

## Hop On The Bus Gustav!



Welcome to issue three of our renamed newsletter!! This is a continuation of the "Communication"

issue where we talked about the LON communications that the Viessmann Vitotronic 100, GC1 control uses. In this issue, we take the single GC1, multiply it by four and add a cascade control to provide full system control.

Before moving on, it must be stressed that the Vitotronic 300-K control discussed here is part of an off-the-shelf product line. The Vitocontrol-S, MW1/MW2 as well as custom control panel application, Vitocontrol-C, utilizes the same Viessmann LON 7172174 communication card. This card is used in all cascade control applications currently.

Primary resource for continued reading:  
*Viessmann NR2 LON Handbook*

### Starting Point

As already noted, the newsletter from two issues back is a great springboard for our discussion here. Feel free to review as necessary.

The Vitotronic 100, GC1 is truly the essential control building block for the Viessmann boiler system. Where the older Dekamatik boiler control

systems allowed a maximum of three boilers. The additional fourth boiler in the Vitotronic NR2 system along with the Vitotronic Cascade control is what really defines this control system.

The Vitotronic controls are entering their ninth year in 2012 of use in the North American marketplace and very little has changed over the years.

A Vitotronic NR2 commercial control system is comprised of two, three or

four Vitotronic 100, GC1 controls. The boilers then communicate with one Vitocontrol-S/C cascade control via LON. The entire boiler plant and system controls communicate via LON communication utilizing CAT5 cabling with RJ45 plugs.

### LON Communication Cabling

A complete stand-alone boiler plant generally starts with a LON termination resistor, CAT5e interconnect cables with the boiler and cascade control and finishes with a termination resistor. The termination resistor is used to suppress reflected noise, minimizing communication issues that may occur particularly in long communication runs.

Each control requires a LON communication card/module if it is to communicate with the main cascade control. The boiler controls do not come with the communication card out of the box.

This is part number 7172173, which is also used in the Vitotronic 300, GW2 control for single boiler, outdoor reset commercial systems.

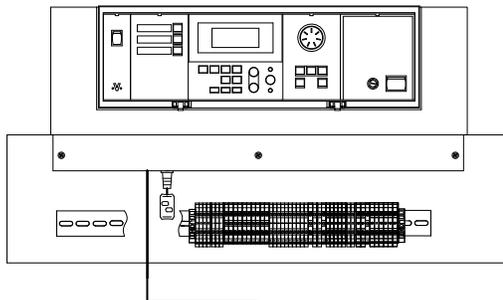
The Vitotronic 300-K cascade control is the only device which has the LON card included.

This is because it is naturally required to communicate with the boiler controls. This is part number 7172174. The Vitocontrol-S, MW2, used with Vitodens WB2B boilers, does not come standard with a 7172174 LON communication card due to its KMK communication with the boilers, but that is a whole different story for another time.

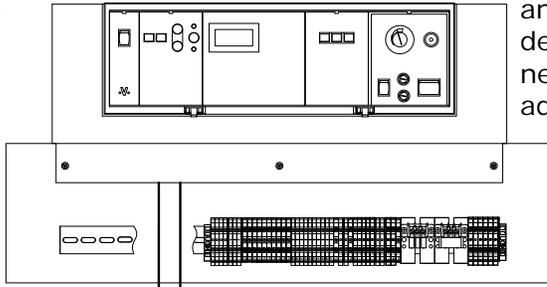


### LON Board

Each LON communication card has two RJ45 jacks which allow the controls to be daisy-chained from one control to the next. The RJ45 jack is larger than a typical phone jack, but the same as a typical computer Ethernet connection.



Communication cables can be purchased from Viessmann or made up on site depending on the length or wiring requirements. If you are making these on site, there are devices which allow you to test the connections. If the desire is to use the Viessmann supplied cable, it is part number 7143495. The Viessmann LON cables are about 7m or 23' in length.



allows the various controls to be distinguished from one another from a communications point of view. Like IP addressing for computers and other office devices on a LAN network, this addressing procedure must be completed when setting up an NR2 system.

two or three boilers in the system. This can cause some issues with communication to gateways and integration with BMS systems.

By default, the cascade also functions as the fault manager handling any of the faults within the system.

**Participant Update/Check**

At this point, *all* the controls are turned on and *all* have the LON communication wiring correct. How are we able to confirm correct communication between the controls and optional devices, such as the Output Module and Versatronik Gateways? This is where the Participant Check comes in.

The LON termination resistors are Vi part number 7143497 and come in packs of two. As mentioned earlier, a typical system LON bus starts with a termination resistor and finishes with a resistor.

The Viessmann NR2 controls have 2 coding levels, one which provides a small number of codes and the other which allows a more detailed configuration. It is coding level 2 which we are concerning ourselves with here.

**Control**

In order to access coding level two, press and hold the and buttons simultaneously. The GC1 boiler controls will indicate coding level 2 with in the screen display, whereas the Cascade control will display "Coding 2" in the screen. Movement within coding can be achieved by pressing the + or — buttons for both styles of controls.



The two functions that are used: Participant Update and Participant Check.

**Participant Update**

As a matter of process, when ensuring the LON communication is functioning correctly a Participant Update is performed. This allows the internal cascade control database to be updated and become aware of the controls connected to the Viessmann LON Bus or changes in LON boards. Once the update is completed, then it is possible to continue with a Participant Check.

**Communication Function**

By design, the Viessmann LON communication system (Cascade/ boiler controls/mixing controls) will work autonomously. This is due to the controls ability to perform an Autobinding function with all of the other Viessmann controls. This function allows the Vitocontrol-S/C to be aware of the other Viessmann LON participants and create an internal database with all of the known Autobinding devices. If another boiler is added, for whatever reason, this program will need to be run again so the cascade control can learn the new participant information. This is known as a Participant Check and a Participant Update. If a LON board is ever changed during the lifespan of the system, this Participant Update/ Check will also need to be performed.

Each control is programmed with a Node ID number. This is the LON address which is necessary for communications and a trouble free Participant Check. In coding level 2, this is address 77.

At address 77, the factory default setting is a value of 1. To change this value, press the OK button and the address value will flash. Change address 77 to the desired value of 1 through 4 for the boiler controls. Node ID 5 is reserved for the Vitocontrol cascade control and an ID of 10 for the first mixing valve controller. It should be noted that it is not necessarily good practice to adjust the Cascade to a lesser value just because there may only be one,

Like accessing coding level 2, there are specific button key combinations that are required. Press the OK button and the button simultaneously. You will see "Participant Check" appear on the screen of the Vitocontrol-S/C control. Once these words are visible, press the reset button under the OK button >I<. This will allow the control to perform the update function and read the LON device information from the various devices on the network. Once the control has finished the update, it will allow you to continue with the check.

**Control Participant Settings**

*(Assumptions: The controls are properly powered and are turned on. If they are not, ensure this is completed first.)*

In the world of communications, it is necessary for various devices to have unique address. This address



**Participant Check**

Accessing the Participant Check is just like that of the Update. Press the OK and the  button simultaneously.

The words "Participant Check" should appear on the screen and you will be able to navigate the available participants with the + and - buttons.

The Participant Check allows a test sequence to be run ensuring that the controls are communicating correctly.

The screen will show a number followed by the LON participant number. The controls may not appear sequentially as they only appear based on how they report back to the Cascade control.

Navigate with the + or - buttons, to a participant number in the user interface screen of the Cascade control. Press the OK button and you should see that particular participant flash and the words "Check OK" should appear in the screen of the Cascade control. If the communication confirms to be OK, then the connection is correct. Devices such as the Output Module will have a green LED which will flash for confirmation of the check.

The most important aspect of this test is to ensure that all of the LON participants appear during the Participant Check. In a typical LON network with four boilers, you will only see four participants as the cascade control is not considered a participant. If a Versatronik 505 communication gateway is present, you usually will see a participant of number 55. This will depend on the rotary dial setting of the gateway. Refer to the installation manual of the Versatronik 505 device. Systems which use Output Modules on the individual boilers will show values from 51 to 54 based on the rotary

dial settings in the Output Modules.

If the controls past a certain point are not responding during the Participant Check, verify the wiring up until that point.

As well, do not rush the Participant Check process as it may take some time for the controls to report to the Vitotronic 300-K. Be patient.

**Boiler Control Programming**

Another aspect of the commissioning process is setting the boiler control system addressing. The GC1 has three selectable systems values. Address 01 can be set to 01, 02 or 03. A value of 01 programs the control to operate as a standalone control. A value of 02 programs the control to communicate with the Cascade control via LON. Lastly, a system setting of 03 allows the control to be controlled by external demand inputs. It should be noted, while the LON communications will function with incorrect system settings, the GC1s will not allow the correct operational demands from the cascade control. C'mon, you didn't think that it was that easy did you?

It is best to refer to the manual for these settings, but essentially, the GC1s need to be set to 01:02 to allow the LON commands to function and cascade the boilers properly.

Like before, it is necessary to access coding level 2 and navigate the various coding with the + and - buttons and make your selection with the OK button.

Other boiler coding addresses such

as type of burner, pump control, return temperature functions are not discussed here as this is only a discussion of LON communication. For more information of the possible codings, refer to the boiler/cascade manuals.

**Logical Bindings**

**Warning:** Very dry material ahead!

Until now, we have reviewed the physical attributes of the LON CAT5e interconnection of boilers and cascade control. It is what happens behind the scenes, which is important.

The review of the single Vitotronic 100, GC1 control's node object points from a couple issues back provides the foundation for our continued discussion now with the cascade control.

**Bindings**

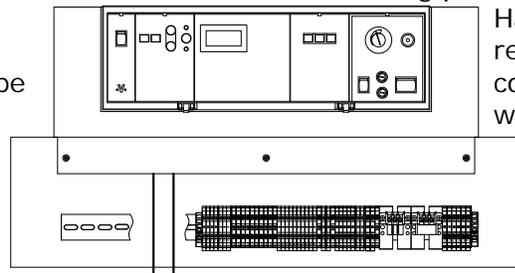
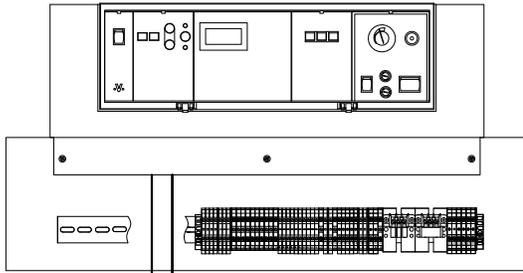
With the confirmation that all of the participants are present and reported back as OK, we can discuss the logical bindings made during the Autobinding process. The LON

Handbook makes reference to these connections. As well, you can refer to the attached page: NR2\_Lonmaker. From this file,

you can reference the logical connections that are made between the controls.

Let's take a quick overview of these connections. To start with, here is an excerpt from the LON Handbook manual:

*"In a multiple boiler system, the operation of the boiler control takes place via three input network variables. In this case, the boiler control is entirely mandated by the cascade control. None of the internal [GC1] demands and DHW production functions are possible. Depending on the chosen control strategy, a cascade control can request from the boiler an output in*



*% of boiler rated output, the boiler set point temperature or both."*

The three input node variables for the GC1 controls which the LON Handbook makes reference to are the nviBocBoilerCmd, nviBoCApplicMd and the nviBoCSetpoint. The three of these represent three different Snivets: a switch, a hvac mode and a temp\_p.

Essentially, what these three inputs provide are a "go, no-go" from the nviBoCBoilerCmd; a boiler operational mode from the hvac\_mode; lastly a boiler set point temperature from the temp\_p nvi input. As the note in the LON Handbook also says, "*the nviBoCBoilerCmd has priority over all other commands. When this variable equals 0, the boiler will be shut down regardless of the value of the other input variables*". So, while it is not difficult to control the boiler, it is important to know what demands are necessary. HOWEVER, if a cascade control is being used in the overall control scenario, there is no reason that a BMS system should even be connecting to these inputs.

The flipside of the input to the Boiler Controller Object (BOC) is the nvo, Network Variable Output. Like any good control function, it is always best to have a control feedback and the nvoBoC provides this information.

The four logical NVO connections which are used are, nvoBoCBlrState, nvoBoCSupplyT, nvoBocBocState and the nvoNodeAlarm. As said previously, these are used to provide the feedback information to the cascade control as a way to confirm the operation of the individual boilers.

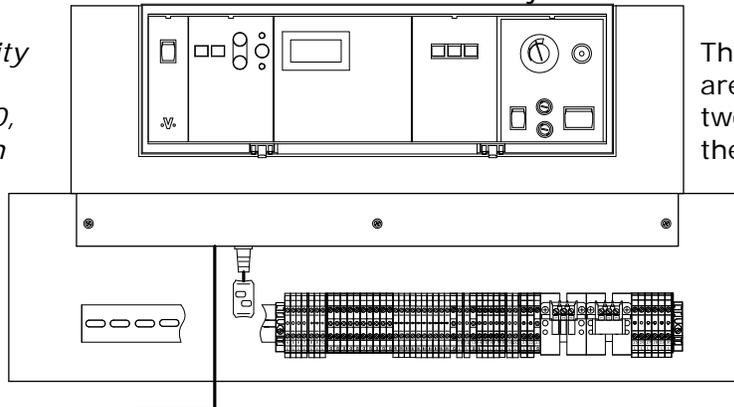
An important point of consideration is that both the nvi and nvo SNVT\_switch and UNVT\_BoCState are points which have multiple Byte information. This fact is important with respect filtering of the status

data string to be able to "see" only the important points that are to be seen.

At this point, before we move onto the cascade control connections, as we know, the Boiler Controller Object has three nvi input variables and four nvo output variables. This number is obviously multiplied by the number of boiler controls within the system. You can see this node object information in newsletter issue 10.

### Vitotronic 300K Node Objects

Up to now, we have been reviewing the cascade control Node Object



to the control as a whole from time, outdoor temperature, error handling, relay status as well as configuration properties such as Auto/Tool binding and heartbeat functions.

Alarm functions of the controls are communicated from the individual Boiler Control Object to the nviNodeAlarm of the cascade Node Object. Since the cascade is the alarm/fault manager, it will "handle" all of the current alarms. As part of the error handling, the nvoNodeAlarm output from the GC1 controls will be transmitted cyclically allowing all of the current faults to be viewed

The three zone functional objects are: HCC1, HCC2 and HCC3. The two latter (HCC2 and HCC3) are the two mixing valve outputs whereas the HCC1 is the unmixed supply water.

Based on the values that influence the overall calculation of the heating circuit set points, the highest temperature set point will be used to guide the operation of the boiler plant. What this effectively means is the greatest heating curve set point calculation will be used for the boilers, plus a differential setting through coding.

from the point of view of the automatic connections that are made during the Autobinding process with the Vitotronic 100, GC1 controls, moving forward, lets discuss the Node Object as a whole.

The graphic on the following page shows the overview of the Vitotronic 300K object. You will see there are 10 objects in total, four of those are for boiler control specific communication, depending on the number of boilers.

Along with the four Production Manager Objects used for boiler communication functions, the remaining objects are: Node Object, Heating Circuit 1, 2 and 3 Object, DHW Controller Object and Central Flow Demand Manager Object.

The Node Object is a requirement of LONMARK which are applicable to the device in general and not only to one single functional object. In it, you will see some universal aspects

Looking at the HCCx object, you will see there is no mention of slope or shift only a nviHCCxApplicMd, nviHCCxSpaceSet and a nviHCCxFlowTSet. Depending on the application mode, an external control input can be used to operate the three heating circuits either based on a room temperature function or provide an actual set point for the supply temperature. Depending on what is required as per the control specification, the modes can be altered to ensure the correct operation. As an example, by changing the operational mode from the factory setting of HVAC\_Auto to HVAC\_OFF, it is possible to put the heating circuit into frost protection.



**Vitotronic 333, Models MW1, MW1S and MW2**

**Node Object**  
 Mandatory Network Variables  
 Time of day  
 Auto/tool configuration  
 Heartbeat information  
 Alarm information from other controls  
 External system outdoor temp sensor

**Heating Circuit 1**  
 Un-mixed zone  
 Mode selection  
 Room temperature setpoint control  
 Control of supply temp set point

**Heating Circuit 2**  
 Mixed zone  
 Mode selection  
 Room temperature setpoint control  
 Control of supply temp set point

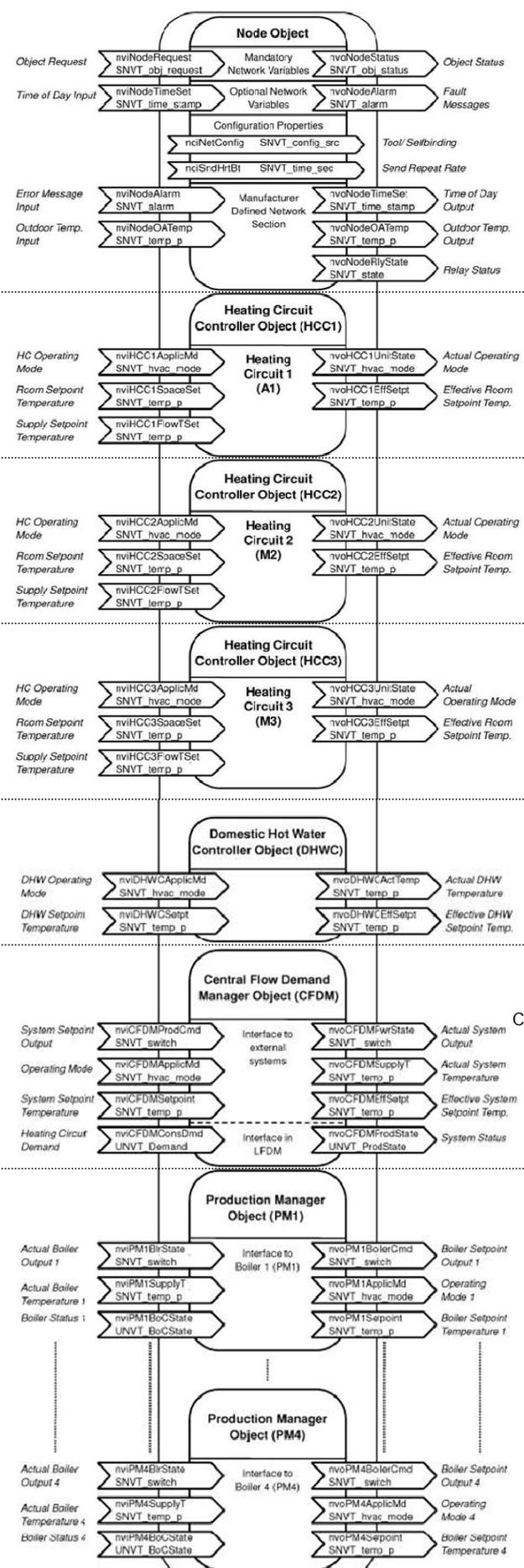
**Heating Circuit 3**  
 Mixed zone  
 Mode selection  
 Room temperature setpoint control  
 Control of supply temp set point

**DHW Control**  
 DHW mode function  
 Set Point control

**Central Flow Demand Manager**  
 Collects demand from other devices  
 Maximum temperature request  
 Alternate system temperature requests  
 Application modes

**Production Manager Boilers 1 Through to boiler 4**  
 Status feedback from boiler controls into the Cascade control  
 Boiler actual temperature  
 Boiler status information

Autobinding links from boiler controls node objects



**Node Object**  
 Mandatory Network Variables  
 Fault messages  
 Time of day  
 Outdoor Temperature Information  
 Relay Status Information

**Heating Circuit 1**  
 Un-mixed zone  
 Mode Status  
 Effective Set Point Temperature

**Heating Circuit 2**  
 Mixed zone  
 Mode Status  
 Effective Set Point Temperature

**Heating Circuit 3**  
 Mixed zone  
 Mode Status  
 Effective Set Point Temperature

**DHW Control**  
 Actual DHW temperature  
 Effective Set Point temperature

**Central Flow Demand Manager**  
 Common supply temperature information  
 Set point information  
 System status information

**Production Manager Boilers 1 through to boiler 4**  
 Status feedback from boiler controls  
 Operational mode information  
 Boiler set point information

Autobinding links to boiler control node objects



The LON Handbook table nviHCCxApplicMode is a great resource for the various modes and overview descriptions.

The Domestic Hot Water Controller Object allows the possibility to control the DHW production by again changing the mode and influencing production with a new set point.

At this point, we are left with the CFDM object. The best description of the CFDM operation can be pulled directly from the LON Handbook: *"The central flow demand manager object collects the demands of the heat consumers in the network and calculates the maximum value of all of the incoming temperature requests"*. Where these set points come from will vary based on LON communication with other Viessmann controls, internal demands of the Cascade control and external demands regarding the 143/146 dry contact inputs. As well, this is where the 0-10VDC Extension Input Module will also impact the overall supply temperature set point of the cascade control.

### The Big Picture

You may be asking how all of these node thingies tie in together? As you know, the cascade control can communicate with up to 4 boilers. If you take the four node objects from the GC1 communication issue and combine it with this cascade control node object, you will have the complete system and how the various control bindings are interrelated.

The cascade node object has the bindings from the GC1 controls as a status/information input and the cascade outputs control signals to the GC1 to achieve overall operation of the system.

### Integration

Until now, the basis of this discussion is from the cascade and boiler controls being in the Autobinding mode. When the controls are moved to the Toolbinding mode and the correct

links are completed, the basis of how the controls function is the same as when in Autobinding mode.

### Autobinding and Toolbinding

So, how do we migrate from Autobinding to Toolbinding? This question takes longer to answer than it does to perform the processes. The Viessmann LON system needs to be discovered by the integration software within Domain ID 07. The controls are discovered and can be viewed on the Integrators software on Domain ID 07 and from there, any desired domain ID can then be set.

Depending on the software that the Integrator has at their disposal, they may be able learn the links that are set up during the Autobinding processes. If this is not the case, the systems integrator needs to make the logical links between the controls. There are documents covering Tridium, LONmaker as well as Automated Logic from the KWE Technologies Group web site under the Support/Documentation tab.

Changing a control from Autobinding to Toolbinding is done at nviNetConfig of the Node Object discussed earlier by changing it from local to external. Based on our experience, this can quite often cause some issues because it may show up on the software screen as already in external mode, but when a "forced read" is performed, the true mode will show. Once the control is truly in external mode, only then will the integrator be able to perform the functions that are necessary to integrate into their system and bind the necessary points. This is where the supporting documentation has proven invaluable to an easy integration.

These steps are the responsibility of the systems integrator. If they are not able to perform this work, it is best then to use the Versatronik communication gateway. Typically the time savings that the gateway provides over and above making the necessary logical bindings justifies the minimal gateway expense.

So at this point, we need to ask ourselves some questions:

- What information is required from the boiler plant with respect to the specification?
- How do we want to control the boiler plant?
- Do we need to communicate LON, BACnet or Modbus?

These are questions which KWE cannot answer for its customers, but generally the answers come from asking how the customer/engineer foresee the operation. Quite often integration is made more difficult than it needs be either by design or not knowing what is available.



## Knowledge Vs. Technique

**know'ledge:** *n* 1. Theroretical or practical understanding of subject or language.

**techni'que:** *n* 1. Mode of artistic execution. 2. mechanical skill in achieving one's purpose, especially skillfully.

Knowledge can be read from a book or learned from a classroom. It is technique that is found between the lines on a page and learned only by doing.

Technique is the application of knowledge, i.e. tricks of the trade.



# Diagnostic Do's & Don'ts

Playing Doctor can take on a whole new meaning in the world of electromechanical systems.

However, the fundamental practices are the same: applying standard tests or techniques to troubleshoot problems.

When trying to find fault in electrical/electronic systems, people will generally always reference their tests to ground. What this means is that they will follow a current path with one meter test lead on ground and the other through the power circuit. While this is an acceptable method, it can lead to an incorrect diagnosis of a problem.

Older Dekamatik controls use a power switch that switches both the Line and Neutral connection. This type of switch allows a full disconnection of incoming wiring than that of switches that just break the Line connection.

Obviously, we would start right from the power outlet to ensure we have 120VAC feeding the control. Next we would want to follow a sequential path through the fuse, power switch and so on through the entire control. Having the reference point on ground may be an issue if there is a break of the Neutral connection.

Let's for a moment assume that the Neutral conductor or the Neutral side of the power switch were to fail. By referencing all you test points to Ground, you would not find the Neutral break. However, if your reference point is part of the Neutral circuit from inside of the control, you would find this almost immediately.

The Vitotronic controls do not use a switched neutral so this is not an issue.

**Do** take proper precaution when working on "live" controls

**Don't** use a light bulb for a tester and say you have 120VAC based on the brightness of the bulb.

**Don't** use a piece of tin-foil for a fuse replacement "just for the time being".

**Don't** reference how a system is working based on a remote mechanical thermometer. A control device has no idea what a thermometer is displaying. Rather, reference why the control isn't functioning, as you think it should, based on the information the control is using. Look at the temperature the control is displaying based on its own sensors.

**Do** use proper test equipment to gather information and **Do** record tests and results for future reference.

**Don't** just perform a relay test to ensure the functionality of a control. Instead, adjust settings and anticipate the operation based on your knowledge of the control.

Adjust the heating curve up and down to watch a mixing valve open or close.

**Don't** be afraid you are going to break something.

**Don't** adjust or change more than one variable at one time. It is impossible to know what fixed the problem for the next time.

**Do** perform simple tests. Swap sensors for known good ones to try and isolate a potential problem. If the fault code or operation changes with the sensor, you have narrowed the problem down.

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