

DeviceNet[®]

Plant Floor Troubleshooting Guide

The ODVA Automotive Special Interest Group (SIG) is pleased to offer this document as a tool for troubleshooting devices that have been implemented into a DeviceNet network as well as the DeviceNet network itself.

The following individuals have been invaluable in putting this document together:

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For more information regarding the ODVA, including the Automotive SIG, please refer to the ODVA website at:

www.odva.org



Plant Floor Troubleshooting Guide

**DeviceNet Plant Floor Troubleshooting
Flowchart**
(Suspected Network Error / Multi-Node Problem)

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**DeviceNet Plant Floor Troubleshooting
Flowchart**
(Intermittent Failures)

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**DeviceNet Plant Floor Troubleshooting
Flowchart**
(Single Node Problem)

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Walking the Network

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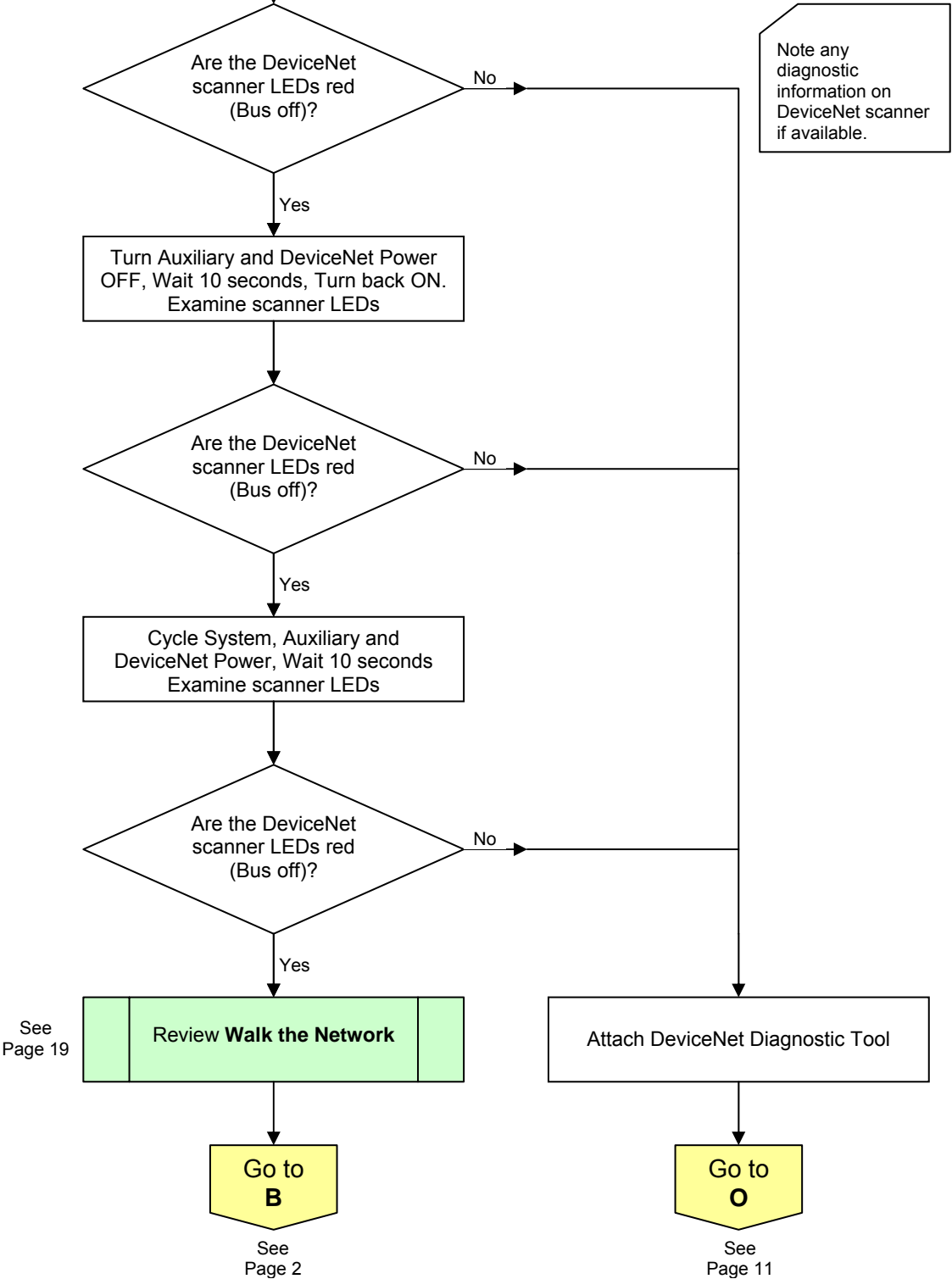
Segmenting the Network to Troubleshoot

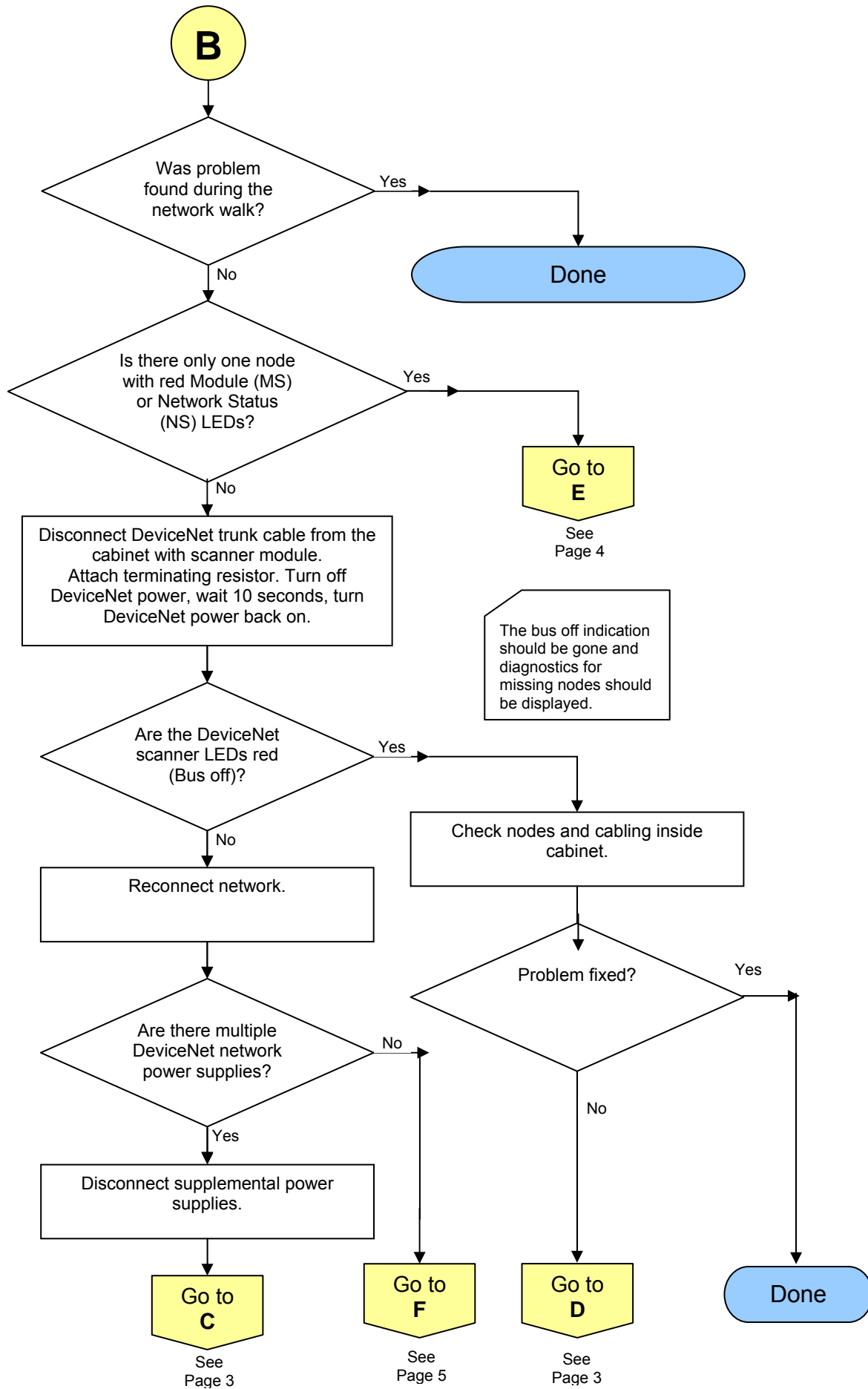
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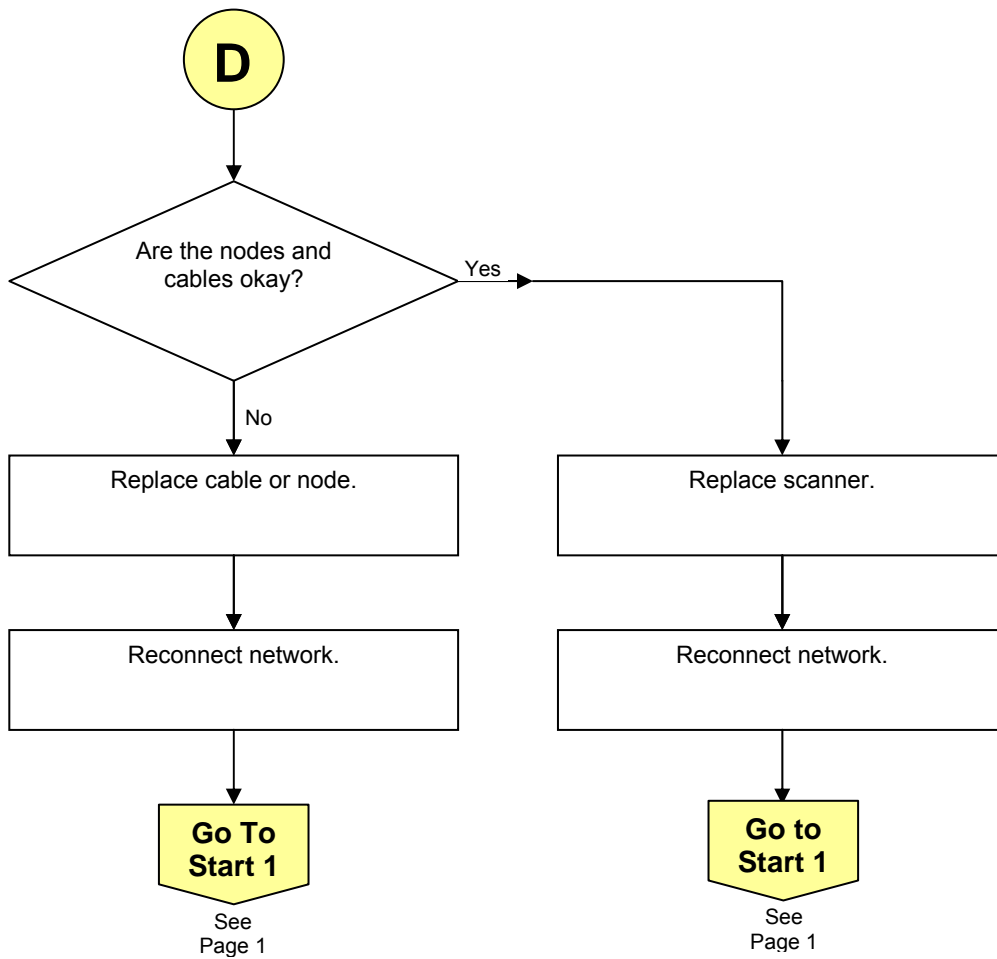
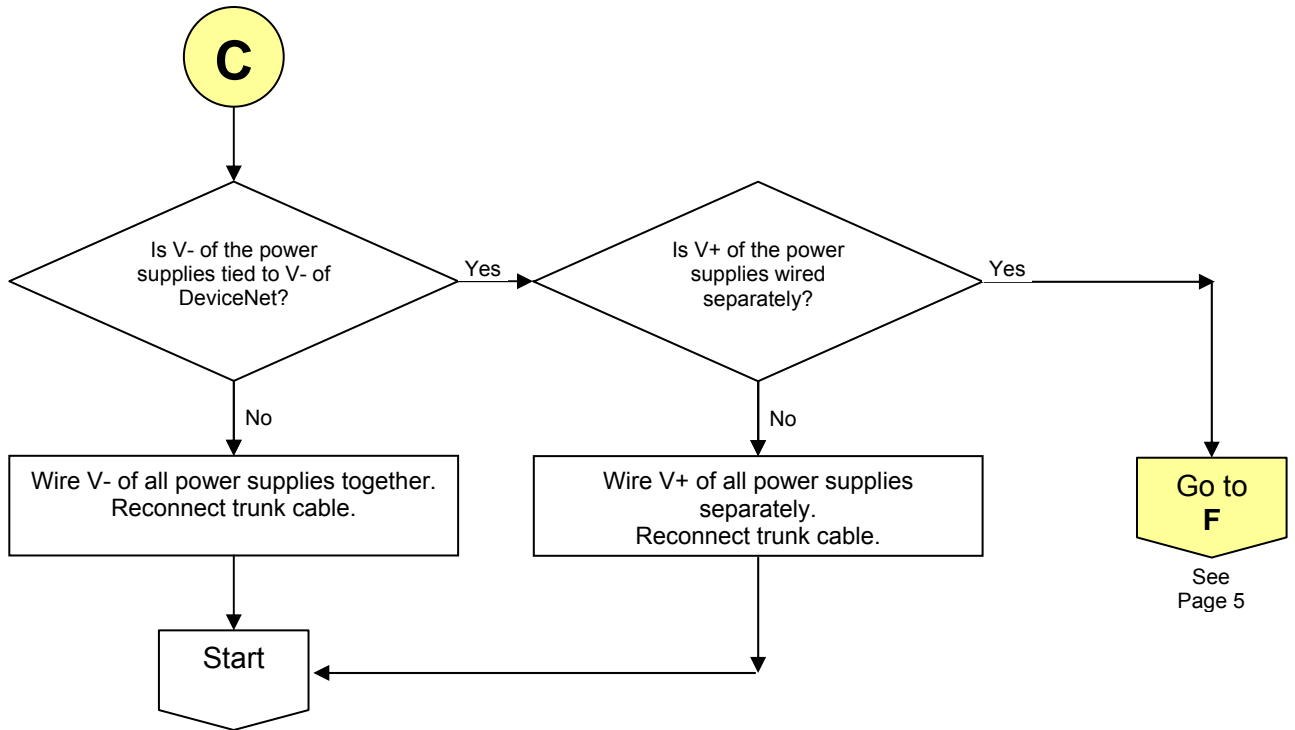
DeviceNet Network Checklist

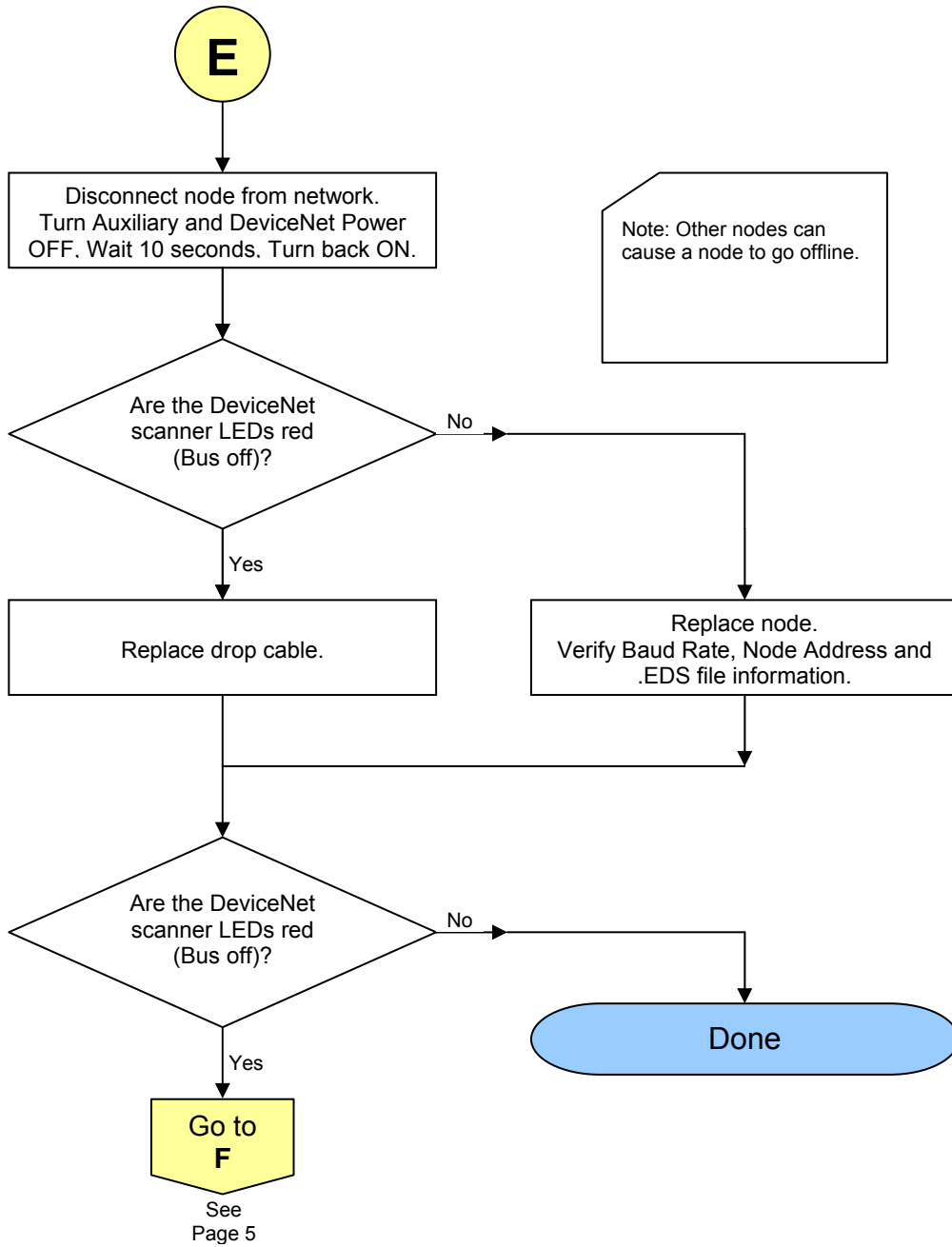
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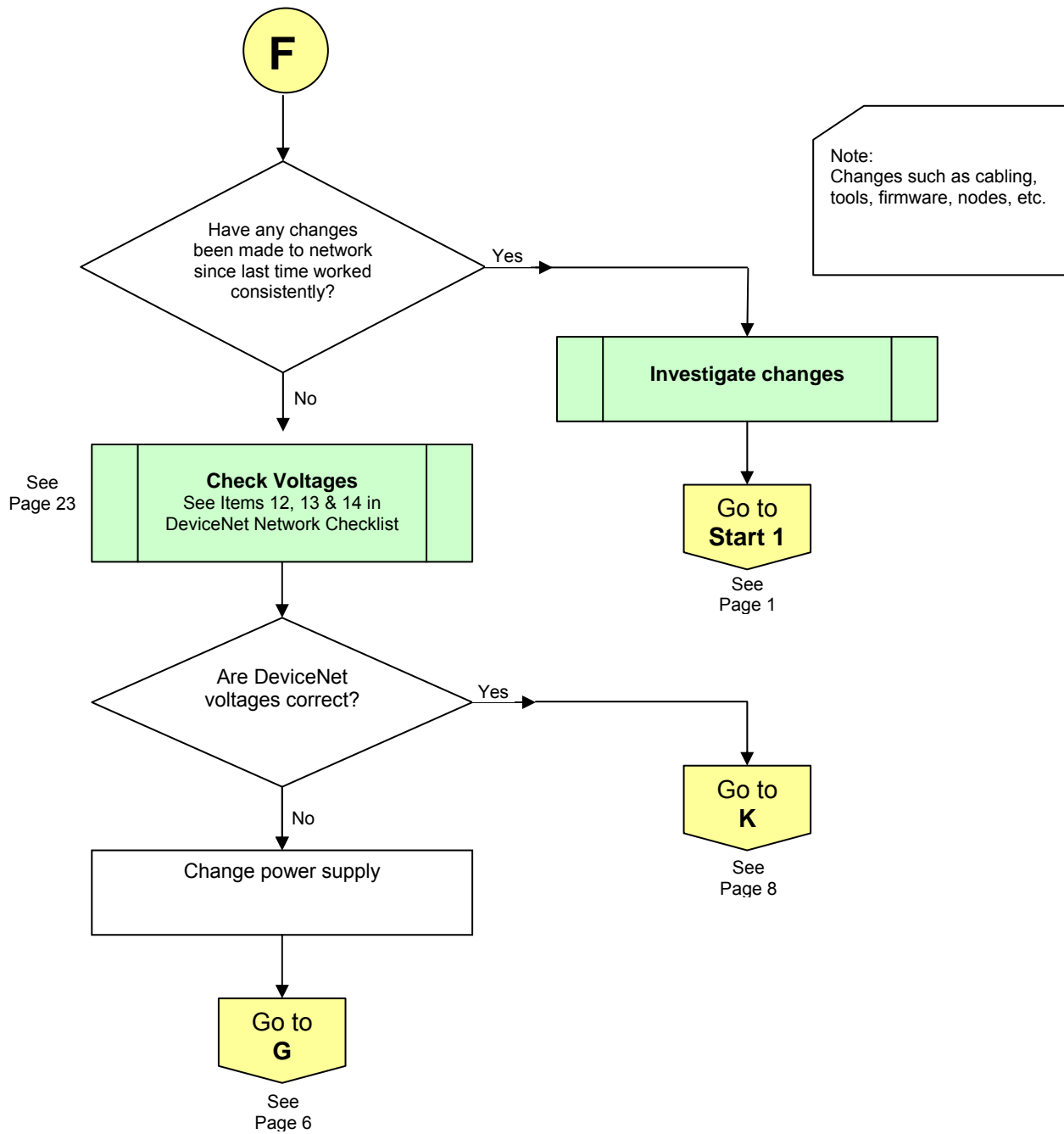
Start 1: DeviceNet Plant Floor Troubleshooting Flowchart
(Suspected Network Error / Multi-Node Problem)

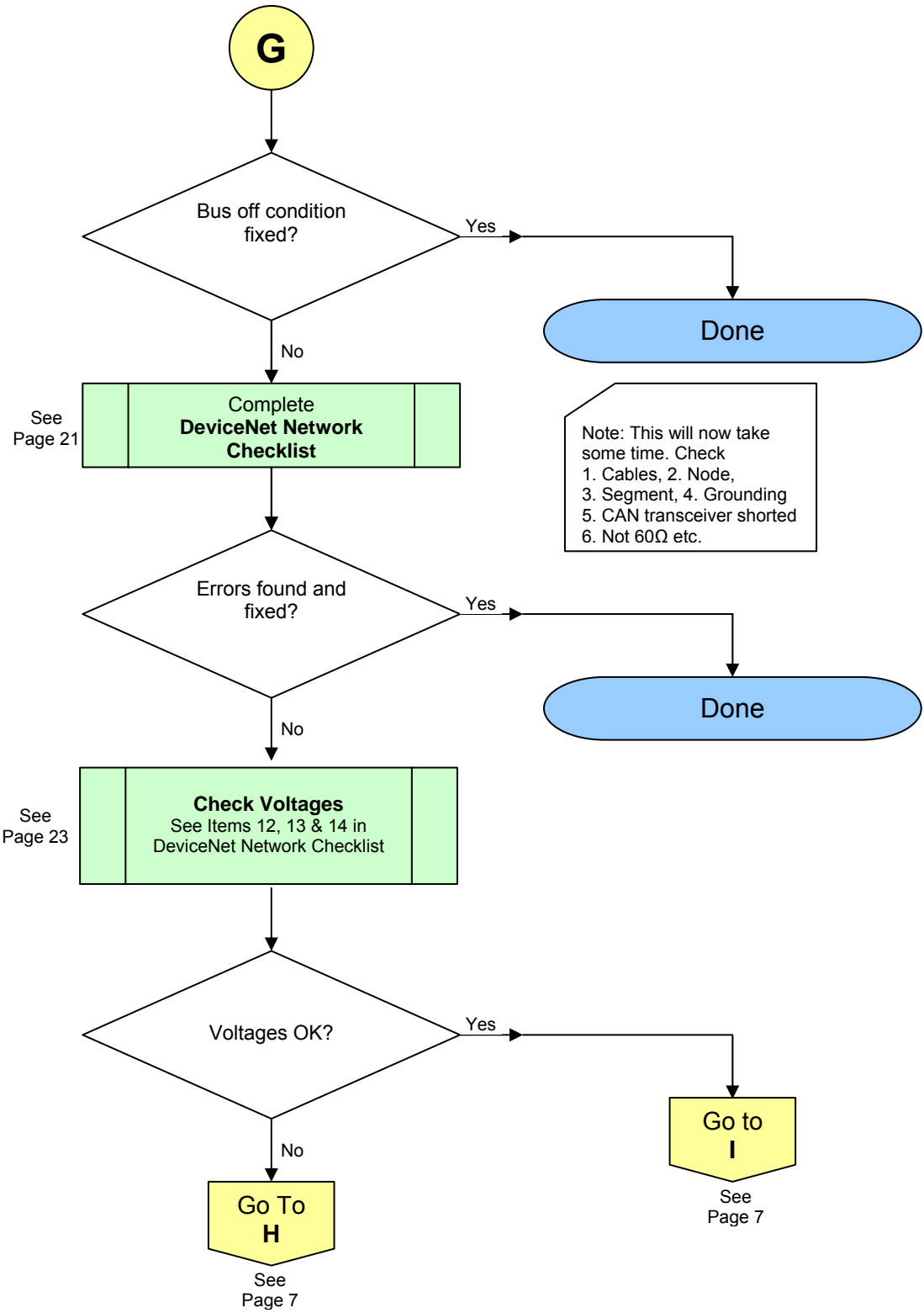


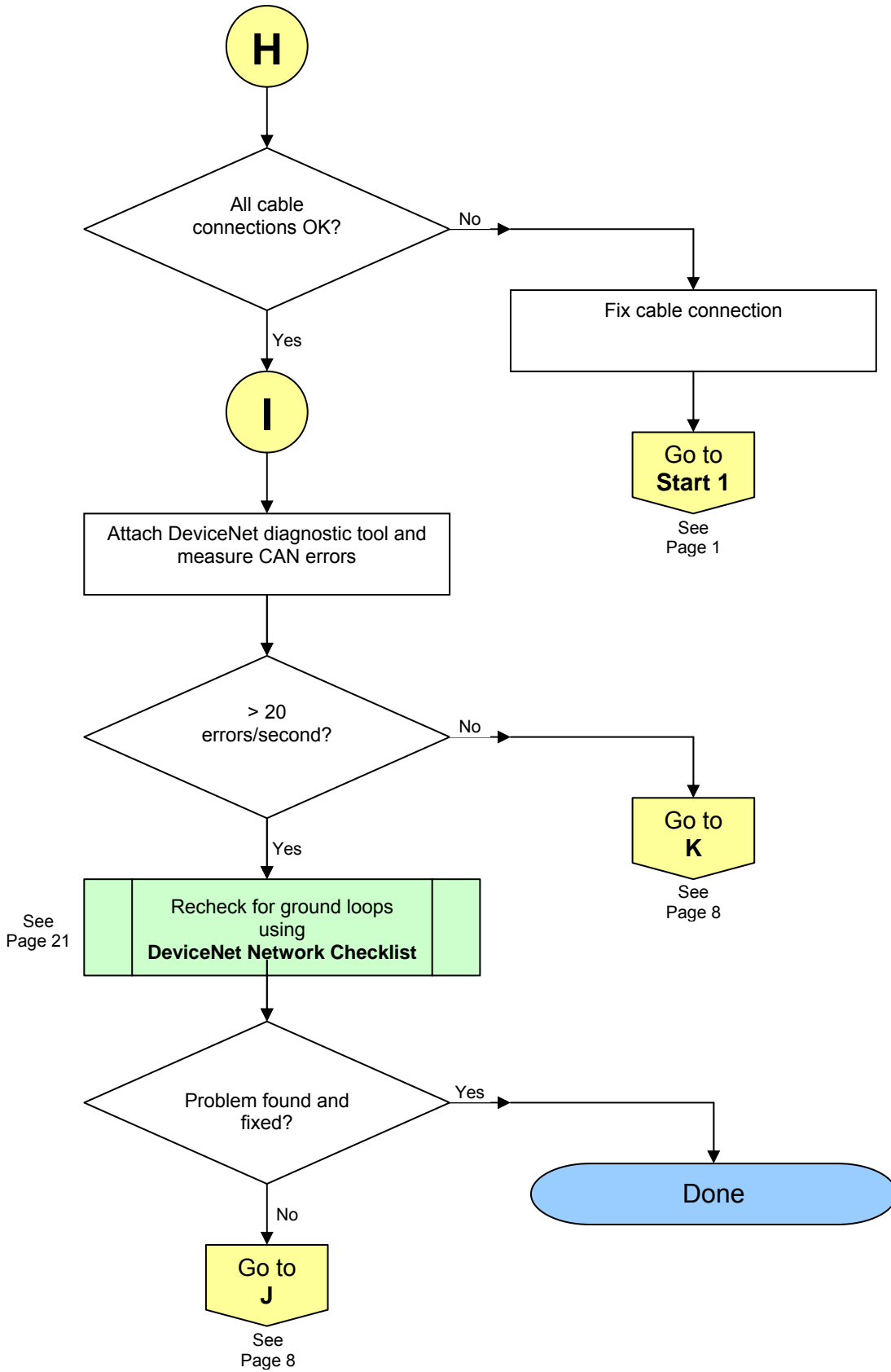


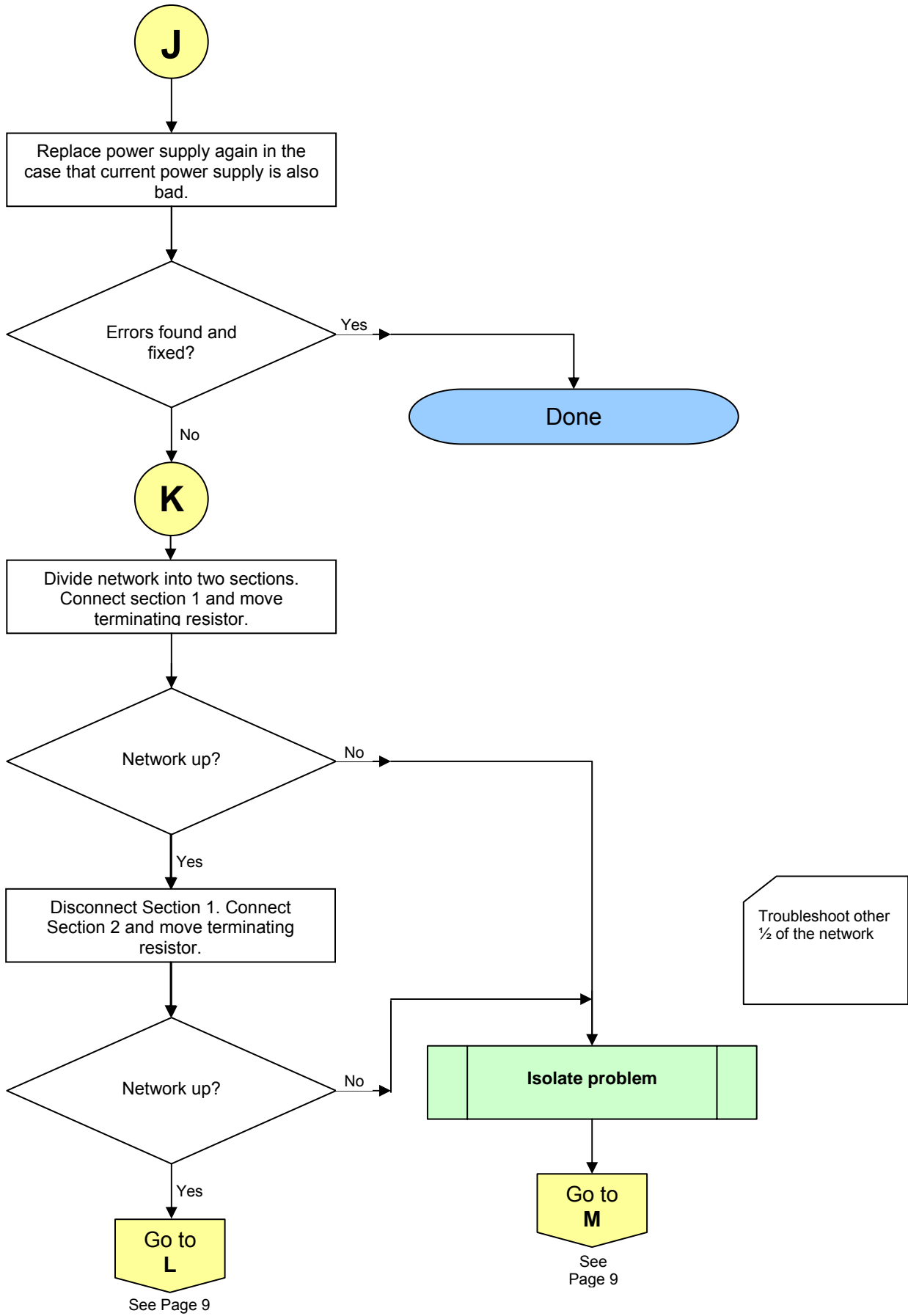


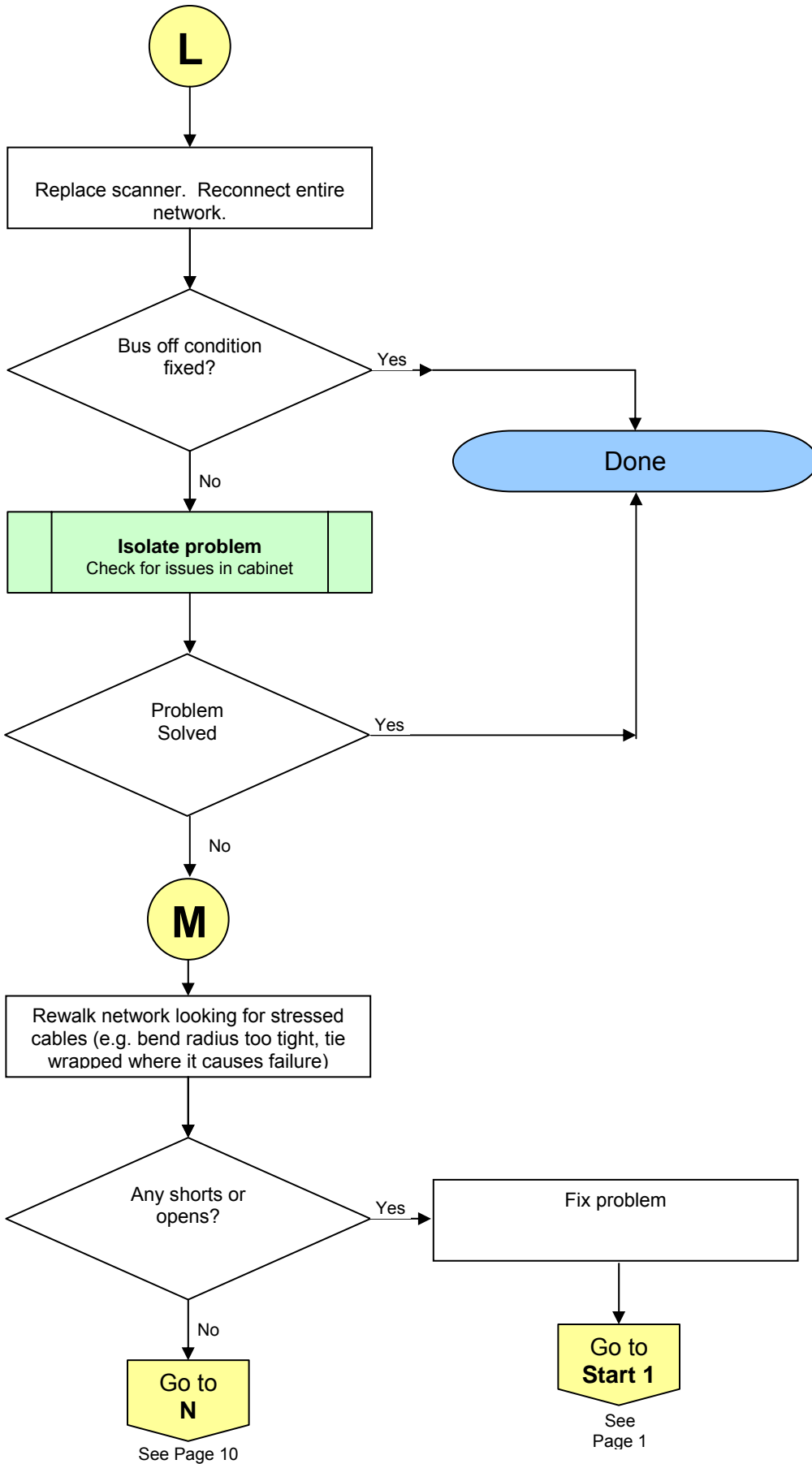






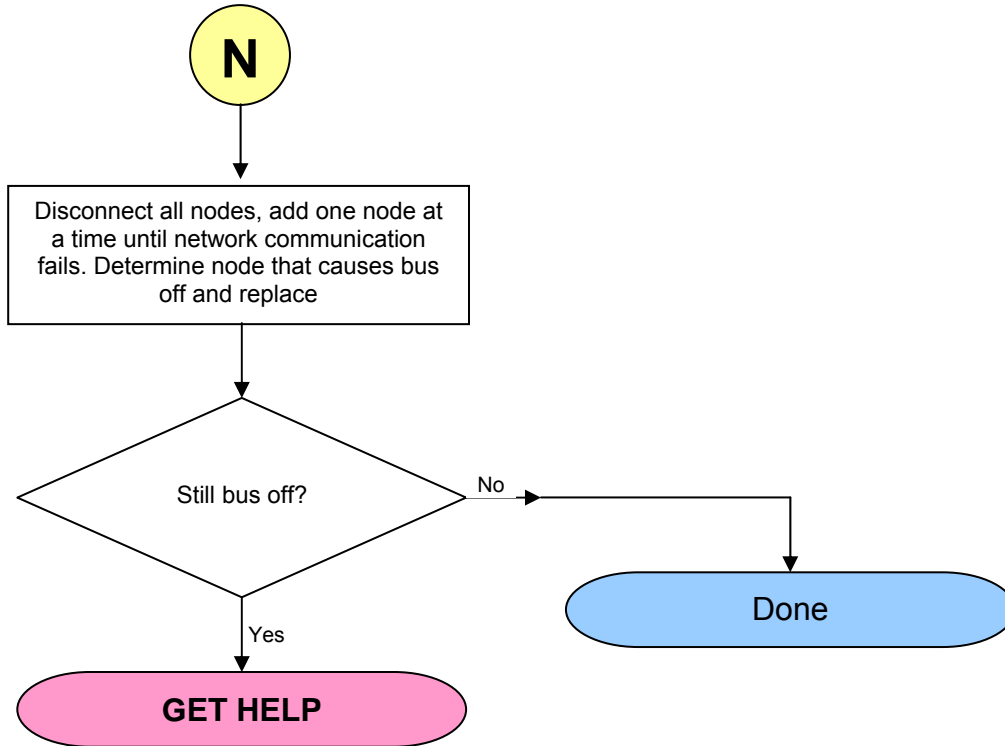




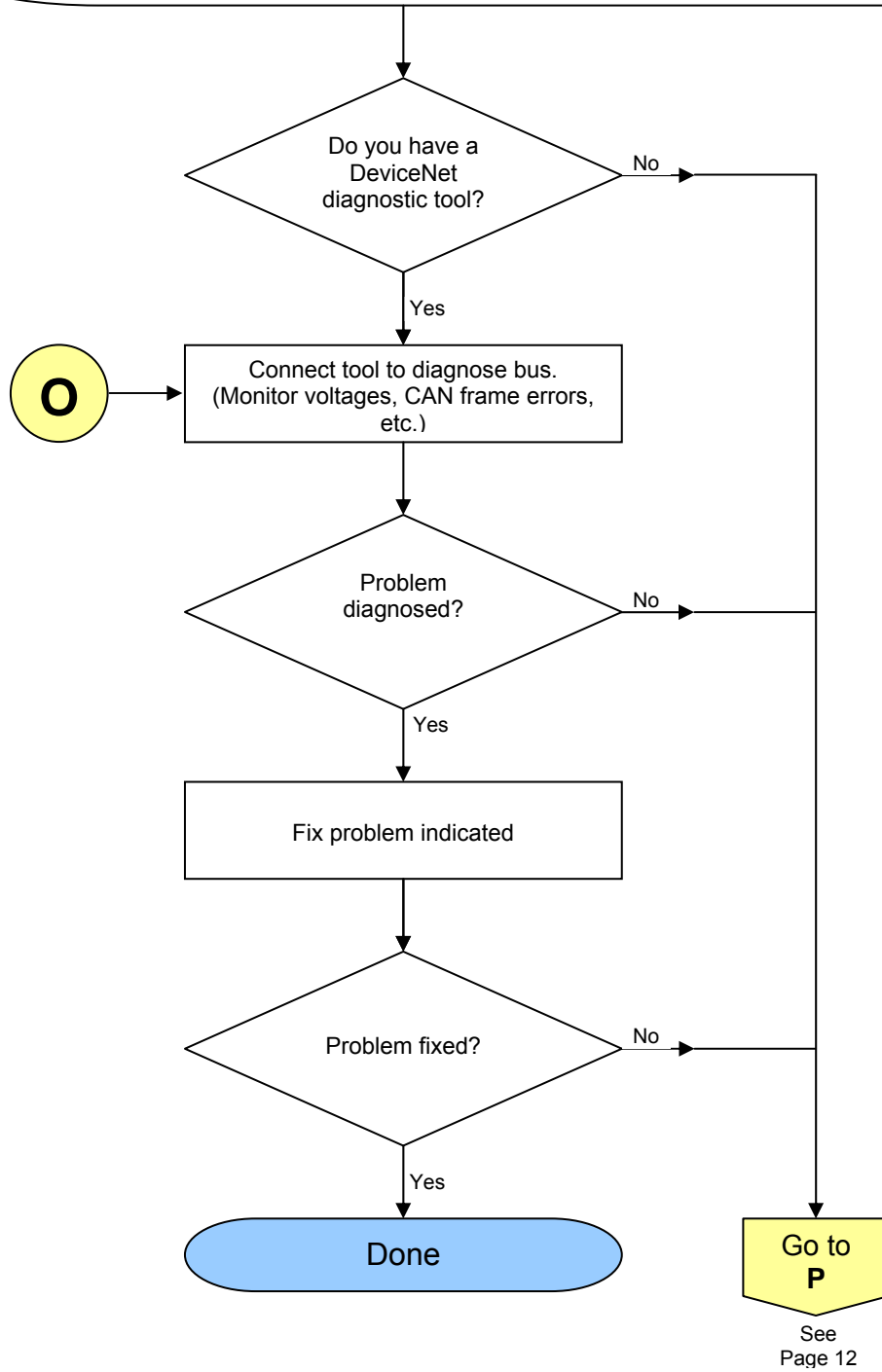


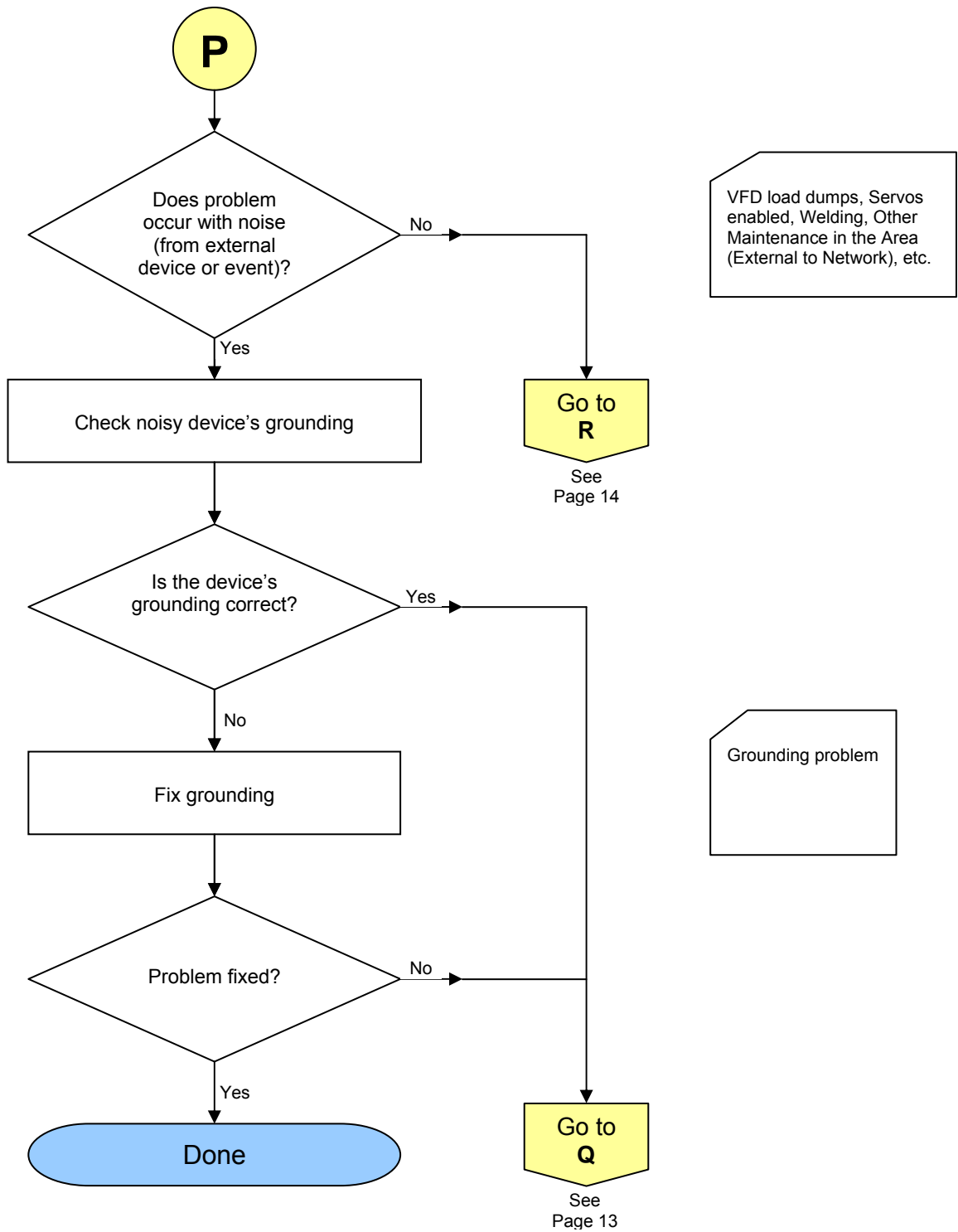
Checking for potential network load issues.

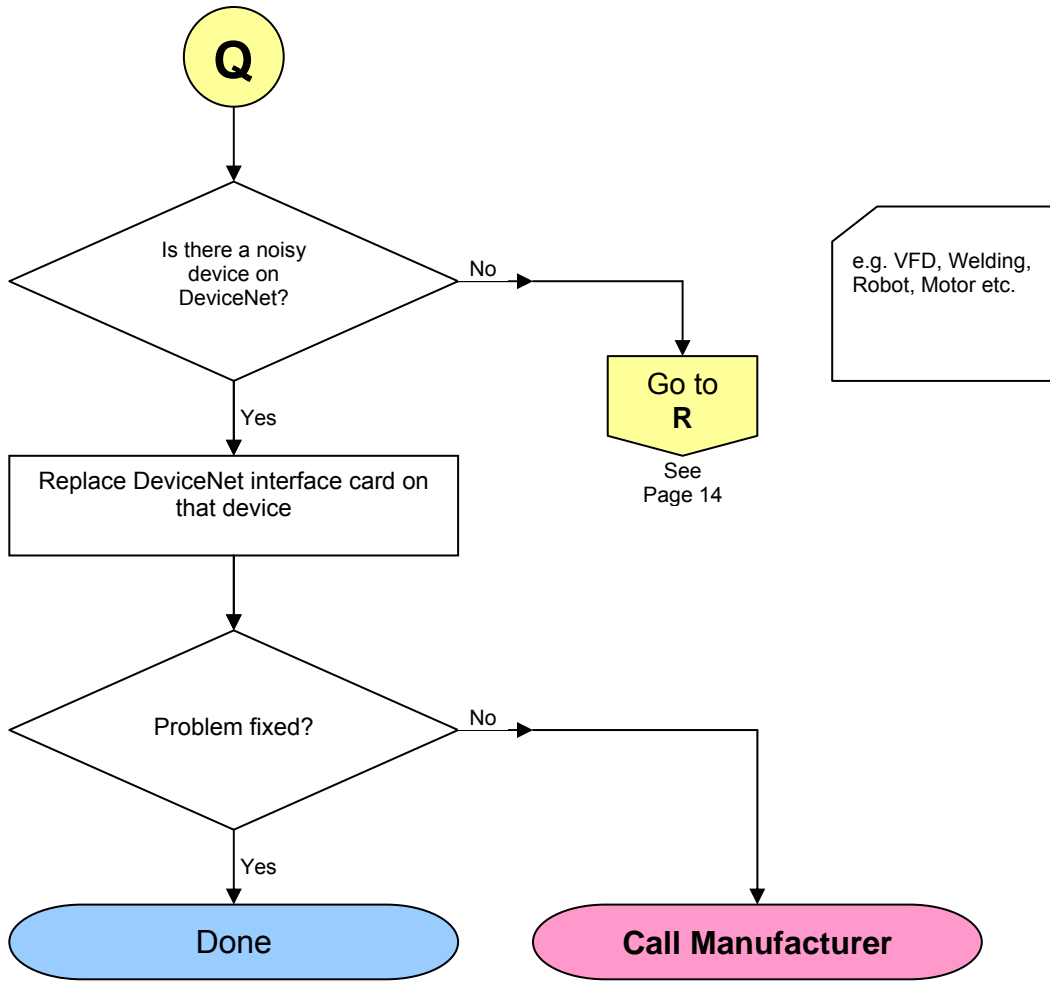
Check for wiring and other nodes within the scanner cabinet.

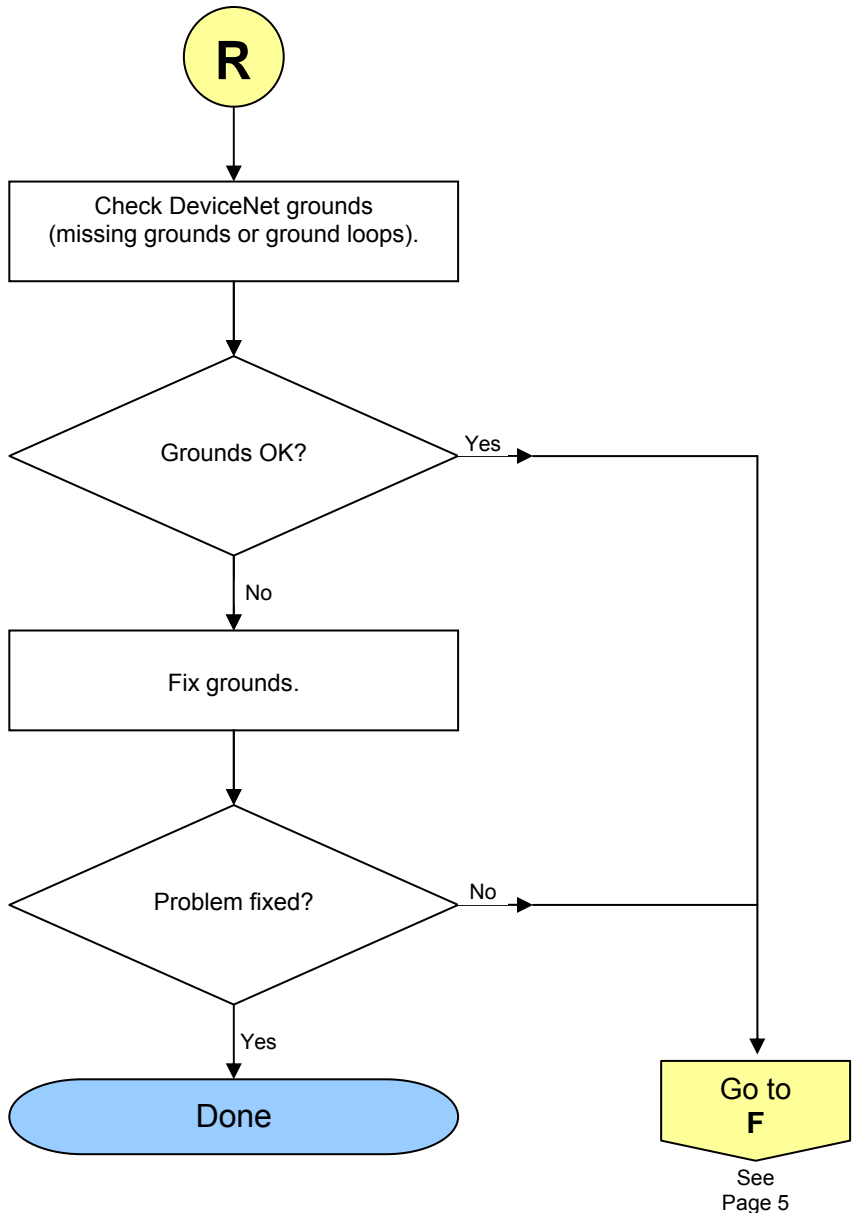


Start 2: DeviceNet Plant Floor Troubleshooting Flowchart (Intermittent Failures)



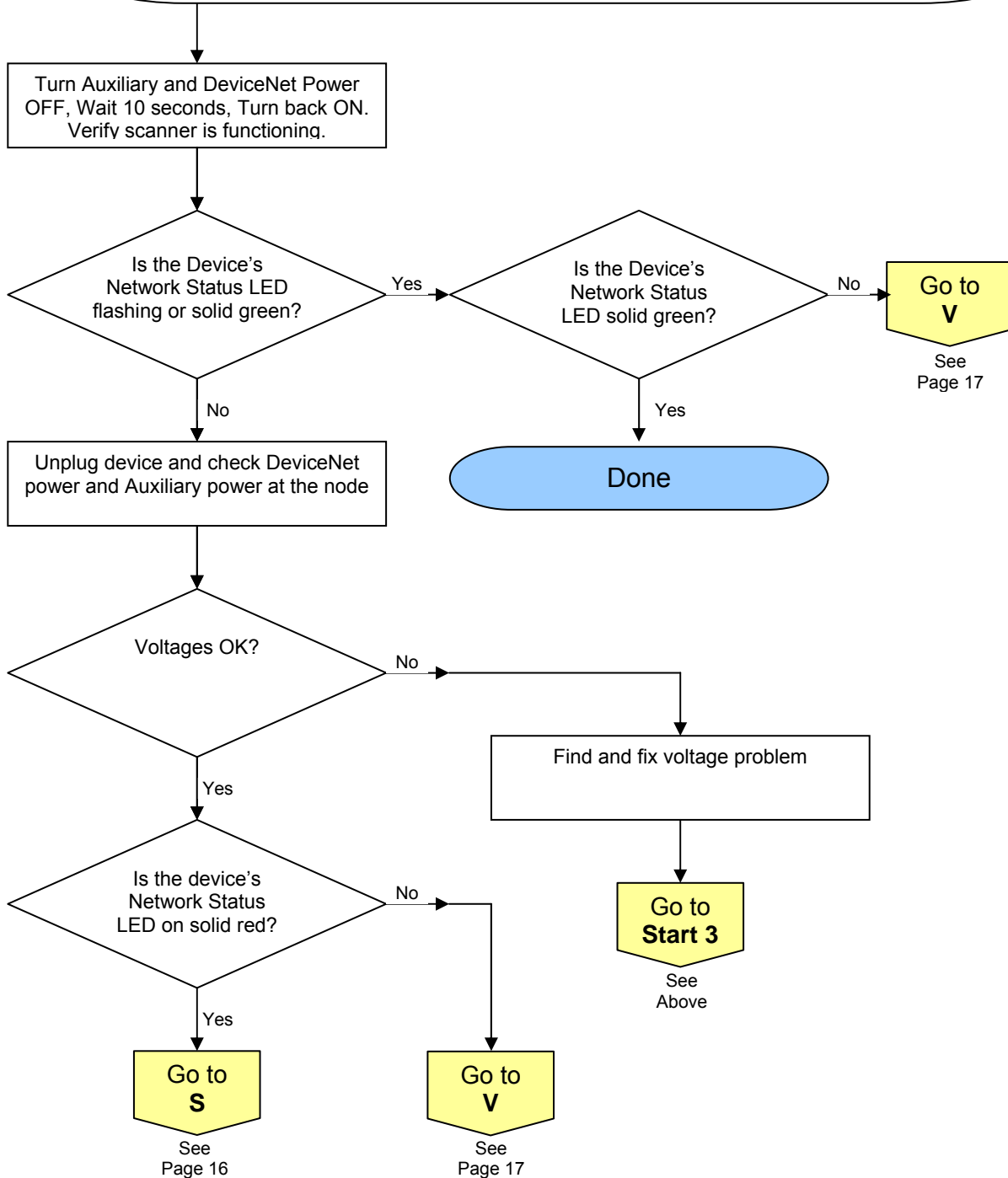


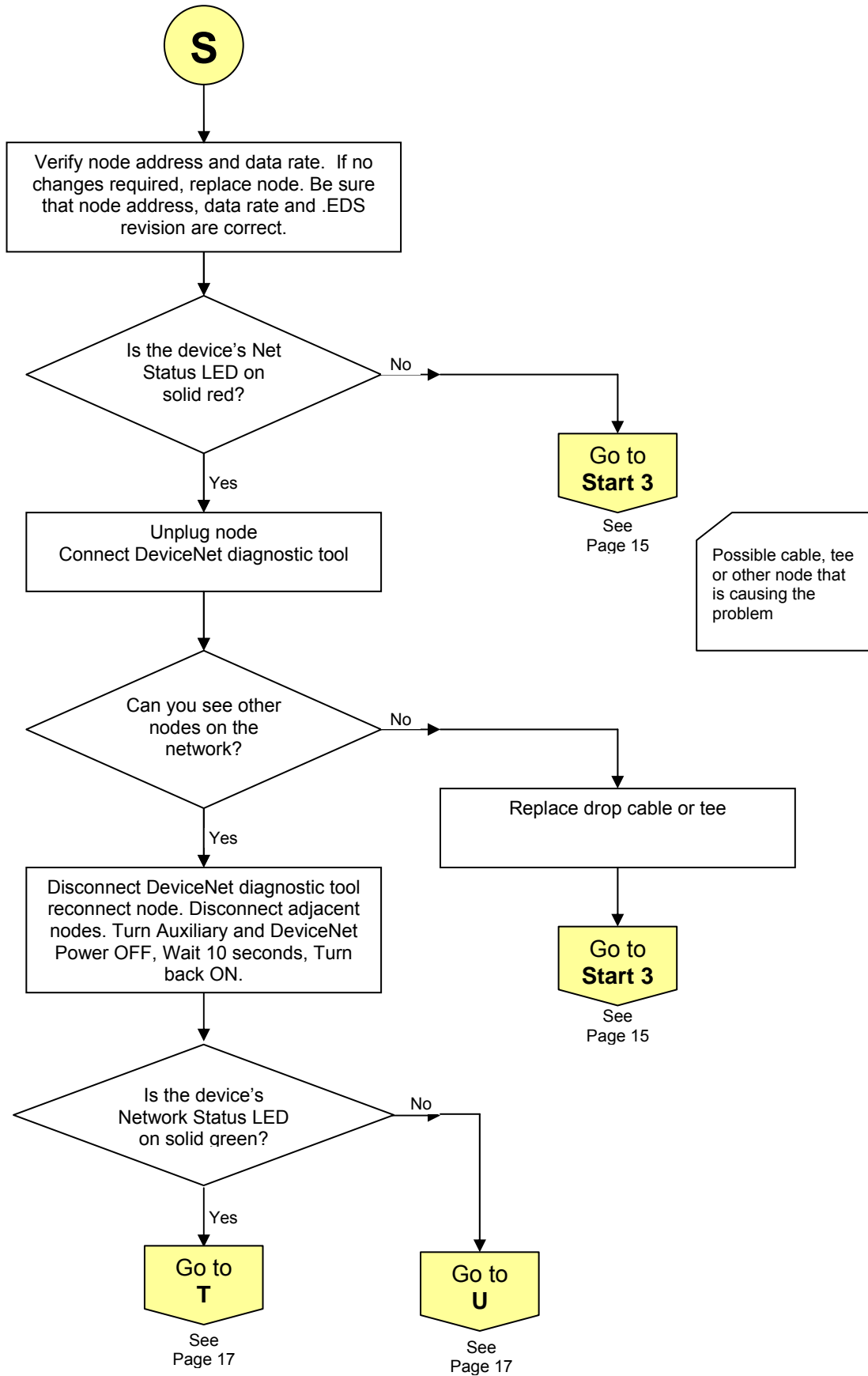




Start 3: DeviceNet Plant Floor Troubleshooting Flowchart (Node Problem)

If this is your third time through this process, consider the possibility that this is a network issue rather than a node issue.





T

One of the adjacent nodes may be causing the problem. Replace bad node. Reconnect nodes one at a time to confirm which node is causing the problem.

Go to Start 3

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U

Disconnect nodes until the device's Net Status LED is on solid green.

Reset power after removal of each node to determine if problem has been corrected.

Reconnect nodes one at a time to confirm which node is causing the problem.

Replace offending node.

Go to Start 3

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If the node's Net Status LED is flashing green, it is ready to establish communication.

V

Check HMI or scanner for diagnostic information for corrective action.

Was corrective action successful?

Yes

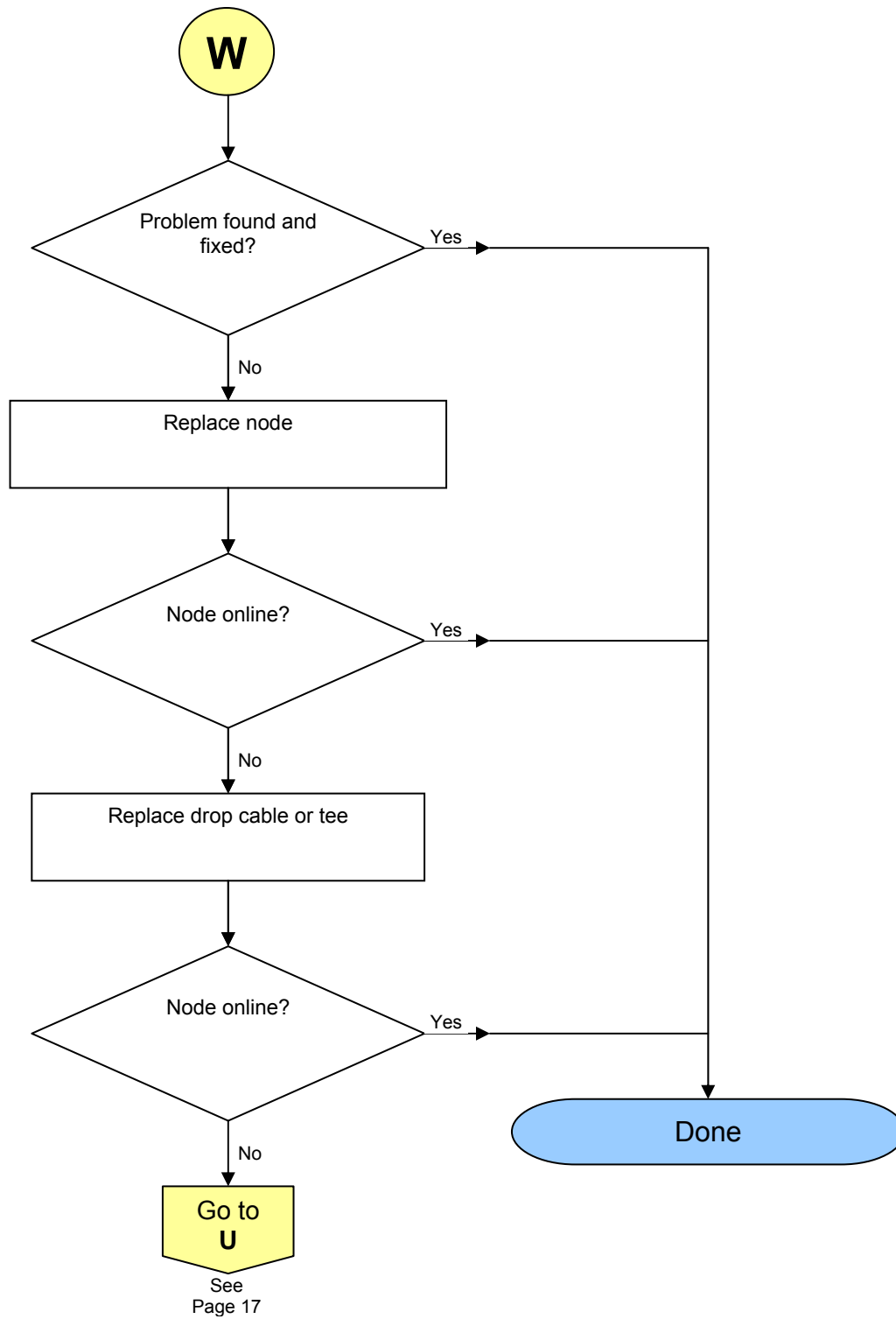
Done

No

Walk the network and check connections.

Go to W

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“Walking” the Network

Here are the things to keep in mind and look for when walking a network.

First try to look at a drawing or layout of the network so you know where the cables go and if the lengths are correct. Sometimes this is not possible but look around in the controller cabinet for this information. Also remember that Auxiliary Power topology and implementation is just as important as DeviceNet topology and implementation. Check both when walking the network (I.e. for additional information, see Auxiliary Power – Section 14 in the DeviceNet Network Checklist).

- Loose connections are the number one cause of failures.
 - Make sure all connections are undamaged.
 - Connections may look good but not be tight. Check them.
- Cable stress is the second thing to look for.
 - Cable radii might be too tight or stressed with tie wraps. There is a lot of vibration in a plant and if the cables are stressed it will create a failure point.
 - Some cable trays are mounted on long fence post and the cables brought down from them. At the point where they leave the cable tray and bend down could be a potential spot for failure.
- Grounds are very important!
 - Visually inspect grounding to assure that grounding location is clean and connection is tight. Make sure that all components are properly grounded.
- Separate high voltage cables from DeviceNet cables!
 - Power, welding or servo cables are sometimes put on top of the DeviceNet cables or put in the same cable trays. DeviceNet cables must have the proper distance between these cables.
 - To clean up the wiring power, servo, or welding cables are tie wrapped together. DeviceNet cables must have the proper distance between these cables.

Segmenting a network to troubleshoot a problem.

Finding a network cable problem is sometimes not the easiest thing to detect. The following step-by-step process will assist in locating cabling issues:

- Divide the network into two halves to determine which half is causing the trouble by physically disconnecting the trunk cable and placing the terminating resistor at the break point
- Once you determine the half causing the trouble you can approach the problem two ways.
 - Continue to divide the defective portion of the network in half to further isolate the trouble; or
 - Re-walk the network making sure that all connections are still “OK” .If everything looks “OK” then start at the controller and go to the first drop. Break the trunk cable and insert a terminator. Walk the terminator down the trunk until the network fails.

Once the problem location has been determined, consider the following cable connection / details as possible causes of the problem:

- Tee Connection
- Drop Connection
- Node Connection
- Loading problem with a node or insufficient bus power. (A volt-amp-meter should be used to determine if the problem is related to bus loading).

If the network has been running and then fails, it is often due to a bad cable or “Tee” connection.

Remember: There could be one or more causes for a specific problem. Take your time and check thoroughly to minimize the possibility of missing something.

Cell Number : _____
 Tool Number : _____

Percent Complete: _____
 Station Number : _____

DeviceNet Network Checklist

The following items should be completed during the implementation of DeviceNet networks commissioning. This will act as a record of the values attained after installation of a working network and can be used for comparison for any future network / device troubleshooting.

ID	Item Description	Checked	Date	Comments
Physical Inspection				
1	Are all DeviceNet devices approved for use on the project? Make sure that DeviceNet taps are of the proper type.		_ / _ / _	
2	Are 24VDC Power Supply calculations supplied? If the network uses more than one supply, is the network connected as designed?		_ / _ / _	
3	Are all the trunk and drop cables separated from high voltage and potential noise sources in accordance with the ODVA DeviceNet Planning and Installation Guide?		_ / _ / _	
4	Are all DeviceNet Drop & Trunk line cables routed without strain on the connection points due to bending or tension? Are all connections tight?		_ / _ / _	
5a	Are the drop cables less than or equal to 20 feet (6 meters)?		_ / _ / _	
5b	Is the sum of all drop lines less than the maximum allowed for the network data rate DeviceNet specification?		_ / _ / _	
6a	Is the trunk line less than the maximum length allowed for the network data rate in the DeviceNet specification?		_ / _ / _	
6b	Are both terminating resistors in place at the ends of the trunk line?		_ / _ / _	
7	Are all selectable DIP switch / rotary switch settings (node address & baud rate) correct?		_ / _ / _	
8	Is the DeviceNet 24VDC power supply (V-) bonded directly to the ground buss bar (#12 wire) at one location only?		_ / _ / _	
9	Are there any frayed or exposed wires on open style connectors creating a possible shorted condition?		_ / _ / _	
10	If the DeviceNet network uses more than one power supply, are the V- connections of all power supplies tied together and V- only bonded to the ground buss at one location?		_ / _ / _	

Note regarding all Electrical Tests that follow:

Always keep the same reference point when making measurements. This allows you to trace wiring problems and find grounding problems. If you put the black lead on the Earth ground point, make sure you always use the same point and the same lead. When performing any resistance check, you cannot have less than "0" Ohms. A negative resistance value indicates you may have voltage on the ground, or on the wire you are checking. Remove the source of any voltage to get an accurate measurement.

Design Source _____
 Design Engineer _____

Controls Engineer _____
 Date _____

Cell Number : _____
 Tool Number : _____

Percent Complete: _____
 Station Number : _____

ID	Item Description	Checked	Date	Comments
11	<p>Network Termination Test</p> <ol style="list-style-type: none"> 1. Follow shutdown procedures (if any) 2. Stop all network communication. 3. Turn all network and auxiliary power supplies off. 4. Measure and record the DC resistance between CANH and CANL at the middle and ends of the network. <p>If the measured value is <50 ohms</p> <ul style="list-style-type: none"> - Check for short circuit between CANH and CANL wiring - Check for more than two terminating resistors - Check nodes for faulty transceivers <p>If the measured value is 50-70 ohms</p> <ul style="list-style-type: none"> - Normal (Do nothing) <p>If the measured value is 71-125 ohms</p> <ul style="list-style-type: none"> - Check for open circuits in CANH or CANL wiring - Check for one missing terminating resistor <p>If the measured value is > 125 ohms</p> <ul style="list-style-type: none"> - Add terminating resistor - Check for open circuits in CANH and CANL wiring 		<p>____/____/____</p>	

Design Source _____
 Design Engineer _____

Controls Engineer _____
 Date _____

Cell Number : _____
 Tool Number : _____

Percent Complete: _____
 Station Number : _____

ID	Item Description	Checked	Date	Comments
12	<p>Network Power Supply Ground Test</p> <ol style="list-style-type: none"> 1. Turn all network power supplies off. Disconnect the V- and Shield wires from ground and from each other. 2. Using a Digital Voltmeter, measure DC voltage from shield to ground at all power supplies. Is there less than 1VDC?¹ 3. Remove all sources of voltage before continuing. 4. Measure and record the DC resistance between V- and earth ground. Measured value should show infinite resistance. If other value is measured, look for swapped V- and shield wires at termination points. 5. Measure and record the DC resistance between Shield and earth ground. Measured values greater than 20kΩ are considered Normal. For measured values that are greater than 1 kΩ and less than 20 kΩ: <ul style="list-style-type: none"> - Disconnect both DeviceNet connectors on the top of the main control panel and repeat the above procedure. If the problem remains, check connections in the main control panel. Look for swapped V- and shield wires at termination points. - If the problem went away, segment the network and isolate the location of the problem, and check for grounded V- or Shield wires. Sometimes the V- and Shield connections are transposed, which would cause ground loops. 6. Reconnect the V- and Shield wires to ground. 7. Go to each end of the network and remove terminator. Check resistance between V- and Shield to verify that there is not a broken shield wire. DC Resistance should be < 20Ω.¹ For measured values greater than 20Ω, check for broken shield 		<p style="text-align: center;">_ / _ / _</p>	

¹ Does not apply to applications in which flat cable is utilized for DeviceNet Communication.

Design Source _____
 Design Engineer _____

Controls Engineer _____
 Date _____

Cell Number : _____
 Tool Number : _____

Percent Complete: _____
 Station Number : _____

ID	Item Description	Checked	Date	Comments
13	<p>Network Power Supply Common Mode Voltage Test</p> <ol style="list-style-type: none"> 1. Turn all network power supplies on. 2. Configure all nodes for their maximum current draw from network power. Turn on outputs that use network power. 3. Measure and record the DC voltage between V+ and V- where each power supply connects to the trunk. 4. Measure and record the DC voltage between V+ and V- at the ends of the network. <p>Measured values between 11.0 VDC and 25.0 VDC are consistent with the DeviceNet Specification for proper DeviceNet communication.</p> <p>However, input devices that may rely V+ and V- for power may not operate properly at voltages less than 20 VDC. Check input device (e.g. proximity sensors, photoelectric sensors, etc.) to verify device is within voltage specifications.</p> <ol style="list-style-type: none"> 5. Measure between V- and Shield. Measured values less than 4.6 VDC are considered normal. <p>If measured value from: Item 4. Is < 11.0 VDC; or Item 5. Is > 4.6 VDC,</p> <p>The network may not operate properly.</p> <p>Possible solutions are :</p> <ul style="list-style-type: none"> - Shorten the overall length of the network cable. - Move the power supply in the direction of the overloaded section. - Move nodes from the overload section to less loaded section. - Move high current loads close to the power supply. - Break the network into two separate networks. - Add power supply. 		<p>____/____/____</p>	

Design Source _____
 Design Engineer _____

Controls Engineer _____
 Date _____

Cell Number : _____
 Tool Number : _____

Percent Complete: _____
 Station Number : _____

ID	Item Description	Checked	Date	Comments
14	<p>Auxiliary Power Measurements</p> <ol style="list-style-type: none"> 1. Monitor the voltage present at both ends of the auxiliary power trunk cable under normal operating conditions and record the high and low values observed. The use of an oscilloscope may be necessary. 2. Check all manufacturers' specifications to verify that the auxiliary power observed falls within the manufacturers' specifications. <p>If problems are observed, consider the following</p> <ul style="list-style-type: none"> - Add an additional power supply - Shorten auxiliary power trunk line cabling - Check for influence of noise - Assure that the grounding requirements outlined in the manufacturers' specifications have been met. 		<p>____/____/____</p>	

Design Source _____
 Design Engineer _____

Controls Engineer _____
 Date _____