

## Does the Method of Protection ‘ic’ Adequately Replace ‘nL’ for Zone 2’ Hazardous Area Equipment?

The requirements for method of protection ‘ic’ are currently included in the standard IEC 60079-11:2006 and the requirements for “nL” contained in IEC 60079-15:2005 have been removed from the latest version, IEC 60079-15:2010 (Ed.4). **However:**

- **Is the comparison between Ex ‘nL’ and Ex ‘ic’ for Zone 2 clear?**
- **What effect will this have on the Ex manufacturer and end-user?**

Sira’s Senior I.S Certification Engineer, Peter Walsh, looks at the transition of the two levels of protection, and highlights the practical issues and possible solutions of the move.

### Summary

In theory it should be an easy transition for the manufacturer to go from Ex ia zone 0 or Ex ib zone 1 use to “Ex ic” for zone 2 use.

However, it is in the application of level of protection ‘ic’ that anomalies can occur if insufficient thought is given at the time of requesting ‘ic’ certification work.

For example, a Notified Body such as Sira certifies hazardous area equipment at the customer’s request to either ‘ia’ or ‘ib’. Later, the customer then requests to have the same equipment certified ‘ic’. It seems obvious enough to conduct the ‘ic’ assessment and simply carry over the safety description of Ui, li and Pi to the ‘ic’ approval and leave it at that. Assuming this happens, the first problem that will be encountered is when the end-user tries to install the “Ex ic” equipment. It’s only at this stage that it’s realised the “ic” equipment has to be supplied from an ‘ic’ power supply/barrier, thus adding to the installation costs, which were not initially envisaged. The second problem is, for reasons that will be explained below, you will probably find that a suitable commercially available ‘ic’ power supply/barrier is not available. The parameters li and Pi become meaningless in the context of ‘normal operation’ and ‘ic’. They can’t be used in the same manner that they can with ‘ia’ or ‘ib’ equipment under fault conditions.

### Breaking the Problem Down Further

#### The ‘Old’ Approach

The ‘old’ approach of ‘nL’ as a method of protection uses the terms ‘energy limited apparatus’, ‘associated energy limited apparatus’ and ‘self protected energy limited apparatus’. However ‘energy limited apparatus’ and ‘associated energy limited apparatus’ can be treated as one for the purpose of this paper.

##### **‘Associated energy limited apparatus’/‘energy limited apparatus’**

This approach assumes sparking occurs either in the field cables and/or in circuitry immediately connected to the field cables, which makes it necessary to provide safety parameters similar to those of intrinsic safety.

##### **‘Self protected energy limited apparatus’**

This approach does not require the manufacturer to look at cable faults and assumes both the field cables and the circuitry that’s immediately connected to it are non-sparking but sparking components exist somewhere in the circuit though they are protected by energy limitation (e.g. potentiometers). Also because the maximum voltage, current, inductance and capacitance in the

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sparkling component are limited locally by the hazardous area equipment itself, it is referred to as 'self protected energy limited apparatus'. Therefore, previously if a manufacturer connected this type of 'nL' equipment to a power supply in the safe area, the issue of sparking within the field cable was not a consideration, hence an associated energy limited power supply was not needed. The option of using this approach does not appear in IEC 60079-11:2006 and so is not possible with 'ic'.



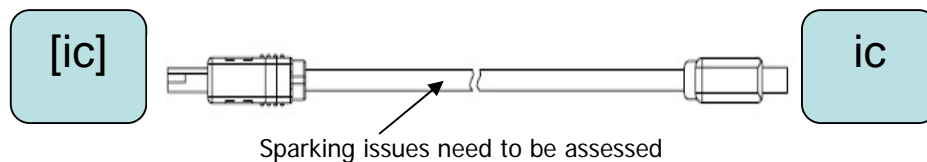
## The 'New' Approach

### Removing "nL" from IEC 60079-15 and bringing it in line with the Intrinsic Safety requirements causes an issue.

The second paragraph of clause 5.1 of IEC 60079-11:2006, states: *'The determination shall include opening, shorting and earthing of the external interconnecting cable.'*

So, having to deal with sparking in the field cable brings the need to connect to an associated 'ic' power supply typically located in the safe area. This would not have been a problem if clause 5.1 of IEC 60079-11 had not included cable faults for "ic" but I understand it was included so as to be in line with the Div 2 requirements of North America.

Therefore the power supply to the 'ic' apparatus **always has to be intrinsically safe** when applying an open or short circuit or an earth fault in the interconnecting cable.



IEC 60079-15:2010 only allows a non-intrinsically safe power supply connected to the equipment provided there are no sparking parts in the equipment.

### "Certify an 'ic' power supply/barrier," I hear you say!

Well, let us go through the steps and see what happens:

Initially, we would need an 'ic' power supply/barrier that matches the hazardous area equipment safety description. Therefore assuming the hazardous area equipment, was a Flow Transmitter and had an 'ia' or 'ib' certified safety description of  $U_i = 30V$ ,  $I_i = 100mA$  and  $P_i = 0.8W$  it would mean we need an 'ic' power supply/barrier with an output safety description of  $U_o = 30V$ ,  $I_o = 100mA$  and  $P_o = 0.8W$ . If that is the requirement then let us also go through the steps needed to achieve this.

Firstly the maximum open circuit voltage ( $U_o$ ) has to be 30V, which does not present any significant problems since we are talking about normal operation without any faults.

Next we need a maximum current ( $I_o$ ) of 100mA. This has to be the maximum current in normal operation. But normal operation can mean any value of current depending on the supply voltage and the resistance of the load. The current will vary not only with the voltage of the 'ic' power supply/barrier but also with the load. What clearly **can't** be done is to assess the 'ic' power supply/barrier on its own in normal operation. You could, of course, assess the hazardous area equipment using the short circuit output current of the power supply/barrier, using it as a worst case, but this is a fault condition not normal operation.

Lastly we need to ensure the maximum power  $P_o$  does not exceed 0.8W. But what does  $P_o$  actually mean?

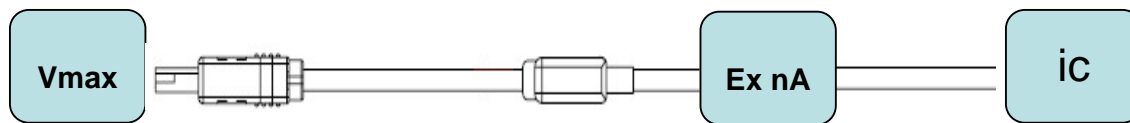
It is really carried over from level of protection 'ia' and 'ib'. The nearest there is to a value of  $P_o$  in the example of the 'ic' Flow Transmitter is the compound (i.e.  $V \times I$ ) of the supply voltage and the quiescent current. There is, of course, the option of assessing the hazardous area equipment using the matched output power of the power supply/barrier, but this is fault conditions not normal operation. Clearly the normal maximum output power ( $P_o$ ) of the 'ic' power supply/barrier cannot be determined on its own in normal operation. As with the assessment of the  $I_o$  the  $P_o$  will vary with both the supply voltage and the load resistance.

The conclusion we seem to be drawing to is that a suitable 'ic' power supply is unlikely to exist because much depends on the supply voltage and the current drawn by the load.

### A Possible Solution?

To get around the problem of a mismatch in safety parameters, when requesting certification work for 'ic', don't simply carry over the  $I_i$  and  $P_i$  safety parameters from the 'ia'/'ib' certificate, but ask for the  $I_i$  and  $P_i$  parameters to be 'don't care'. In this way it forces the certifying body to assess/test the equipment using its normal operating parameters and would probably involve them undertaking a temperature rise test to determine the temperature class under the worst case power dissipation.

With respect to having to use an intrinsically safe supply, presently the only way of being allowed to use a non-intrinsically safe supply is to use 'nA' in IEC 60079-15:2010 for the field cables and to assess the sparking components by intrinsic safety 'ic':



The certification code would then be "**Ex nA ic**" followed by whatever the apparatus group and T class was possible.

However IEC 60079-15:2005 detailed the requirements for self protected energy limited circuits and referred any sparking assessment to IEC 60079-11 but since the "nL" requirements have been removed from IEC 60079-15, what is to be used in their place - 'ic'? The method of protection 'nA' is not intrinsically safe. Historically it was not acceptable to interconnect intrinsically safe and non- intrinsically safe circuits without first going through associated intrinsically safe apparatus, which is signified in the marking by the use of square brackets (eg. Ex [ia] IIC). Since 'energy limited' has been totally removed from IEC 60079-15 there is no longer a clear link between IEC 60079-11 and IEC 60079-15.

The part of coding that appears to be missing is [ic]. Therefore if the Ex nA equipment is also assessed for [ic] it would take care of the missing link. The code would then look like "**Ex nA [ic] ic**", followed by whatever the apparatus group and T class was possible. The marking looks rather messy but at least it solves the problem.

In some cases, where the end user does not need to know about the [ic] or 'ic' part, there is a justification for simplifying the marking to "**Ex nA ic**" or "**Ex nA**" but clearly this is not specified in the standard and so confusion will reign once again.

Effectively 'ic' takes only part of the energy limited requirements of IEC 60079-15, but not all of them, so it is not a complete replacement.

### Confusion over Clarity

There is certainly an issue of clarity on this subject but only time will tell if the situation will be adequately resolved. If you are a manufacturer posed with this, or a similar problem with respect to level of protection 'ic', contact Sira for a discussion.

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References:  
IEC 60079-15:2005  
IEC 60079-15:2010  
IEC 60079-11:2006