load resistance will come down to  $250/1000 = 0.25\Omega$ , and under these conditions, the combined filters may not meet the residual requirement of less than 10A. Please refer to MPE computer simulations of residual currents of filters connected in parallel for more information on this.

Of course, if a single filter was used for this requirement, it would also need to comply with the residual current requirement with the  $0.25\Omega$  load, but it would be designed to do this in the first place.