



Flownex® SE Version 8.12.8 Release Notes

Document number: FN-8.12.8-RN094

Revision: 1

Status: Approved

by

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August 2021



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1. Scope

This document contains the release notes of Flownex® Simulation Environment 8.12.8 in August 2021. Flownex® SE 8.12.8 includes major enhancements to even further improve user-friendliness and ease of use, enhanced solving capability and speed, additional features and solvers, new models and components, etc. The major and minor enhancements will be described in the release note.

2. References

2.1 APPLICABLE DOCUMENTS AND DATA

The following documents and data are applicable:

TITLE	REFERENCE NUMBER
[1] General User Manual	Flownex® SE 18.pdf
[2] Flownex® Library Theory Manual	Flownex® Theory Manual.pdf
[3] Flownex® Library Manual	Flownex® Manual.pdf
[4] Control Library Manual	DCS Library Manual.pdf
[5] Electrical Library Manual	Electrical Network Solver Manual.pdf
[6] Flownex® Demo Manual	Flownex® Demo Network Manual.pdf

2.2 APPLICABLE SOFTWARE

The following software files are applicable:

SOFTWARE DESCRIPTION	VERSION NUMBER	FILE NAME
[7] Flownex® Simulation Environment	8.12.8	<i>FNXSE 8.12.8.exe</i>

3. Enhancements

3.1 MAJOR ENHANCEMENTS

3.1.1 Distributed Control System (DCS)

- Added a Velocity based PID controller. The goal of the Velocity PID controller is to have a PID that calculates the change of output variables instead of the output itself. This way different controllers can easily be used to control the same variable and switching between them does not cause spikes in the output.

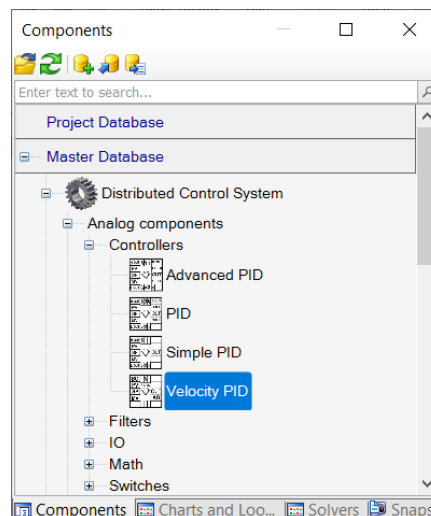


Figure 1: Velocity PID Controller.

- Added steady state operation for DCS components. The DCS components can propagate their inputs before or after steady state. The Execute before steady state option ensures that the control system values are initialised and passed to the flow components before the steady state solution is calculated. This results in a smooth change in controlled values when the transient solution starts. The DCS components can also be executed during steady state. In this case, the DCS components will execute as if a transient is being executed using the time step specified in the Scheduler (or Time Step settings). The Steady State behaviour settings for the DCS can be found on the DCS Solver, as seen in Figure 2. By default, the Execute before steady state option will be enabled for new projects and it will be disabled for older projects.

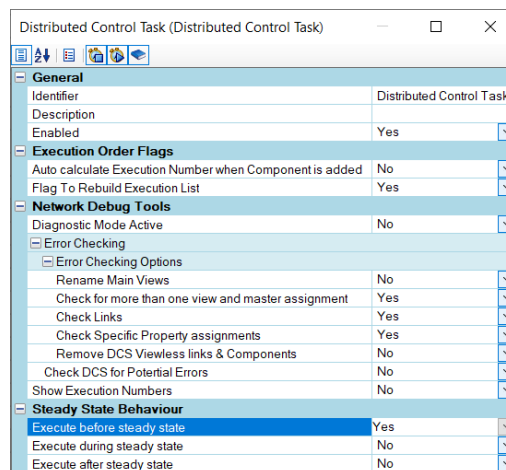


Figure 2: DCS Solver Steady State Behaviour Settings.

3.2 MINOR ENHANCEMENTS

3.2.1 Component Inputs

- The Description input of components can now be changed on all components in a multi-selection. This is useful for grouping components together in order to easily locate these components using the API or the Find dialog.

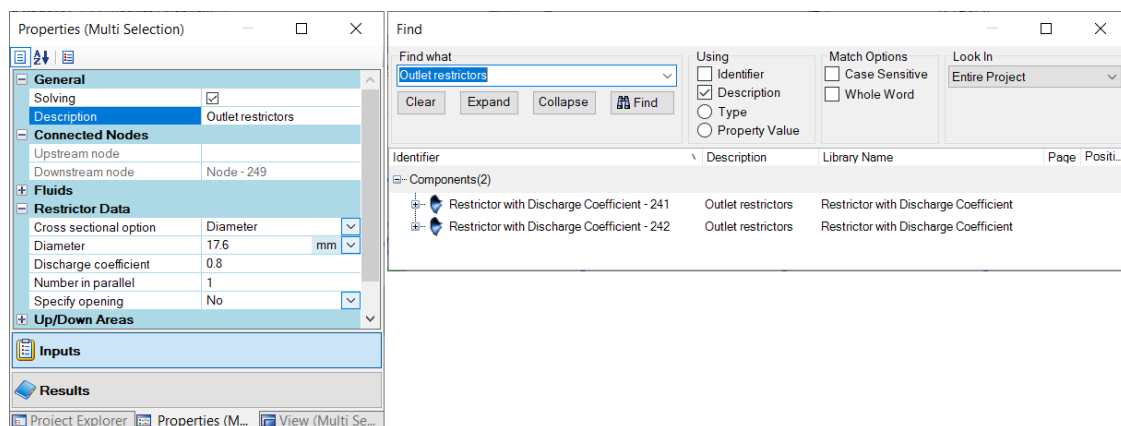


Figure 3: Multi-Editing Component Descriptions and Using the Description to Search for Components using the Find Dialog.

- A Search feature on the Component Selection dialog has been enabled. Input fields where users select a certain component as input, now shows a dialog with more filters to enable easier location of components in a large network. This works similar to the Find dialog.

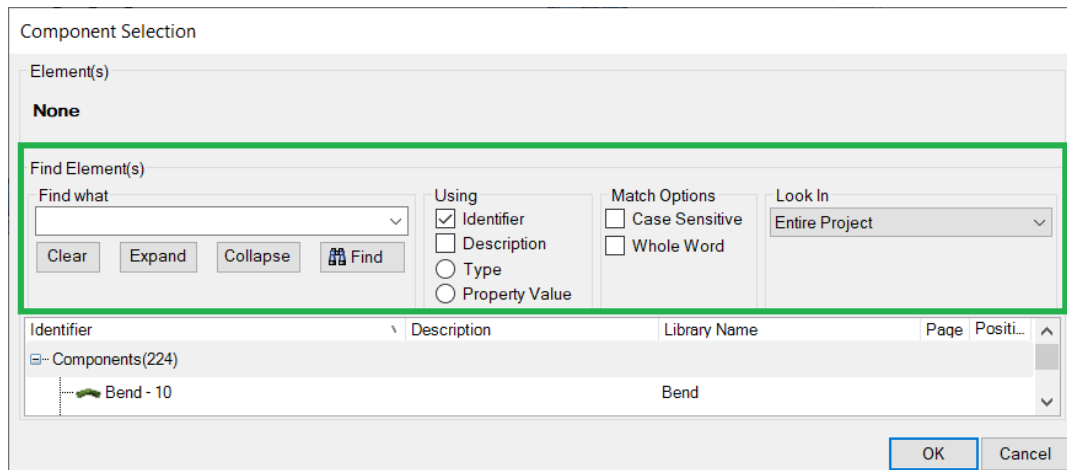
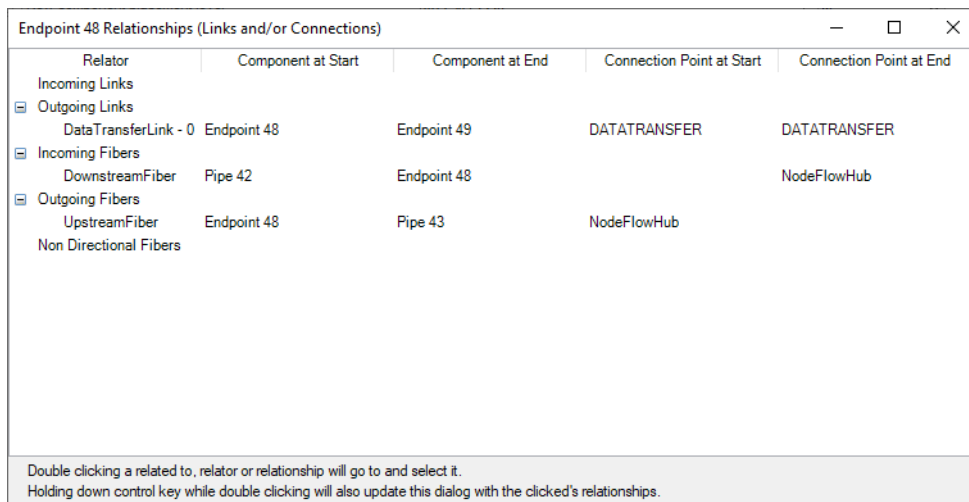


Figure 4: New Search Feature for the Component Selection Dialog.

3.2.2 Drawing

- The component connectivity can be shown by right clicking on any component and choosing “Display Links/Connections” from the context menu. This dialog has been updated to make it easier to understand and now also shows the port and hub names in the connections. The displayed port, fiber and hub names are useful when a user wants to determine which names to use when making connections to specific ports, fibers or hubs using the API.



Relator	Component at Start	Component at End	Connection Point at Start	Connection Point at End
Incoming Links				
[-] Outgoing Links				
DataTransferLink - 0	Endpoint 48	Endpoint 49	DATATRANSFER	DATATRANSFER
[-] Incoming Fibers				
DownstreamFiber	Pipe 42	Endpoint 48		NodeFlowHub
[-] Outgoing Fibers				
UpstreamFiber	Endpoint 48	Pipe 43	NodeFlowHub	
Non Directional Fibers				

Double clicking a related to, relator or relationship will go to and select it.
Holding down control key while double clicking will also update this dialog with the clicked's relationships.

Figure 5: Links and/or Connections Dialog.

3.2.3 API

- The ability to specify port names when linking components using the network builder has been added. This is useful for linking components that contain many ports like the DCS controller components.

- The ability to specify a hub name when connecting components using the API was added. This is useful for linking components that contain several hubs. Details of the new function can be found in the API Help manual.
- Communication through the API with existing open Flownex instances has been improved. The same functions can now be used to control instances that have been launched by the API or other existing instances. This makes the code simpler, for instance the same Python functions can now be used with both.

3.2.4 Flow Solver

- Added humid air fluid functions (psychrometric fluid functions) to Material Scripts that enables the calculation of mixture mass fractions from the following three input combinations:
 - Pressure, dry bulb temperature and relative humidity.
 - Pressure, dry bulb temperature and wet bulb temperature.
 - Humidity ratio.
- Added an error for non-physical user-specified constant convection coefficients. The solver will not run when a negative heat transfer coefficient is specified.
- Added an option to select between Effective area and Conduction shape factor specification for the Composite Conductivity element.

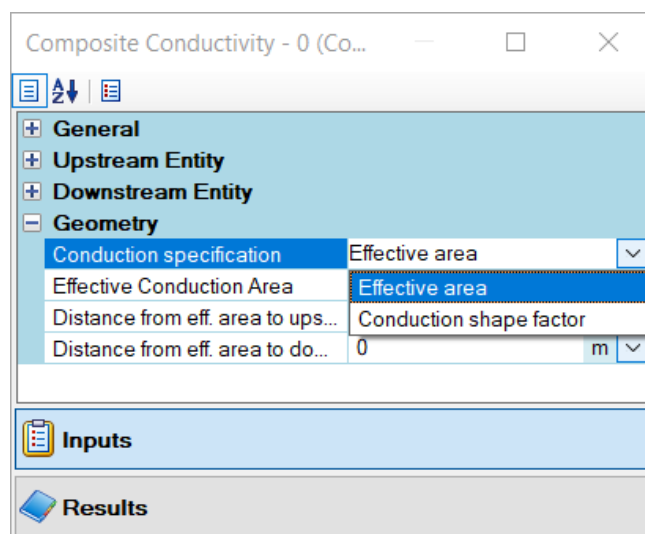


Figure 6: Effective area and Conduction shape factor options.

3.2.5 Scripts

Compiler warnings were not shown when compiling Scripts. For Script components, the warnings are now shown when using the Debug button. This provides users the opportunity to address any warnings that the Scripts may issue during compilation.

3.2.6 Installation Verification Tool

The installation verification tool has been updated to allow it to run several Flownex instances in parallel. This aids in both increased stability and speed. The user can select the number of parallel instances to use on the user interface. By default, it is set to half the number of available logical processors.

3.2.7 Nuclear Scripts

3.2.7.1 Reactor Builder Script Changes

- Cavity flow paths have been updated to:
 - Allow for adjacent vertical cavities to generate separate vertical flow paths.
 - Allow for adjacent horizontal cavities to generate separate horizontal flow paths.
 - Allow the user to specify that adjacent single cavities must remain distinct. This feature can be used in conjunction with the above options, to allow separate connections to flow elements outside of the generated reactor network.
- Implemented the associations between Ports and Node connection as a list to facilitate removing the previously hardcoded limit of 20 ports.
- Changed the folder structure and location of feedback files from the project folder to a sub-folder \point_kinetics_inputs\<<Reactor drawing page>. The point kinetic input files for a network shown in a page specified in the Reactor drawing page, are now located in the same sub-folder.
 - When the network is generated the first time the default point kinetics input files are copied to this subfolder. A new file, nominal_conditions.txt will be added to the existing list of input files. It will have the nominal power (in kW) as input with the rest of the file consisting of comments lines for the user to specify the nominal conditions associated with the set of point kinetic inputs contained in this sub-folder.
- Removed the discretization options for the sphere; the option is now always equally spaced. This was done since internal grid independence studies showed superior grid independence for the equally spaced option.
- A Tri-structural Isotropic (TRISO) model option was added, consisting of one node per fuel kernel, one node per composite coating, and a node on the interface between the fuel and composite coating (for a total of three nodes per TRISO particle). The discretization for this feature is described in the Reactor Builder Script and Runtime Neutronics Script User Manual in Appendix B, Section 5.2.
- Feedback groups:
 - Removed spurious warning messages when generating a network with general fuel zone specified, that nodes have already been added to a feedback group.



- Allow for numbered (arbitrary) feedback groups in addition to the named feedback groups.
- Allow for an unlimited number of materials to be specified per feedback group.

3.2.7.2 Reactor Result Script Changes

- Added a feature to specify a period for results file generation during a transient simulation.
- Added tabular output for newly added TRISO particle results.
- Added Pebble Wall Node results to Secondary Node result tables.
- Addressed error in the flow element indexing that resulted in partial table printouts.

3.2.7.3 Runtime Neutronics Script Changes

- The Runtime Neutronics Script was updated to accommodate the generic/numbered reactivity feedback groups. When the numbered feedback group option is selected then:
 - The number of groups that are active needs to be specified by the user,
 - The feedback group that is associated with the moderator needs to be selected by the user.
- Updated and properly documented comment lines in all sample point kinetics input files:
 - Added nominal_condition.txt file.
 - Updated comment in heat_distribution.txt to clearly indicate that the first two lines refer to the boundary of the zones and not the zone increments.
- Added Xenon modelling capability—the model is described in the Reactor Builder Script and Runtime Neutronics Script User Manual in Section 3.2.
 - Xenon parameters are provided in a xenon_transient.txt input file.
 - The reactivity associated with the Xenon along with the normalized Xenon and Iodine concentrations is provided as transient outputs.
- Nominal power is now read from the nominal_condition.txt input file and shown on the property page for ease of reference after the script has executed once.
- The “update reference temperature” option has been changed to “Calculation mode” with two options:
 - Initialize/Nominal conditions: This option will update the reference temperature for the feedback groups and set the control rod reactivity to zero.
 - Off-nominal conditions: When this option is selected, the steady state power will become available as input and will be used in the steady state run. The reference temperatures will remain unchanged, and the control rod depth will be adjusted to offset the fuel/moderator/reflector reactivity that resulted from the non-nominal operation.

- Moved displayed modelling parameters that are read from the point kinetics input files to a separate category (“Read from files in point_kinetic_input folder”) to clearly differentiate them from inputs that should be provided on the property page.

3.2.8 Select Flow Circuit

Added the ability to select all components on the drawing canvas that are part of a specific Flow Circuit (components that are connected and have the same assigned fluid).

This feature can be used by right-clicking on any component in the Flow Circuit and selecting “Select Flow Circuit”. All components in that Flow Circuit will then be selected and their common properties are displayed on the property grid.

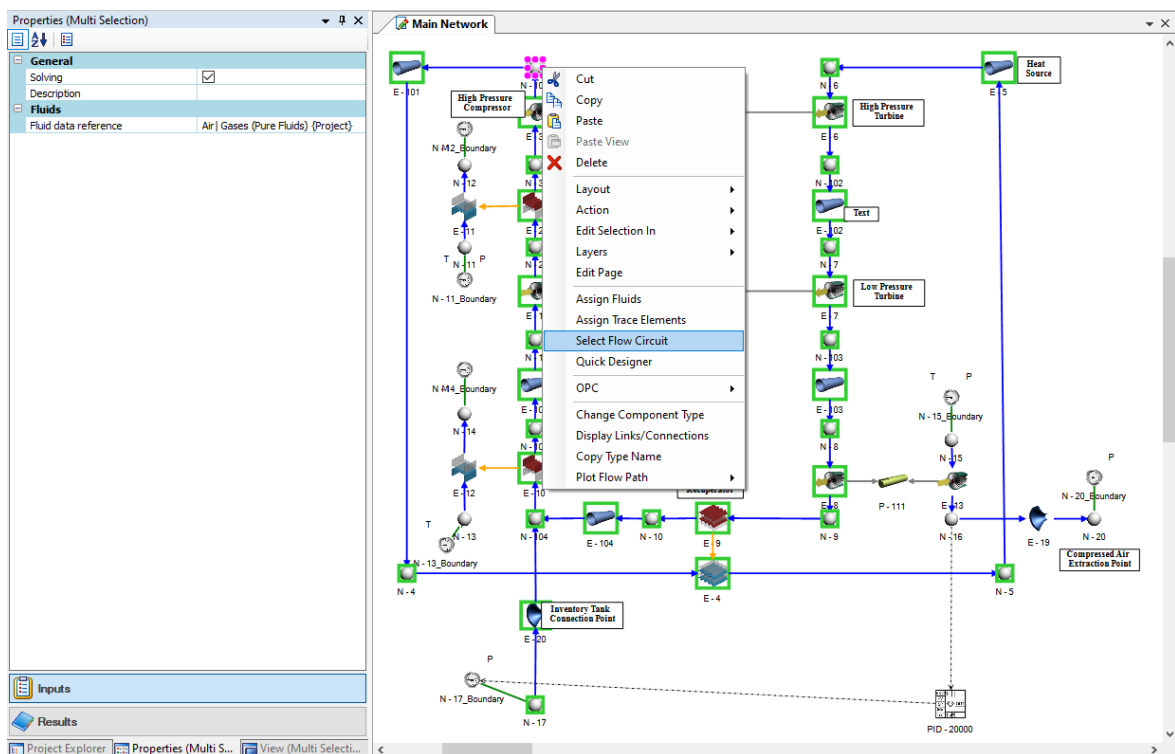


Figure 7: Select Flow Circuit.

3.3 BUG FIXES

3.3.1 Compound Components

- Fixed the problem where lists could not be exposed in compounds.
- Fixed the problem where the result layers were not displayed for some compound components. These included components such as the Gradual Pipe Transition, Orifice in Pipe Transition, Abrupt Contraction and Expansion and Long Orifice.
- Fixed the problem where any fiber could connect to an exposed hub from a compound component. This caused a problem where invalid component connections could be made to



the Angle Valve, Gate Valve, Globe Valve, Sharp Edge Diaphragm Valve, Sluice Valve, Smooth Diaphragm Valve and Y-Valve.

- Fixed the problem where a large number of items in the Reactor Chart got duplicated when a user pressed Cancel and the chart was reloaded. This caused the chart file to increase in size every time a user pressed Cancel and kept many unused items in the lists.

3.3.2 Flow Solver Components

- Removed the incorrect reporting of negative values being calculated for specific heat. This happened when the specific heat polynomial option was used for defining the enthalpy of the fluid, the latter which may be negative.
- Added a warning when the static pressure of a two-phase fluid at inlet to an ANSI standard based Valve exceeds the critical pressure of the fluid. Under these conditions Flownex® applies the gas-phase equations, not the liquid phase equations.
- Fixed the reporting of incremental areas on the Rotor disk of the Rotor-Stator component that erroneously reported the outer radius instead of the area.
- Limited the participating gas partial pressure emissivity correction in the Leckner correlation for gas to surface radiation to zero in order to prevent calculating undefined numerical values.
- A relaxation parameter was applied to the friction factor for very small non-condensable mass fractions that resulted in non-physical friction factors being calculated. The problem was addressed by removing the relaxation calculation.
- The incorrect vapor mass fraction approximation was used for determining the specific heat for a two-phase fluid with non-condensable gas during the critical mass flow and static pressure calculation.
- Addressed issue with Composite Heat Transfer (CHT) convection script indexing for CHT connected to flow nodes by adding an index indicating which index in the parallel path a convection element is associated with. This allows for correct indexing of the associated flow nodes in CHT element convection scripts.
- When a CHT element is connected to a Node on one side and a sub-divided Pipe on the other, two convective elements were created per increment on the side connected to the Node. This resulted in the subdivided results being displayed incorrectly.
- Fixed the problem where the Adiabatic Flame element added combustion product species that were not available in the gas mixture list to first fluid in list and not into background fluid.
- Addressed the incorrect reporting of the pressure difference excluding elevation change result for the Primary side of the Shell and Tube Heat Exchanger. This pressure difference was incorrectly divided by the number of gas passes.
- Removed the limitation that the CHT element can only be connected between two subdivided elements. CHT elements may now also be connected between a sub-divided element and



a single node. The convection heat transfer to a flow Node and the conduction heat transfer to a solid Node is now correctly accounted for. Previously a warning was issued that this topology was not permitted, but the simulation was not stopped and non-physical results were reported.

- Addressed the incorrect treatment of loss coefficients for sub-divided reactor zones. The user specified loss coefficients were assigned to each element associated with a sub-divided zone, whereas the inlet and outlet loss coefficients are now only applied to the first and last element in a sub-divided string of elements.
- Fixed problem where two-phase tank level was temporarily set to zero when loading a snap.
- Fixed precursor equation in solid and liquid fuel nuclear example scripts.

3.3.3 Excel Input Sheets

- Fixed the problem where data was lost when a user performed a save-as operation on a project after editing Excel input sheets.

3.3.4 Licensing

- Fixed the problem where some example Script components were available for use in the Basic Thermal Fluid module.

3.3.5 GIS Importing

- When importing GIS files, the generation of background maps using some online sources did not function correctly anymore. The importing was updated to remove sources that do not work anymore and the speed of importing was significantly improved.

3.3.6 Initialize Steady State from Snap Files

- The problem was fixed where the fixed mass flow value was used from the snap file and not from the user interface specification when initializing a steady state from a snap file.

4. Manual Updates

The following sections in the Flownex® General User Manual have been updated:

- Updated the Component Selection dialog window screenshot.
- Updated Component on drawing canvas context menu description:
 - Updated Display Links/Connections dialog with latest changes.
 - Added Select Flow Circuit.
 - Added Copy Type Name.
 - Added Plot Flow Path.

The following sections in the Flownex® Library Manual have been updated:

- Updated the Normalised reactor power description.
- Updated the Normalised precursor atom density description.
- Updated the Composite Conductivity Input properties with the option to select between Effective area and Conduction shape factor specification.

The following sections in the Flownex® Control Manual have been updated:

- Added the Velocity PID component theory.
- Updated the Distributed Control Task in the Solvers Library section to include the Steady State Behaviour settings.

The following new Nuclear manuals have been added:

- Step by Step Reactor Builder Script and Runtime Neutronics Script Example.
- Reactor Builder Script and Runtime Neutronics Script User Manual.

The following networks have been added to the Tutorial templates:

- Added Reactor_StepByStep.zip to the Tutorials folder.
- Added Reactor_Script_StepByStep.zip to the Tutorials folder.

5. V&V Updates

The following documents and associated projects have been added to the V&V pack.

- FNXVV-0038.12 - Flownex Verification Report: Grid Dependence of the Nuclear Reactor Element and Reactor Builder Script.
- FNXVV-0063 – Flownex Verification Report: Two-Phase with Incondensables.
- FNXVV-VER-0095 - Flownex Verification Report: Velocity PID.