

# AUTOMATIC FAULT DETECTION AND DIAGNOSTICS FOR AIR HANDLING UNITS AND ZONE TERMINAL UNITS ACCEPTANCE

CEC-NRCA-MCH-13-A (Revised 01/19)

CALIFORNIA ENERGY COMMISSION



CERTIFICATE OF ACCEPTANCE		NRCA-MCH-13-A
Automatic Fault Detection and Diagnostics (FDD) for Air Handling Units and Zone Terminal Units Acceptance		(Page 1 of 6)
Project Name:	Enforcement Agency:	Permit Number:
Project Address:	City:	Zip Code:
System Name or Identification/Tag:	System Location or Area Served:	

<b>Compliance Result:</b> AUTOMATED ("Complies" or "Does Not Comply")	Enforcement Agency Use: Checked by/Date
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<b>Intent:</b>	Verify that the system detects common faults in air handling units and zone terminal units. Submit one Certificate of Acceptance for each system that must demonstrate compliance. ( <a href="#">§120.2(i)</a> , <a href="#">NA7.5.12</a> )
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A. Construction Inspection			
Building:	Floor:	Room/Area/Zone:	Control/Systems:
1	Required Documentation (check <b>all</b> of the following):		
<input type="checkbox"/>	a.	NRCC-MCH-03-A, NRCA-MCH-05-A, designs, schematics, and schedules as approved by the authority having jurisdiction.	
<input type="checkbox"/>	b.	Manufacturer specification or tear-sheets for the installed economizer, air handling unit(s), zonal terminal units and fault detection diagnostic system (FDD) as available.	
Prior to Functional Testing, verify and document the following:			
2.	Installation (check <b>all</b> of the following):		
<input type="checkbox"/>	a.	Verify that the FDD hardware is installed on HVAC unit. ( <a href="#">NA7.5.11.1(a)</a> )	
<input type="checkbox"/>	b.	Verify that the FDD system matches the make and model reported on the required documentation ( <a href="#">1a</a> ). ( <a href="#">NA7.5.11.1(b)</a> )	
3.	<b>IF</b> the manufacturer <b>HAS</b> certified the FDD to the Energy Commission (check the following): ( <a href="#">§120.2(i)8</a> )		
<input type="checkbox"/>	a.	Verify that the FDD is currently listed with the Energy Commission approved list: ( <a href="#">§120.2(i)8</a> , <a href="#">JA6.3</a> ) <a href="http://www.energy.ca.gov/title24/equipment_cert/fdd/index.html">http://www.energy.ca.gov/title24/equipment_cert/fdd/index.html</a>	
4.	<b>IF</b> the manufacturer <b>HAS NOT</b> certified the FDD to the Energy Commission, reference the Required Documentation 1a. and 1b (check <b>all</b> the following): ( <a href="#">Exception to §120.2(i)8</a> )		
<input type="checkbox"/>	a.	Verify that the following temperature sensors are permanently installed: outside air, supply air, and when required for differential economizer operation, a return air sensor. ( <a href="#">NA7.5.12.1(a)</a> , <a href="#">§120.2(i)1</a> )	
<input type="checkbox"/>	b.	Verify that the temperature sensor have an accuracy of $\pm 2^{\circ}\text{F}$ over the range of $40^{\circ}\text{F}$ to $80^{\circ}\text{F}$ . ( <a href="#">NA7.5.12.1(a)</a> , <a href="#">§120.2(i)2</a> )	
<input type="checkbox"/>	c.	Verify that the controller has the capability of displaying the value of each sensor. ( <a href="#">§120.2(i)3</a> )	
<input type="checkbox"/>	d.	Verify that the controller provides a system status by indicating the following conditions: <ul style="list-style-type: none"> <li>Free cooling available;</li> <li>Economizer enabled;</li> <li>Compressor enabled;</li> <li>Heating enabled, if the system is capable of heating; and</li> <li>Mixed air low limit cycle active.</li> </ul> ( <a href="#">§120.2(i)4</a> )	

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A. Construction Inspection			
Building:	Floor:	Room/Area/Zone:	Control/Systems:
<input type="checkbox"/>	e.	Verify that the unit controller allows manual initiation of each operating mode so that the operation of cooling systems, economizers, fans, and heating systems can be independently tested and verified. ( <a href="#">§120.2(i)5</a> )	
<input checked="" type="checkbox"/>	f.	Verify that the faults are reported in one of the following ways: <ul style="list-style-type: none"> <li>• Reported to an Energy Management Control System regularly monitored by facility personnel.</li> <li>• Annunciated locally on one or more zone thermostats, or a device within five (5) feet of zone thermostat(s), clearly visible, at eye level, and meeting the following requirements:               <ul style="list-style-type: none"> <li>○ On the thermostat, device, or an adjacent written sign, display instructions to contact appropriate building personnel or an HVAC technician; and</li> <li>○ In buildings with multiple tenants, the annunciation shall either be within property management offices or in a common space accessible by the property or building manager.</li> </ul> </li> <li>• Reported to a fault management application which automatically provides notification of the fault to remote HVAC service provider.</li> </ul> ( <a href="#">§120.2(i)6</a> )	
Construction Inspection Compliance Result: AUTOMATED ("Complies" or "Does Not Comply")			

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B1. Functional Testing for Air Handling Unit Economizers			
Building:	Floor:	Room/Area/Zone:	Control/Systems:
Steps	Perform the following test for each AHU with FDD controls. ( <a href="#">§120.2(i)7</a> )		Results
1	If applicable, bypass alarm delays to ensure that faults generate alarms immediately. ( <a href="#">NA7.5.12.2(a) Step 1</a> )		
2	<b>Sensor Failure</b> ( <a href="#">NA7.5.12.2(b)</a> )		
a.	Disconnect local supply air temperature sensor from unit controller and verify that the FDD system reports a fault. ( <a href="#">NA7.5.12.2(b) Step 1, Step 2</a> )		P/F
b.	Connect SAT sensor to the unit controller and verify that FDD indicates normal system operation and clears all faults and alarms. ( <a href="#">NA7.5.12.2(b) Step 3, Step 4</a> )		P/F
c.	IF the outside air temperature sensor (OAT) is local, THEN disconnect the local OAT from the unit controller and verify that the FDD system reports a fault. ( <a href="#">NA7.5.12.2(b) Step 5, Step 6</a> )		P/F
d.	IF Step 2c performed, THEN connect the local OAT sensor to the unit controller and verify that FDD indicates normal system operation and clear all faults and alarms. ( <a href="#">NA7.5.12.2(b) Step 7, Step 8</a> )		P/F
3	<b>Inappropriate economizing</b> ( <a href="#">NA7.5.12.2(c)</a> )		
a.	Override the operating state to occupied heating mode by overriding zone thermostat(s) to create a heating demand and overriding the OAT sensor below the low limit lockout. ( <a href="#">NA7.5.12.2(c) Step 1</a> )		
b.	From the control system workstation, override the economizer dampers to 100 percent outdoor air and verify that a fault is reported at the control workstation. ( <a href="#">NA7.5.12.2(c) Step 2, Step 3</a> )		P/F
c.	Remove the economizer damper override and verify that the control system indicates normal system operation. ( <a href="#">NA7.5.12.2(c) Step 4</a> )		P/F
d.	Remove all overrides and clear all faults and alarms. ( <a href="#">NA7.5.12.2(c) Step 5</a> )		
e.	Override the operating stat to economizer-only cooling mode by overriding zone thermostat(s) to create a cooling demand and overriding the OAT sensor so that free cooling is available. ( <a href="#">NA7.5.12.2(c) Step 6</a> )		
f.	From the control system workstation, override the economizer dampers to 0 percent outdoor air and verify that a fault is reported at the control workstation. ( <a href="#">NA7.5.12.2(c) Step 7, Step 8</a> )		P/F
g.	Remove the economizer damper override and verify that the control system indicates normal system operation. Remove all overrides and clear all faults and alarms. ( <a href="#">NA7.5.12.2(c) Step 9, Step 10</a> )		
4	IF Step 1 performed, THEN reinstate alarm delays. ( <a href="#">NA7.5.12.2(d) Step 1</a> )		
B1 Functional Testing Compliance Results: AUTOMATED ("Complies" or "Does Not Comply")			

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B2. Functional Testing for Air Handling Unit Valves			
Building:	Floor:	Room/Area/Zone:	Control/Systems:
Steps	Perform the following test for each Value on each AHU with FDD controls. ( <a href="#">§120.2(i)7</a> )		Results
1	If applicable, bypass alarm delays to ensure that faults generate alarms immediately. ( <a href="#">NA7.5.12.3(a) Step 1</a> )		
2	<b>Valve/actuator fault:</b> ( <a href="#">NA7.5.12.3(b)</a> )		
a.	<b>Cooling Demand:</b> Override the operating state to occupied cooling mode by overriding zone thermostat(s) to create a cooling demand and overriding the OAT sensor to 90°F. ( <a href="#">NA7.5.12.3(b) Step 1</a> )		
b.	From the control system workstation, override the heating coil valves to the full open position (100% heating mode). ( <a href="#">NA7.5.12.3(b) Step 2</a> )		
c.	Verify flow through the valve by differential temperature or differential pressure method. ( <a href="#">NA7.5.12.3(b) Step 3</a> )		P/F
d.	Verify that a fault is reported at the control workstation. ( <a href="#">NA7.5.12.3(b) Step 4</a> )		P/F
e.	Remove the heating coil valve override and verify that the control system indicates normal system operation. ( <a href="#">NA7.5.12.3(b) Step 5</a> )		P/F
f.	Remove all overrides and clear all faults and alarms. ( <a href="#">NA7.5.12.3(b) Step 6</a> )		
g.	<b>Heating Demand:</b> Override the operating state to occupied heating mode by overriding zone thermostat(s) to create a heating demand and overriding the OAT sensor to 40°F. ( <a href="#">NA7.5.12.3(b) Step 7</a> )		
h.	From the control system workstation, override the cooling coil valve to the full open position (100% cooling mode). ( <a href="#">NA7.5.12.3(b) Step 8</a> )		
i.	Verify flow through the valve by differential temperature or differential pressure method. ( <a href="#">NA7.5.12.3(b) Step 9</a> )		P/F
j.	Verify that a fault is reported at the control workstation. ( <a href="#">NA7.5.12.3(b) Step 10</a> )		P/F
k.	Remove the cooling coil valve override and verify that the control system indicates normal system operation. ( <a href="#">NA7.5.12.3(b) Step 11</a> )		P/F
l.	Remove all overrides and clear all faults and alarms. ( <a href="#">NA7.5.12.3(b) Step 12</a> )		
3	IF Step 1 performed, THEN reinstate alarm delays. ( <a href="#">NA7.5.12.3(c) Step 1</a> )		
B2 Functional Testing Compliance Results: AUTOMATED ("Complies" or "Does Not Comply")			

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B3. Functional Testing for Zone Terminal Units			
Building:	Floor:	Room/Area/Zone:	Control/Systems:
Steps	Test one of each type of terminal unit (VAV box) in the project. A minimum of 5 percent of all terminal boxes (all types together) must be tested. ( <a href="#">§120.2(i)7</a> )		Results
1	<b>Sensor drift/failure</b> ( <a href="#">NA7.5.12.4(a)</a> )		
a.	Disconnect the tubing to the differential pressure sensor of the VAV box. ( <a href="#">NA7.5.12.4(a) Step 1</a> )		
b.	Verify that control system detects and reports the fault. ( <a href="#">NA7.5.12.4(a) Step 2</a> )		P/F
c.	Reconnect the sensor and verify proper sensor operation. ( <a href="#">NA7.5.12.4(a) Step 3</a> )		
d.	Verify that the control system does not report a fault. ( <a href="#">NA7.5.12.4(a) Step 4</a> )		P/F
2	<b>Damper/actuator fault</b> ( <a href="#">NA7.5.12.4(b)</a> )		
a.	<u>Damper stuck open</u> : Command the damper to be fully open (room temperature above setpoint). ( <a href="#">NA7.5.12.4(b)1 Step 1</a> )		
b.	Disconnect the actuator to the damper. ( <a href="#">NA7.5.12.4(b)1 Step 2</a> )		
c.	Adjust the cooling setpoint so that the room temperature is below the cooling setpoint to command the damper to the minimum position. Verify that the control system reports a fault. ( <a href="#">NA7.5.12.4(b)1 Step 3</a> )		P/F
d.	Reconnect the actuator and restore to normal operation. ( <a href="#">NA7.5.12.4(b)1 Step 4</a> )		
e.	<u>Damper stuck closed</u> : Set the damper to the minimum position. ( <a href="#">NA7.5.12.4(b)2 Step 1</a> )		
f.	Disconnect the actuator to the damper. ( <a href="#">NA7.5.12.4(b)2 Step 2</a> )		
g.	Set the cooling setpoint below the room temperature to simulate a call for cooling. Verify that the control system reports a fault. ( <a href="#">NA7.5.12.4(b)2 Step 3</a> )		P/F
h.	Reconnect the actuator and restore to normal operation. ( <a href="#">NA7.5.12.4(b)2 Step 3</a> )		
3	<b>Valve/actuator fault (For systems with hydronic reheat)</b> ( <a href="#">NA7.5.12.4(c)</a> )		
a.	Command the reheat coil valve to (full) open. ( <a href="#">NA7.5.12.4(c) Step 1</a> )		
b.	Disconnect power to the actuator. Set the heating setpoint temperature to be lower than the current space temperature, to command the valve closed. Verify that the fault is reported at the control workstation. ( <a href="#">NA7.5.12.4(c) Step 2</a> )		P/F
c.	Reconnect the actuator and restore normal operation. ( <a href="#">NA7.5.12.4(c) Step 3</a> )		
4	<b>Feedback loop tuning fault (unstable airflow)</b> ( <a href="#">NA7.5.12.4(d)</a> )		
a.	Set the integral coefficient of the box controller to a value 50 times the current value. ( <a href="#">NA7.5.12.4(d) Step 1</a> )		
b.	The damper cycles continuously and airflow is unstable. Verify that the control system detects and reports the fault. ( <a href="#">NA7.5.12.4(d) Step 2</a> )		P/F
c.	Reset the integral coefficient of the controller to the original value to restore normal operation. ( <a href="#">NA7.5.12.4(d) Step 3</a> )		
5	<b>Disconnected inlet duct</b> : From the control system workstation, commands the damper to full closed, then disconnect power to the actuator and verify that a fault is reported at the control workstation. ( <a href="#">NA7.5.12.4(e) Step 1</a> )		P/F
6	<b>Discharge air temperature sensor</b> : Adjust zone setpoints to drive the box from dead band to full heating. ( <a href="#">NA7.5.12.4(f) Step 1</a> )		
a.	Verify that in heating, the supply air temperature resets up to the maximum setpoint while the airflow is maintained at the dead band flow rate. ( <a href="#">NA7.5.12.4(f) Step 2</a> )		P/F
b.	Verify that after the supply air temperature is reset up to the maximum setpoint, the airflow rate then increases up to the heating maximum flow rate in order to meet the heating load. ( <a href="#">NA7.5.12.4(f) Step 3</a> )		P/F
7	Remove all overrides, clear all faults and alarms, and return the system to normal operation.		
B3 Functional Testing Compliance Results: AUTOMATED ("Complies" or "Does Not Comply")			

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## DOCUMENTATION AUTHOR'S DECLARATION STATEMENT

1. I certify that this Certificate of Acceptance documentation is accurate and complete.

Documentation Author Name:	Documentation Author Signature:
Documentation Author Company Name:	Date Signed:
Address:	ATT Certification Identification (If applicable):
City/State/Zip:	Phone:

## FIELD TECHNICIAN'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

- The information provided on this Certificate of Acceptance is true and correct.
- I am the person who performed the acceptance verification reported on this Certificate of Acceptance (Field Technician).
- The construction or installation identified on this Certificate of Acceptance complies with the applicable acceptance requirements indicated in the plans and specifications approved by the enforcement agency, and conforms to the applicable acceptance requirements and procedures specified in Reference Nonresidential Appendix NA7.
- I have confirmed that the Certificate(s) of Installation for the construction or installation identified on this Certificate of Acceptance has been completed and signed by the responsible builder/installer and has been posted or made available with the building permit(s) issued for the building.

Field Technician Name:	Field Technician Signature:	
Field Technician Company Name:	Position with Company (Title):	
Address:	ATT Certification Identification (if applicable):	
City/State/Zip:	Phone:	Date Signed:

## RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

- I am the Field Technician, or the Field Technician is acting on my behalf as my employee or my agent and I have reviewed the information provided on this Certificate of Acceptance.
- I am eligible under Division 3 of the Business and Professions Code in the applicable classification to accept responsibility for the system design, construction or installation of features, materials, components, or manufactured devices for the scope of work identified on this Certificate of Acceptance and attest to the declarations in this statement (responsible acceptance person).
- The information provided on this Certificate of Acceptance substantiates that the construction or installation identified on this Certificate of Acceptance complies with the acceptance requirements indicated in the plans and specifications approved by the enforcement agency, and conforms to the applicable acceptance requirements and procedures specified in Reference Nonresidential Appendix NA7.
- I have confirmed that the Certificate(s) of Installation for the construction or installation identified on this Certificate of Acceptance has been completed and is posted or made available with the building permit(s) issued for the building.
- I will ensure that a completed, signed copy of this Certificate of Acceptance shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a signed copy of this Certificate of Acceptance is required to be included with the documentation the builder provides to the building owner at occupancy.

Responsible Acceptance Person Name:	Responsible Acceptance Person Signature:	
Responsible Acceptance Person Company Name:	Position with Company (Title):	
Address:	CSLB License:	
City/State/Zip:	Phone:	Date Signed: