Excel® Worksheets for Predicting
Hydrodynamic Noise in Control Valves
In accordance with IEC 60534-8-4: 2015

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About the worksheets

These worksheets calculate aerodynamic noise in control valves based on IEC 60534-8-4: 2015, **INDUSTRIAL-PROCESS CONTROL VALVES –Part 8-4: Noise considerations – Prediction of noise generated by hydrodynamic flow**.

If you are not interested in details about the worksheets and how they work, you can skip directly to the **Using the Worksheets** section.

The interested user can compare the worksheet calculations with the step-by-step calculations given in Annex A of the Standard, Examples 1 and 2. My comparison has shown exact agreement with Examples 1 and 2.

Comparing the worksheet calculations with hand calculations or with the calculations in Annex A of the Standard to confirm that the worksheets do, indeed, follow the Standard has a significant benefit. Once this has been done, the calculations from the worksheets can be compared to the calculations of a manufacturer's proprietary valve sizing program (where the actual calculation method is hidden) to confirm that the manufacturer's software does, indeed, follow the Standard.

The User Interface ("UI") tab is the only one most users will need to use. The "Calcs" tab is where all the calculations take place, but the casual user does not need to be concerned with these calculations.

The Standard only supports one set of engineering units, (kg/s, Pa, kg/m3, m/s, m). Just below the Unser Interface area is a "**Unit Selection for user interface**" where the user can select the engineering units they wish to use. In the area to the right of the user interface is the **Conversion from user interface units to Units required by the IEC Standard** area**.** in this area, the user's selected engineering units are converted to the Standard's supported engineering units. From that point forward, all calculations are carried out in the units supported by the Standard.

No attempt has been made to include multistage low noise valves in the calculations. There are many proprietary designs available with different capabilities and the necessary parameters for a noise calculation are likely to be difficult to obtain from valve manufacturers. If you see a noise problem in your calculations you should contact one or more manufacturers for their recommendations and their noise predictions.

Unlike the Standard for Aerodynamic noise, the Hydrodynamic noise Standard does not include a calculation for F_d, the Valve Style Modifier, but instead refers to **IEC 60534-2-3:2015 Industrial-process control valves - Part 2-3: Flow capacity - Test procedures.** Values of F_d should be available from manufacturer's literature. I have included a table of typical values at the end of this instruction.

On the "Calcs" tab, I have repeated the parameters in the **Conversion from user interface units to Units required by the IEC Standard** area. This may seem redundant, but I have done this for two reasons. 1) It should be easier for the interested user to follow the step-by-step calculations by viewing only the "Calcs" tab, and 2) this gives flexibility in the future to easily incorporate these noise calculations into Excel control valve sizing worksheets.

How the Worksheets Work

In the first column where each variable, constant or formula is entered, its cell, is assigned, as its name, the variable name to its immediate left, and it is this name that is used whenever that cell's contents are used in a subsequent formula. With this knowledge, the user can easily see the flow of the calculations by studying the worksheet. For example, on the User Interface the variable "Inlet pressure" in Column D has the name "P_1..1". On the Calcs tab, the first column where the Inlet pressure appears is in Column D, and its cell name is P_1..D. Only the first column of calculations uses names for each variable. The other 3 columns (which perform the same calcuations) use only cell number references.

There are two worksheets. One for flow in mass flow units and one for standard volumetric flow units. The Standard supports only mass flow units. The volumetric flow sheet is identical to the mass flow sheet except that flow is entered in standard volumetric flow units. On the **Conversion from user interface units to Units required by the IEC Standard** volumetric flow units are converted to mass flow units. From that point on, the calculations of both sheets are identical.

The conversion from volumetric flow to mass flow first converts the flow in the user's selected units to m^3/sec, then multiplies it by the density which, if necessary, has been converted to kg/m^3,which yields the flow in kg/sec.

Using the Worksheets

If the engineering units on the UI (User Interface) tab of the worksheets do not agree with your given data, scroll down to the **Unit Selection for user interface** area that is below the user interface. Type the option number into the blue **Flag value** column for the unit you want to use that is listed in the **Options** column. The **Flag Value** does two things. 1) It changes the appropriate label in Column B of the user interface. 2) It implements the correct unit conversion factor in Columns S through V so that your chosen engineering unit is converted to the units that are required by the Standard. Note that changing the **Flag #** for Density changes both the units for the process density and for the "Density of pipe material." Immediately below the user interface area in Column A is listed the density of steel pipe in both kg/m^3 and lbm/ft^3.

Enter the required process data in Column D (and optionally also E, F and G). The **Calculated results** fields will remain blank until all the required data (with the exception of the "**TAG"** field) is entered in the blue fields.

Ideally, valve parameters F_L, F_d, x_{Fz} and A_η should be obtained from valve manufacturer's literature. For preliminary calculations, you can use the typical data included at the end of this instruction. For x_{Fz} you have the option of entering a known value (preferred) or enter "UCV" and the worksheet will calculate an approximate value using Equation 3 in the Standard. Before purchasing a valve, I recommend contacting your supplier(s) giving them a copy of your calculations and asking for their comment and recommendations. In the end, it is the valve supplier, who has intimate knowledge of their products, that should stand behind their recommendation.

Typical Liquid Pressure Recovery Factors (F_L)

	F_L at % of Rated Flow Capacity (C_v or K_v)					
Valve type	10	20	40	60	80	100
Globe, parabolic plug Flow-to-open	0.96	0.96	0.96	0.95	0.91	0.89
Globe, 4 V-port cage Flow into center	0.97	0.97	0.97	0.95	0.90	0.90
Multi-stage globe	0.99	0.99	0.99	0.99	0.99	0.99
Eccentric rotary plug Flow-to-open	0.91	0.89	0.85	0.82	0.78	0.76
Segment ball Flow into ball face	0.94	0.93	0.89	0.80	0.75	0.42
Full Ball Standard port	0.91	0.91	0.90	0.85	0.77	0.67
90 degree butterfly Shaft downstream	0.87	0.85	0.80	0.75	0.66	0.58

Typical Valve Style Modifier (F_d)

Valve type	F_d at % of Rated Flow Capacity (C_v or K_v) 10	20	40	60	80	100
Globe, parabolic plug Flow-to-open	0.12	0.18	0.25	0.32	0.38	0.48
Globe, 4 V-port cage Flow into center	0.42	0.43	0.37	0.29	0.35	0.39
Eccentric rotary plug Flow-to-open	0.12	0.18	0.22	0.30	0.36	0.42
Segment ball Flow into ball face	0.71	0.79	0.86	0.93	0.97	0.99
Full ball Standard port	0.43	0.66	0.85	0.94	0.98	1.0
90 degree butterfly Shaft downstream	0.14	0.14	0.18	0.26	0.33	0.36

Typical values of Valve correction factor for acoustic efficiency, $A\eta$

Globe	-4.6
Eccentric rotary plug	-4.6
Segment ball	-4.6
Butterfly	-4.3