ACxelerate

Automated Commissioning Tool

Carrier

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Important changes are listed in **Document revision history** at the end of this document.

Contents

ACxelerate automated commissioning

ACxelerate automated commissioning allows you to verify and report on the health state of VAV dampers and reheat valves in your VAV boxes.

To obtain the health report for any of your equipment, you first need to:

1 Configure the equipment.

2 Configure and design your test. See *Configuration & Design* (page 11).

3 Set up and initiate a Run Test on selected equipment. See *Run Test* (page 14).

4 View the analytics report. See *Analyzing Data* (page 20).

ACxelerate Requirements

To use ACxelerate, you will need to:

- have Access Commissioning Tools privilege
- purchase and download the Automated Commissioning Tool license

ACxelerate License

- Your free 6 month trial must be used within 2 years of the i-Vu® Pro license issue date, and begins on the first use of ACxelerate. You can purchase a renewal license for ACxelerate; this period begins immediately after activation.

- To activate renewal license: upload the ACxelerate license file to > **System Options** > **License Administration**.

- Both the ACxelerate free trial and renewal license include unlimited Run Tests.

- If the ACxelerate free trial or renewal license expires, the Configuration and Analyze Data page remains accessible but Run Tests are locked.

- If using a dealer license, no ACxelerate license is required. It includes unlimited Run Tests but report downloads are disabled.

Before you begin checklist

General

☐ Avoid using consecutive underscore characters in the equipment display name, or the test won't execute properly. For example, type `VAV_1`, not `VAV__1`.

☐ Verify that the i-Vu® Pro BACnet communication is well established between the VAVs and AHUs you will be testing. This tool sends override commands to VAVs at fixed time intervals (18 minutes is the default). If communication fails, commands will not reach the VAV boxes and the test may return incorrect results.

☐ AHU and VAV Display Names must be unique in the i-Vu® Pro database. AHU and VAV Reference Names must start with the '#' symbol.

☐ We recommend creating an AHU display name with no more than 31 characters. Otherwise, the AHU group tab hyperlink in the Excel® reports download will not work. However, you can still manually access the AHU tab.

☐ Zero flow balancing of all VAV boxes must be done prior to starting a Run Test. Otherwise, the VAV airflow sensor issue may be marked as damper stuck.

☐ VAV must be linked to AHU using any one of the following sources:

Linkage (recommended)
Airside Linkage must be set up correctly for ACxelerate to complete the auto-commissioning process.

NOTE When using Linkage for ACxelerate, Master, Sub-master, and Rogue zone configurations are fully supported.

User Tree
AHUs can be linked to VAV by having them both in a dedicated area. For example, in the tree to the right, AHU1 and VAV1-VAV7 are in dedicated area 'floor1'. VAVs can reside in area (ZoneA, ZoneB...) which are under the area floor1 where AHU is present.
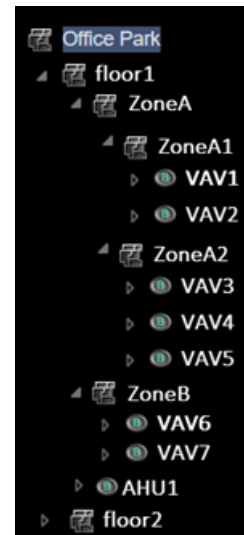
☐ The AHU must be fully commissioned. High static shutdown (hardware/software interlock) must be working before using ACxelerate. The supply fan speed control static pressure setpoint must be constant and **high enough** to avoid starving VAV when cumulative VAV damper load on AHU fan is 60% of actual box size.

NOTE During the damper/reheat valve Run Test, average damper/reheat valve open position of all VAVs served by an AHU is between 40% to 60% open.

☐ The AHU supply air temperature must be at a constant setpoint (bypass any setpoint optimization algorithms).

- [ ] People should not be occupying the zones being tested, but make sure the equipment schedule microblock is in the occupied state.

     For systems with series fan VAVs, the series fan boxes' schedule must be occupied so the fan is rotating in the right direction before initiating the Run Test.

- [ ] All hardware configuration and design parameters of the **Airflow Control** microblock must be set to the appropriate value as per the VAV box's design. This includes the **Manufacturer's specified air flow at 1" water column** parameter (value is supplied by the VAV box manufacturer and is usually printed on the side of the VAV box).

- [ ] ACxelerate does not support any browser extension or built-in browser feature for content filtering, including ad-blocking. Before using ACxelerate, disable any such browser extension or feature. Example: uBlock Origin.

Reheat valve test

- [ ] The boiler control system must be fully commissioned.

- [ ] Bypass any setpoint optimization algorithms to keep the boiler supply temperature at a constant setpoint. Set to the highest temperature allowed by the operator. Maintaining a constant hot water temperature ensures a noticeable difference in the VAV's discharge air temperature when the reheat coil goes from the closed position to the open position.

- [ ] The associated boiler pumps should operate continuously over the duration of the test and be kept at a constant setpoint.

- [ ] Keep the AHU supply air temperature at a constant setpoint. We recommend keeping the setpoint at 55°F (13°C) or lower to achieve a noticeable difference between AHU supply air temperature and the VAV discharge air temperature when the VAV reheat coil is 100% open.

Overview of the ACxelerate Automated Commissioning Tool

To obtain the health report for any of your equipment, complete the following tasks in this order.

Task 1. Configuration & Design

In the first task, create a database of equipment in order to do the following:

- Discover all the equipment
- Define the relationships between AHUs and VAVs
- Define reference names of points which need to be targeted
- Defines the test configuration parameters for damper loop and reheat valve loop test

This only needs to bet set up one time, but you can return here at any time to the following:

- Rediscover new equipment and point list due to change in equipment or its point names
- Change the equipment's configurations

See *Configuration & Design* (page 11) for further instruction on creating your database of equipment.

Task 2. Run Test

In the second task configure the test by selecting the equipment for the test, setting up parameters, and scheduling the test. This also displays the progress of the test running for each VAV.

Once the test is complete, it passes the collected samples through to the analytics engine to find faults in VAVs.

NOTE If the Configuration & Design task has previously been performed, start from here.

See *Run Test* (page 14) for further instruction.

Task 3. Analyze Data

In the third task use a dashboard to display the result of the analytics performed by the Run Test task above. It also allows the end user to download the reports in HTML and Excel formats (**NOTE** This feature is not available with a dealer license). This task activates once the Run Test is completed.

NOTE If the test was run in the past, then you can visit the dashboard of the last run test from this tool's homepage.

See *Analyzing Data* (page 20) for further instruction.

ACxelerate Process Flowchart

Semantic Tagging *(for ACxelerate)*

AHU Equipment Tagging (manual only)

AHU Point Tagging (manual for non-library point reference names)

VAV Point Tagging (manual for non-library point reference names)

Licensing *(for ACxelerate)*

Upload a new ACxelerate renewal license to the **License Administration** page if your free trial period or existing renewal license is expired.

ACₓelerate™ Automated Commissioning Tool

Configuration & Design

Detect Devices

Component

Design

Test

Start here once you completed **Semantic Tagging**.

Start here if you previously completed **Detect Devices** and need to change **Time Step**.

If **Design** failed for any AHU group, start over at **Component**.

Configure ACxelerate in **Configuration & Design**.

Run Test

Data source

Group-Equip select

Time

Run Test

Analyze → Go Analytics

Start here to schedule test.

Once **Run Test** is scheduled or running, you can exit ACxelerate here and return when test is complete.

Schedule and run the test on VAVs in **Run Test**.

(Configuration & Design must have been previously configured at least once to execute Run Test.)

Analyze Data

Damper performance ✓ OR Valve performance ✓

1. Select an AHU

2. Select a Fault type

3. Select a VAV

4. Write comment

View result or download report of completed test.

(Make sure to click Analyze after executing Run Test.)

Semantic tagging for ACxelerate

Use semantic tagging to reference AHU equipment and points in AHU and VAV equipment. VAV equipment does not need semantic tags. It includes:

- Built-in semantic tags which are used by ACxelerate (you may see more built-in tags for ACxelerate, but they are for future use)

- Built-in semantic tag rules

Semantic Tags used in ACxelerate

Below is a list of semantic built-in tags that refer to the points in the description.

For AHU equipment

Tag	ID	Description
ACx AHU	acx_ahu	Applied to VAV AHU equipment to be tested
Hot Water Source	acx_hw_source	Optionally applied to Hot Water System or Boiler System equipment in which Hot Water Supply Temperature Point is present

For points in VAVs

Tag	ID	Description
ACx Flow Control	acx_airflow	Applied to airflow microblock to override damper command
ACx Airflow Value	acx_airflow_value	Applied to point to read airflow value
ACx Enable Damper Lock	acx_dmp_lock_check	Applied to point to read damper lock status - This is an optional point and required only if external damper lock enable point is present in VAV equipment.
ACx Heat Type	acx_heat_type_check	Applied to read heat type at relinquish.default used in equipment file. This is an optional point which is generally used in Carrier factory controllers
ACx HW Valve	acx_hw_valve	Applied to analog output microblock intended to override Reheat Valve command. This is an optional point required only for reheat valve test.

ACx Smart HW Valve CF	acx_hw_smart_valve_cf	Applied to analog output microblock intended to override smart Reheat Valve command. This is an optional point required only for reheat valve test that are smart valve in the Carrier factory controller.
ACx VAV Discharge Temp	acx_vav_dat_value	Applied to point to read VAV Discharge Air Temperature. This is an optional point required only for reheat valve test.

For points in VAV AHUs

Tag	ID	Description
ACx AHU Supply Air Temp	acx_ahu_sat_value	Applied to point to read AHU Supply Air Temperature. It's an optional point required only for reheat valve test.
ACx AHU Supply Fan Status	acx_ahu_fan_status	Applied to point to read AHU Supply Fan Status.

Semantic Built-in Tags rules for Point Tags

The following list shows the built-in rules for points in VAV and in VAV AHU (there are no built-in rules for AHU equipment tag). Note that the reference names used in rules are taken from the EquipmentBuilder library as well as reference names used in Carrier factory controllers.

If you are using an EquipmentBuilder generated equipment file, Carrier factory controller, or reference name mentioned in the table below, then you do not need to assign any tags for any points.

Rule name	Reference name	Tags (ID)
ACx Flow Control	air_flow	ACx Flow Control (acx_airflow)
ACx Airflow Value	air_flow/flow_input	ACx Airflow Value (acx_airflow_value)
ACx Enable Damper Lock	lock_dmpr	ACx Enable Damper Lock (acx_dmp_lock_check)
	dmpr_lock	
ACx Heat Type	heat_type	ACx Heat Type (acx_heat_type_check)
ACx HW Valve	hw_valve	ACx HW Valve (acx_hw_valve)
ACx Smart HW Valve CF	hw_valve_b	ACx Smart HW Valve CF (acx_hw_smart_valve_cf)
ACx VAV Discharge Temp	da_temp	ACx VAV Discharge Temp (acx_vav_dat_value)
	sa_temp	

ACx AHU Supply Air Temp	sa_temp	ACx AHU Supply Air Temp (acx_ahu_fan_status)
	sat	
	lvg_air_temperature	
	sa_temp_sens	
	supply_temp	
ACx AHU Supply Fan Status	sf_status	ACx AHU Supply Fan Status (acx_ahu_sat_value)
	sf_status_bi	
	sfan_status	
	sfs	
	supfanstat	

NOTE These built-in rules are only for VAV and VAV-AHU points. AHU equipment tag 'ACx_AHU (ID: acx_ahu)' needs to be assigned manually to each AHU equipment. You can do this by either individually assigning it to each equipment through the **Tags** tab in **Properties** page of each equipment, or by creating custom rules in the ⬛ > **System Options** tree > **Semantics** > **Custom Rules**.

Enabling/disabling ACxelerate

⚠️ **CAUTION** Before disabling ACxelerate make sure there is no ACxelerate activity in progress and no concurrently open ACxelerate browsers.

The ACxelerate database connection can be enabled or disabled from the ACxelerate home page (> **System Options** tree > **ACxelerate**). In the disabled state, ACxelerate is not connected to its database and cannot be used. In the enabled state, ACxelerate can be used as usual.

By default, it will be in the enabled state and for every restart of the i-Vu® Pro application it will retain its last state.

NOTE Enabling/disabling ACxelerate allows for a hot backup of the i-Vu® Pro application. If a hot backup is necessary, we recommend disabling ACxelerate when it's not in use. Otherwise, leave it enabled.

Configuration and Design

Once the ACxelerate database connection is enabled, you can configure and design ACxelerate.

This section covers:

- Discovering all VAV equipment and relating it to the appropriate AHU group with AHU equipment tagging
- Defining time step interval
- Designing the Run Test database for the configured VAVs

To initiate Configuration and Design

1 In the ![icon] > **System Options** tree, click **ACxelerate**.

2 Enable ACxelerate if not already enabled.

3 Click **Configuration & Design**, then click **Detect devices**.

4 Click **Auto-detect devices**.

    ○ Verify project and data source information:

        ▪ **Project Name** is written by default. Change as per project needs.

        ▪ **Data Source From** option defaults to **Linkage**. **User Tree** source is also available based on which option is used to link AHU and VAV. See *Before you begin checklist* (page 3) for details.

5 Click **OK** to accept values or click **Reset** to revert to default values.

ACxelerate will scan the i-Vu® Pro database to find all VAVs and associate them with the AHU group. It will also find all required points for the damper and reheat valve test in the VAV and AHU equipment. ACxelerate is not required to be connected to the live system in order to complete Configuration & Design.

Once complete, the VAV matrix is displayed on-screen and the same data is also saved to Project Namecommission.xlsx where 'Project Name' is the name you created. The file is saved to **i-Vu Proxx\webroot**<system_name>**\webapp_public_acxelerate**.

The content in each column of the VAV matrix is explained below:

Point	Description
Air Source	'Display Name' of AHU equipment that this group of VAVs belong to
Equipment	'Displays Name' of VAV that the configuration parameter belongs to
Component Actuator	Parameter belongs to damper or reheat valve test

Time Step	By default, the step size is fixed at 20%. This means for the range of 0% to 100% as full stroke of actuator, there will be 6 steps where complete actuation range will be tested (0%, 20%, 40%, 60%, 80% and 100%). The time period for which data will be collected for each step is set here. The default value is 1080 seconds (18 minutes). While changing this make sure that:
	All VAVs damper and reheat valve tests are set to the same value.
	Values are set in multiples of 60 seconds.
	Values are not set less than 840 seconds for both damper and reheat valve system. For a damper only system, values cannot be set less than 660 seconds.
	If the system response is slower and more data points are required, then this period should be increased.
Actuator Mode	Path of the point to the override actuator value in VAVs
Actuator Enable Node	Path of the point to enable the actuator override in VAVs
Pos Cmd	Path of the trend point which store data for the override actuator value in VAVs
Pos Fdb	Path of the trend point which stores data for the value of damper position (feedback) in VAVs
Air Flow	Path of the trend point which store data for the airflow value in VAVs
VAV Dis Temp	Path of the trend point which store data for the VAV discharge air temperature value in VAVs
AHU Sup Temp	Path of the trend point which store data for the AHU supply air temperature value present in VAVs
Fan Status	Path of the Boolean status point to read the AHU supply fan status present in AHUs
Max AirFlow	Path of the point to read the cooling max airflow value in VAVs
Min AirFlow	Path of the point to read the occupied minimum airflow value in VAVs

NOTE Excel® contains additional columns for internal use only and should not be changed. These include Constraint Type, Constraint Limit, Lower Range, High Range, Var Step, Nominal Flow, and Location.

Causes of auto-detect device failure:

○ AHU Equipment Tag 'ACx_AHU (ID: acx_ahu)' is not assigned to AHU Equipment.

○ Option selected for Data Source (where AHU and VAV are linked) is either incorrect or not working. Do not use for User Tree; VAVs are searched from their controller model type.

To modify time step from the table, use one of two methods:

Modify

1. Click **Modify**.

2. **Time Step** is the only value that can be modified from here. Changing the value in any row applies the same value to all rows.

3. Click **Save**.

Load file/Load existing file

To use this option, the auto-detect device option must have been used at least once so that the Excel® file "Project Namecommission.xlsx" already exists. Use Excel® to modify the file and upload it here.

NOTE Changes made in Excel® are not verified when uploading but will be verified in the Component tab.

6　After verifying that the equipment and parameter information from the VAV Matrix is correct, click **Component**.

- ○　Damper is selected by default in the component selection option. If there is any reheat valve present on site, then only check the **Reheat Valve** check box.

- ○　Click **OK**. Here you can modify **Time Step** for the selected component, if necessary.

- ○　To temporarily clear a reheat valve for test, do this in **RunTest/Group-Equip** Select; see Setting up and running a test.

- ○　Entries in the VAV Matrix that are marked in red have points missing that are required for the damper test.

- ○　Entries marked in orange have points missing that are required for the reheat valve test.

- ○　Missing points are caused by a semantic tagging mismatch and can cause the damper test and reheat valve test to fail.

7　Click **Design**. ACxelerate will automatically define the override values for each step of all VAVs to be used in the damper/reheat valve test.

NOTE　The list is complete when all items are marked "Done". This may take up to a minute. If any of the AHU groups fail, start over at **Component**.

8　Click **Test**.

Run Test

Run Test allows ACxelerate to:

- select VAVs for the test
- schedule the damper and/or reheat valve test
- collect the field present value data and store it in its own database
- pass data through the Analytics engine to find VAV faults
- route you to the Analyze Data Dashboard where results are displayed

NOTE If the Configuration & Design task has been previously performed, you can start the Run Test from here.

To select VAVs for Run Test

1 Click **Data source**, then click **Functional Test**. Click **OK** to continue.

2 Click **Group-Equip select**.

3 Select AHU(s) from the **Group selection** column (left) and the desired associated VAV(s) from the **Equip selection** column (center).

NOTE AHU groups marked in red have failed or were aborted in the previous test.

4 Right click to select a VAV from the **Equip selection** column.

5 Click ⬛ to move selected VAV from the **Equip selection** column to the **Enable or disable the test individually** column (right). To move all VAVs, click ⬛.

NOTE The **Enable or disable the test individually** column shows VAVs selected for the function test. VAV names are prefixed by AHU followed by two underscores. For example, if AHU name is 'AHU1' and VAV name is 'VAV1' then it will display as 'AHU1__VAV1'.

6 Right click to select/deselect VAVs in the **Enable or disable the test individually** column. Selection status is shown by the damper and reheat valve selection symbols:

Symbol	Meaning
●	Damper test is selected for VAV
●	Damper test is not selected for VAV
▲	Reheat valve test is selected for VAV
▲	Reheat valve test is not selected for VAV

7 Click to remove selected VAVs from the **Enable or disable the test individually** column. To remove all VAVs, click .

8 Once the required VAVs are selected, you can group select/clear the damper or reheat valve test from the **Group Select** check box in the bottom of Equipment selection window.

9 Click **OK** to continue.

⚠️ **CAUTION** For systems with low diversity and/or significantly over-sized VAV boxes causing AHU supply fan to max out for 70% of damper load, we recommend testing half of the VAVs in an AHU system at a time to avoid supply-starvation incidents.

We recommend to:

○ Test the damper first. Fix any faults and re-run the test until it passes.

○ After the damper test passes, test the reheat valve. Fix any faults and re-run the test until it passes. You can also test the damper and reheat valves together.

To schedule Run Test

Click **Time** and select the date and time to run the test on all selected equipment. Date format is **mm/dd/yyyy**, and time format is **HH:MM** (24 hour).

• To ensure the test runs, schedule it to at least 2 minutes in the future.

If the damper and reheat valve tests are selected together, the damper test is scheduled first, followed by reheat valve. By default, the reheat valve test time is set to begin 30 minutes after the damper test is scheduled to be completed. (Damper Run Test is completed in = Time Step * 6 in minutes)

• To edit reheat valve test time, click Unlock and schedule the reheat valve test at least 30 minutes after the damper test is scheduled to be completed.

• If the reheat valve is selected for testing, you can set the **damper Lock at** to a value between 40 to 60% (default is 50%.) This locks all VAV dampers to the set value while the reheat valve test is in progress.

• Select the **Temperature Unit** to which Temperature points are set. The default is °F.

To initiate Run Test

1 Click **OK** to proceed to **Run Test**.

- ○ The Run Test screen shows the Run Test Under Progress status. The damper test and reheat valve test each have their own tabs, depending on whether one or both tests are selected.

- ○ All VAVs selected for the test are grouped by serving AHUs. Each VAV has dedicated rows with 8 steps displayed in columns described as follows:

Step 1: Lock

- ○ In the damper test, **Lock** indicates an active damper override.

- ○ In the reheat valve test, **Lock** indicates an active damper and reheat valve override.

- ○ When executed, it turns from black to green. If failed, it turns red.

Steps 2-7: Test override values

- ○ The damper test displays 6 damper override values in order of execution.

- ○ The reheat valve test displays 6 reheat valve override values in order of execution.

- ○ The reheat valve test in progress damper will be overridden to the value set in the **Time** window (not displayed in Run Test section).

- ○ Each step will be executed for the time set in Time Step in Configuration & Design. When executed, each value turns from black to green. If failed, they turn red.

Step 8: Unlock

- ○ In the damper test, **Unlock** indicates that the damper override is released.

- ○ In the reheat valve test, **Unlock** indicates that the damper and reheat override is released.

- ○ When executed, it turns from black to green. If failed, it turns red.

- ○ In the damper test, all VAVs start the test at the same time. Unless VAVs are aborted, they execute each step at the same time and finish at same time.

- ○ The reheat valve test follows the same procedure.

2 Click **View ALL VAV** to view test progress of any group. The test is not complete until all items in the list are marked Done in the **Test Status** column.

The VAV Run Test will end in one of three states:

State	Meaning
✔ Success	VAV test was completed successfully.
✖ Failed	VAV test failed to start due to a missing point. If the reheat valve is not present in the VAV but is selected for the reheat valve test from **Group-Equip Select**, it will show as failed and can be ignored.
! Aborted	VAV test was either automatically or manually aborted and failed to complete.

3 Once Run Test is complete, click **Analyze**. This process will take a few minutes.

4 Once complete, click **Go Analytics** to view results on the **Analyze Data** Dashboard.

NOTE If you go to the **Analyze Data** Dashboard without first clicking **Analyze**, the dashboard will display results from the previously run test.

NOTE While initiating Run Test, ACxelerate may display an orange pop-up screen as shown below. Do not perform any actions until this message closes. It will stay on screen for up to several minutes depending on server processing power and number of VAVs.

Once the orange pop-up screen closes, you can leave the screen while the test is in progress and return here when the test is expected to complete.

To cancel Run Test

a To cancel a specific VAV test, click **Abort**.

⚠️ **CAUTION** Aborting the majority of the VAV tests for an AHU can create a high static risk if they are run while Building Schedule is unoccupied.

b To cancel all VAV tests associated with an AHU, click **Abort All VAV**.

c To cancel all AHU-VAVS tests in the lists, click **Abort All**.

Automatic Aborts

- ○ If the AHU fan status is OFF, all VAVs associated to that AHU group will automatically abort. Automatic abort may take up to 30 seconds to start.

- ○ If the AHU fan status is not readable due to a communication issue, ACxelerate will attempt to read the AHU fan status for 3 minutes. If the AHU fan status is still not readable, then all VAVs associated with that AHU group will automatically abort.

- ○ If a VAV point with the Tag Name 'ACx Enable Damper Lock' (Tag ID: acx_dmp_lock_check) turns true while test is in progress, it will automatically abort. Automatic aborts may take up to 30 seconds to start.

- ○ If the damper override command does not match the damper position for 3 minutes from the step start time (applicable for all 6 steps in Run Test), the VAV test will be automatically aborted.

- ○ If VAV controller is not readable while Run Test is under progress, ACxelerate will continue to make attempts until the end of the currently active step. If the VAV remains unreachable, it will automatically abort.

VAV test data details

VAV damper test data

- ▪ VAV damper test data is not collected for the first 3 minutes of each step. This time is used to allow the damper to transition to a new commanded state while allowing the air flow value to stabilize. Sample collection for the airflow sensor value starts from end of 4th minute and continues every minute for the duration of the step. This process is repeated for all 6 steps.

- ▪ A minimum of 7 stable state samples are required for ACxelerate analytics to work. The damper test time step value (set at the time of configuration) cannot be lower than 10 total minutes (3 minutes transition time + 7 minutes stable state data).

VAV reheat valve test data

- VAV reheat valve test data is not collected for the first 6 minutes of each step. This time allows the valve to transition to a new commanded state while allowing the VAV discharge air temperature value to stabilize. Sample collection for the AHU supply temperature and the VAV discharge air temperature sensor value starts after 7 minutes and continues every minute for the duration of the test. This process is repeated for all 6 steps.

- A minimum of 7 stable state samples are required for ACxelerate analytics to work. The reheat valve test time step value (set at the time of configuration) cannot be lower than 13 minutes (6 minutes transition time + 7 minutes stable state data).

- During the reheat valve test, it could take more than 6 minutes for the sensor value to stabilize. Some transition data nearing the stabilized state may be recorded. If this occurs, increase the time step to a higher value (a minimum of 7 stable state samples are required).

Analyzing data

To view the analysis

1 Click **Go Analytics** in Run Test to view the current test results. You can also view previous test results from Analyze Data on the Home page.

2 Click on each **Damper Performance** and/or **Valve Performance** tab to view results.

3 From upper overview, select any AHU Group to review from either the **Group Select** drop-down list or from any pie chart. Each AHU pie chart is divided into 3 fault categories: **Healthy**, **Minor**, and **Major** faults.

4 All VAVs from the selected AHU group are grouped by fault category. Each category displays a point curve for all VAVs with that fault. Click any filled fault box to see further details. This screen will also show any healthy faults.

5 This section will display the potential root cause of the VAVs. Click on the **Equip select** drop-down list and select any VAV to see its corresponding IO curve. The damper test IO curve has the damper position on the X axis and airflow on the Y axis. The reheat valve test IO curve has the reheat valve position on the X axis and the temperature differential (VAV discharge temperature minus AHU supply temperature) on the Y axis.

6 Add any comments you wish to retain into the comments box on the right. Comments will be exported to the reports. Select either **Html** or **Excel** in the upper-right; then click **Export results**. Test results are found in your system's **Download** folder or wherever you have designated your browser to save the files.

7 AHU level warning message (if any) appear here.

NOTE Report downloads are disabled for dealer licenses.
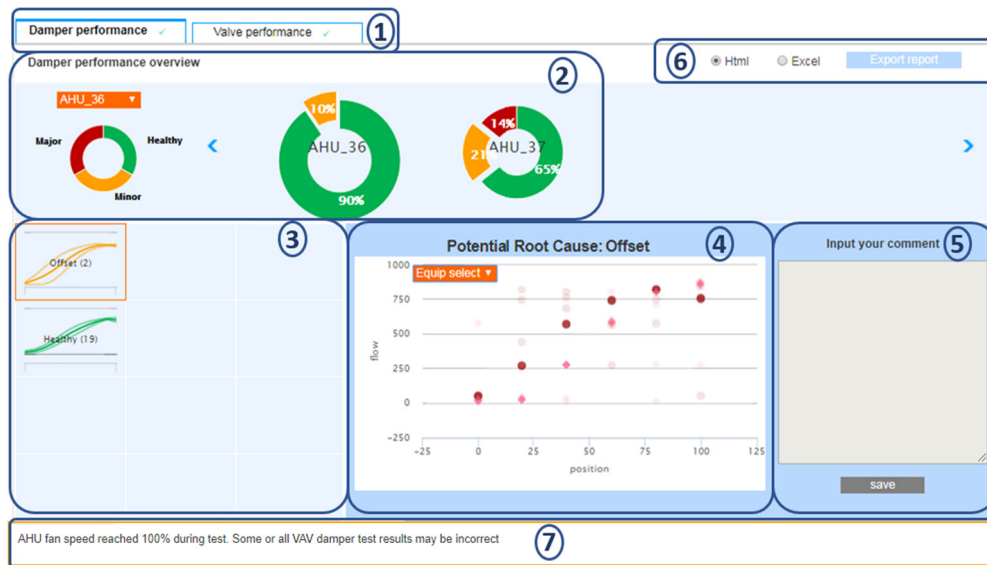
TIP Raw data is available in the Excel® file on each AHU tab. This data is hidden to the right of column 'P'. To view the additional details, hover over the column headings, right-click, and select **Unhide**.

Faults identified by ACxelerate

ACxelerate VAV test results are divided into 4 fault types with 3 severity levels:

Fault type	Fault name	Description
Healthy (Severity Level: 0) Indicates a healthy VAV. It may also show system level anomalies or unusual VAV configurations.	**Healthy**	No fault identified; device and sensor under test are working normally.
	Maximum Airflow Error (Damper performance only)	Maximum recorded airflow value during the test is less than the cooling maximum airflow setpoint. This could also indicate a possible starving box, as the maximum VAV load on AHU Fan is up to 60% at any point during the test.
	Minimum Airflow Error (Damper performance only)	Minimum recorded airflow value during the test is more than the occupied minimum airflow setpoint. This could also indicate a possible leakage fault. If minimum airflow is set to 0 cfm, the minimum airflow alarm will always appear. For CAVs with minimum airflow and maximum cooling airflow set to same value, the minimum airflow error alarm will never appear.
	Minimum and Maximum Airflow Error (Damper performance only)	Both maximum and minimum airflow errors are detected.
Minor Faults (Severity Level: 1) Indicates minor functional faults in the VAV. It may also show system level anomalies or minor issues.	**Starving**	For the damper, there may be a starving actuator. For the reheat valve, causes could include: • starving valve • oversize • valve and actuator together displaying quick-opening behavior • stuck actuator
	Obstruction	There may be obstacles in the duct/pipe or higher airflow/water flow resistance.
	Over-Stroking	Damper/reheat valve is stroking at a higher percentage than the actuator percentage.
	Under-Stroking	Damper/reheat valve is stroking at a lower percentage than the actuator percentage.
Major Functional Faults	**Leakage**	Leakage of air/water when damper/reheat valve is closed.

| Fault type	Fault name	Description
(Severity Level: 2) Indicates major functional faults in the VAV. Shows critical issues in VAV functionality.	**Stuck**	Damper/reheat valve is stuck in a particular position.
		An error in airflow sensor zero flow calibration could cause a damper test sensor issue to be flagged as Stuck Alarm.
	Sensor Issue	For damper test, the VAV airflow sensor is at fault.
		For reheat valve test, the VAV discharge air temperature and/or AHU supply air temperature sensor are at fault.
	Reverse-Stroking	Damper/reheat valve operating in reverse of the expected direction.
	Expert Diagnosis Required	If the input-output curve is abnormal but does not fall under any of the mentioned faults, manually check the VAV box for issues.
		This fault could be caused by higher variation in airflow or static pressure from the AHU fan during the damper or reheat valve test.
		It could also be caused by higher variation in boiler supply temperature or boiler pump speed during the reheat valve test. Time step value may need to be increased to allow residual heat to settle during step position changes.
	Actuation Range Insufficient	Data samples collected by the tool do not cover all of the expected steps defined at design stage. Actuation range is comprised of 6 steps: 0%, 20%, 40%, 60%, 80%, 100%. If data associated with any of these steps is not available, it will lead to this fault.
Major Data Faults (Severity Level: 2) Indicates major faults in collecting data from VAV and/or AHU controllers. There may be a communication issue or the controller is offline.	**Data Insufficient**	Data samples collected by the tool from the i-Vu® Pro database are not sufficient to run analytics. 42 or more are required to run the analytics.
	Data Unavailable	Data sample collection failed due to offline VAV, or VAV test failed.

NOTE If damper and reheat valve test are selected together and any fault is identified during a damper test for a VAV, the reheat valve test results may not be valid. Repair the damper, then re-run the tests.

Testing other types of VAV boxes

ACxelerate can run tests for single-duct VAVs with damper and reheat valve control. Fan control or dual-duct (two damper) control is not available. See the guidelines below for testing other types of VAVs.

Fan power box

- **Series Fan VAVs**: Manually override the series fan running in the correct direction before running the ACxelerate damper and reheat valve test. For a reheat valve test, go to **Run Test** > **Time** > **Damper Lock at** and set the damper lock value to 60%.
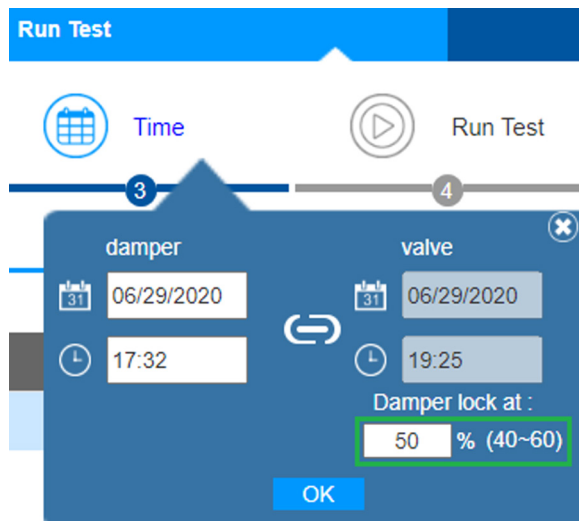
NOTE For Series fan VAV, during the reheat Valve test it is important that the air flowing through VAV damper (when the damper is 60% open) is greater than or equal to the air pulled by VAV Fan. To achieve this, run the AHU at highest allowed statis pressure setpoint. If this does not help, then try reducing the VAVs for the test and ensure all unselected VAV dampers are closed.

- **Parallel Fan VAVs with reheat coil installed in series**: Manually override the parallel fan to **Off** before running the ACxelerate damper and reheat valve test.

- **Parallel Fan VAVs with reheat coil installed in parallel duct before fan**: Manually override the parallel fan to **Off** before running the ACxelerate damper test (you cannot execute a reheat valve test for this VAV).

NOTE The additional built-in tags and tag rules for series and parallel fans in Semantics for ACxelerate are for future use, and can be ignored at this time.

Dual duct VAVs

Only one damper and airflow sensor can be tested at a time in a VAV. To test both decks in dual-duct VAVs:

1   Create separate custom semantic tag rules for each airflow microblock and airflow value for each deck (cold and hot) using tags as shown in the table below. Keep them disabled.

Point Description	Reference name	Built-in Tags (ID)
Cold Deck Airflow Control Microblock	at actual	ACx Flow Control (acx_airflow)
Hot Deck Airflow Control Microblock	at actual	ACx Flow Control (acx_airflow)
Cold Deck Airflow Value	at actual	ACx Flow Control / Flow Input (acx_airflow_value)
Hot Deck Airflow Value	at actual	ACx Flow Control / Flow Input (acx_airflow_value)

2   To test a cold deck:

a)   Enable Cold Deck Airflow Control Microblock and Cold Deck Airflow Value Custom Semantic Tag rules.

b)   Force hot deck damper to close.

c)   Discover ACxelerate equipment and run the test.

d)   Once the testing is complete, disable the custom tag rules from step a.

3   To test a hot deck:

a)   Enable Hot Deck Airflow Control MicroBlock and Hot Deck Airflow Value Custom Semantic Tag rules.

b)   Force cold deck damper to close.

c)   Discover ACxelerate equipment and run the test.

d)   Once testing is complete, disable the custom tag rules from step a.

NOTE You can also use this strategy to test additional applications that combine the VAV Zone Controller II with the Secondary Terminal controller.

VAVs with 2 reheat coils

The process below is only for valves with 2 reheat coils installed in series with a VAV damper, with both reheat coils supplying air to the same VAV discharge air temperature sensor. This can also be used for parallel smart valves used for reheat coils.

1. Create separate custom semantic tag rules for each reheat coil valve AO microblock as shown in the table below. Keep them disabled.

Point Description	Reference name	Built-in Tags (ID)
Reheat Valve1 AO Microblock	at actual	ACx HW Valve (acx_hw_valve)
Reheat Valve2 AO Microblock	at actual	ACx HW Valve (acx_hw_valve)

2. To test reheat valve 1:

   a) Enable Reheat Valve1 AO Microblock Custom Semantic tag rules.

   b) Force Reheat Valve2 AO Microblock to close.

   c) Discover ACxelerate equipment and run the test.

   d) Once the testing is done, disable the custom tag rules from step a.

3. To test reheat valve 2:

   a) Enable Reheat Valve2 AO Microblock Custom Semantic tag rules.

   b) Force Reheat Valve1 AO Microblock to close.

   c) Discover ACxelerate equipment and run the test.

   d) Once testing is complete, disable the custom tag rules from step a.

NOTES

- ACxelerate can test only one reheat valve at a time.

- Base board valves cannot be tested.

VAVs with SCR Control Electric Reheat

The ACxelerate reheat valve test is designed for water coils control with value and actuator. However, this tool can also be used to test whether the SCR system is functioning or failed. If you do so, note the following:

1. This test requires VAV discharge air temperature.

2. In the **Run Test** section, at the **Time** popup screen on the reheat valve side, set the **damper Lock at** to 60%.

3. Ignore all minor faults. Proceed as if SCR Reheat is functioning properly.

4. Consider stuck faults as SCR Control Reheat failures.

Document revision history

Important changes to this document are listed below. Minor changes such as typographical or formatting errors are not listed.

Date	Topic	Change description	Code*
3/22/21	Dual duct VAVs	Clarified NOTE	C-TS-CP-E
	To initiate Configuration & Design	Replaced Cool Request with Linkage, clarified ACx online connectivity requirements, Design step	C-TS-CP-E
	Before you begin checklist	Removed Cool Source Tree method	C-TS-CP-E

* For internal use only