Know Your Standards

In view of the fact that we stopped our review of the Sections of IEC 61000-4 at Part 20 last time, we should start with Section 21, if it exists, and indeed it does.

IEC 61000-4-21

Section 21, extensively revised in 2011, is about tests in reverberation chambers, but humorous vocalizations are not even mentioned. It concerns tests of immunity and intentional or unintentional emissions for electric and/or electronic equipment and tests of screening effectiveness. Conducted emissions are excluded. It is quite long (114 pages) and very detailed. As for IEC 61000-4-20, it may be best to follow the instructions of the particular chamber in use.

As for all Basic EMC standards, it does not prescribe tests or limits for specific products or product families. These are determined by the relevant product committees, in consultation with CISPR and IEC TC77. However, a Note indicates that the responsible committee considers that simulations are not adequate for quantative determinations.

IEC 61000-4-22

This section, first published in 2010, is about measurements of radiated emissions and immunity to them in fully-anechoic rooms (FARs). It is much shorter than Section 21, and covers the frequency range 30 MHz to 18 GHz. Nevertheless, it goes into much detail about the measurements and how to ensure that they are as accurate as possible. The method is generally more suited to physically small products, although large FARs do exist. The results are expressed as electric field strength, since the measurements are not in the far field at lower frequencies.

There are signs of inadequate editing; for example the above-mentioned Note in the Scope is more or less repeated as main text, and clause 4.2 more or less repeats the latter half of clause 4.1. However, there doesn't appear to be cases of inadequate clarity.

IEC 61000-4-23

This and the next two Sections are about HEMP (High-altitude ElectroMagnetic Pulse), defined as such a pulse produced by a nuclear explosion outside the Earth's atmosphere, so with luck, it appears that it can be omitted from detailed study by most people. However, it does include data useful in other circumstances, such as the shielding effectiveness of an 0.5 mm thick aluminium enclosure against electric and magnetic fields from 100 Hz to 10 MHz. There is also a four-page annex on the characteristics of coaxial cables.

This Section is 'Test methods for protective devices for HEMP and other radiated disturbances' Clearly, this might involve smoke and loud noises (there actually is a test described as 'the smoke test'), and indeed full-scale testing using a high-power Marx generator and a large guided-wave structure (tens of metres) is described. Another set-up uses a very large bicone antenna suspended from a helicopter and driven by a 1.5 MV Marx generator. However, less spectacular methods of measurement are also described. One surprising thing is that a diagram said to be of a Rogowski coil does not show the characteristic feature – that the lead-out from one end of the toroidal coil is fed through the centre of the winding to the other end of the coil, so that the terminations are close together.

IEC 61000-4-24

This is 'Test methods for protective devices for HEMP conducted disturbance', and is a less exciting document than is included in Section 23. A second edition is planned, expected to be published in 2015. Unfortunately, the Review Report has not been supported by a Document for Comment, outlining the planned improvements. In principle, the device under test is enclosed in a screening box and zapped with a high-voltage pulse, to see how much energy it lets through.

IEC 61000-4-25

There is a new 2012 edition of this Section, 'HEMP immunity test methods for equipment and systems'. It is actually the 2002 edition with Amendment 1 embodied. It is concerned with laboratory tests, as opposed to the large-scale tests described in IEC 61000-4-23. Rather too many trivial or obvious definitions are included, as is a wordy description of 'radiated' and 'conducted', part of which is then repeated! The tests are described as being carried out in simulators, in contrast to statements in other standards that simulation is not reliable. For conducted disturbances, three types of disturbance, characterized by early, intermediate and late time of arrival at the EUT, are considered. Early time disturbances are represented by the IEC 61000-4-18 damped sinusoid for lower energies, the 5/50 ns pulse of IEC 61000-4-4- for intermediate energies and pulses defined in Section 25 itself for the highest energies. For intermediate time, the 10/700 µs pulse of IEC 61000-4-5 is used, while for late time, Section 25 defines a 60 s trapezoidal pulse. Generators for the waveforms described in the Section are also specified.

IEC 61000-4-26

This was to be 'Calibration of probes and associated instruments for measuring electromagnetic fields', but that subject is really for CISPR/A to deal with, so the project was cancelled.

IEC 61000-4-27

The title of this Section is: Testing and measurement techniques - Unbalance, immunity test for equipment with input current not exceeding 16 A per phase. In fact it applies only to true 3-phase load equipment for 50 Hz or 60 Hz supplies, not 3-phase and neutral equipment that actually presents independent single-phase loads to the network.

Unbalance (different phase voltages and/or interphase angles) can be caused by large single-phase loads, arc furnaces and fault conditions. Induction motors present an abnormally-low impedance to unbalanced supplies, similar to that under starting conditions. Overheating, to the point of severe and dangerous damage, may occur. Other loads may be disturbed so as to produce abnormal conducted harmonic current emissions. Control equipment that does not have sensors on all three phases may operate incorrectly. Abnormal acoustic noise is also a possibility.

Immunity is determined by applying deliberately unbalanced supplies, and evaluating the response of the EUT according to the usual Performance Criteria, including Criterion D - unrecoverable loss of function.

IEC 61000-4-28

This Section is: Variation of power frequency, immunity test for equipment with input current not exceeding 16 A per phase. It applies only to 50 Hz and 60 Hz equipment. The Scope says that the standard should not be applied to products that do not show significant lack of immunity to the small variations of supply frequency that are characteristic of most public supplies, which means most products.

As usual for immunity testing, the results are assessed in terms of the Performance Criteria.

IEC 61000-4-29

This one is called: Voltage dips, short interruptions and voltage variations on d.c. input power port immunity tests

It's written in terms of quite high-power DC distribution systems – the test generator is specified for up to 36 V output at up to 25 A. But this subject really needs to be considered for quite low-power products; in most cases there is enough stored energy in capacitors across the supply to tide over any short interruptions, but not always. For example, a product was quite immune *unless* an incandescent lamp alarm indicator was on; if an interruption occurred then, the microprocessor reset and the alarm indicator went out. Not good!

IEC 61000-4-30

The subject of this Section is Testing and measurement techniques - Power quality measurement methods, and it is, actually, a 'hot topic', although this isn't widely publicised. The point is that governments have determined that electric power is a commodity that must have consumer-protection quality standard applied to it, such as EN 50160 (which, in my opinion isn't standard at all, but something between a promise and a prediction). So the supply authorities are committed to 24/365.24 monitoring of voltage value, stability and unbalance, frequency, waveform purity and mains signalling voltages.

Three levels of measurement are specified - Class A (precision), Class S (good enough for statistics!) and Class B ('grandfather' class for existing instrumentation). For classes A and S, the basic measurement time interval is 20 ms. Measurements are then aggregated over intervals of 3 s, 10 min and 2 h. Measurements must be continuous, with no gaps. Details are given of how to assess voltage dips, swells and interruptions, unbalance and harmonics. There is a large amount of detailed information about other matters, even down to specifications for test leads and practical guidance on their use. It seems doubtful that the people who need this information are able to obtain it directly from the standard, but must be able to get the information form training courses based on it.

That's all for this time: there are a few more Sections (some still in their eggshells) to be considered before we move to another fascinating field.

If there is a standard or standards that YOU would like me to dissect, please use the response email address. Please note that I cannot quote long sections of text, nor pass them on by email, and I cannot answer a question like 'What is the difference between the 2005 version and the 2009 version?', because it's too complicated to relate every little change, and an apparently trivial change may be very significant for YOUR product, if for no-one else's.

J. M. Woodgate B.Sc.(Eng.), C.Eng. MIET MIEEE FAES HonFInstSCE
Email:desk@nutwooduk.co.uk
Web: www.jmwa.demon.co.uk