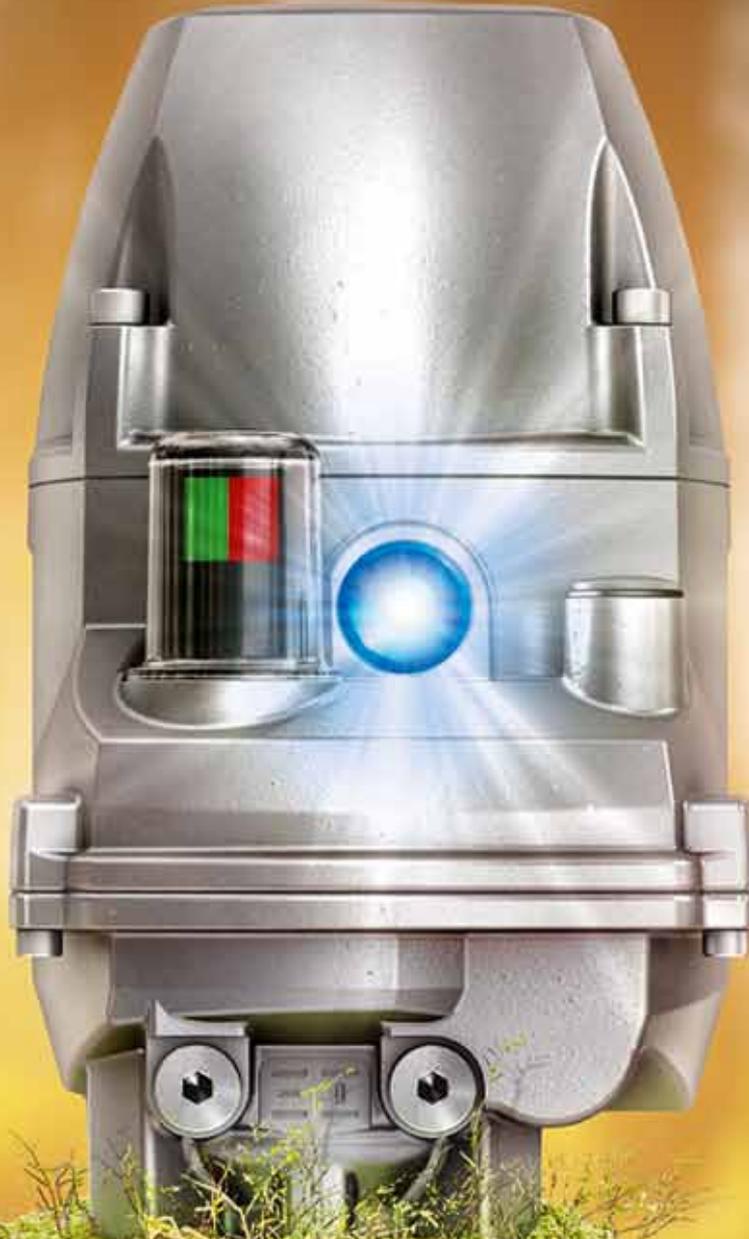


# Valve World

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Severe service



- 20 China: opportunities and challenges
- 26 Control valves: material and design challenges
- 29 Valve World Conference program 2022
- 44 Quick method to predict control valve hydrodynamic noise

## Cover Story:

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# Excel-worksheet predicts control valve hydrodynamic noise

Most control valve manufacturers include EC 60534-8-4:2015 in their control valve sizing and selection software to predict control valve hydrodynamic noise. However, users who want to make quick noise predictions or who want to construct valve sizing applications, programming the above noise standard can be a daunting task. Therefore, I have developed an Excel-based worksheet that enables a quick and simple calculation.

By Jon F. Monsen

## About the author:

Jon F. Monsen, Ph.D., P.E. is a control valve technology consultant at Valin Corporation. He has more than 40 years' experience in the control valve industry and lectured nationally and internationally on the subjects of control valve application and sizing. He is also the author of the chapter on "Computerized Control Valve Sizing" in the ISA Practical Guides book on Control Valves and wrote the book Control Valve Application Technology: Techniques and Considerations for Properly Selecting the Right Control Valve. He can be reached at [JMonsen@valin.com](mailto:JMonsen@valin.com)

Reference 1 (see box text on next page) includes a simplified method for predicting hydrodynamic noise developed by H. D. Baumann, an internationally recognized control valve expert who has spent many years investigating control valve noise mechanisms and theory. Reliable valve noise test data is difficult to find unless you are a valve manufacturer and then

you tend not to share it. I did find 18 noise tests that I believe to be reliable, and using this simplified noise prediction method, average errors from test data ranged from minus 2.5 to plus 3.7 dB(A).

Control valve noise prediction methods normally claim accuracy of plus or minus 5 dB(A). IEC 60534-8-4:2015 gives two example calculations. For Example 1, this simplified method calculates

	A	B	C	D
1	<b>Control Valve Hydrodynamic Noise</b>	Calculation method by Hans D. Baumann		
2	Valve World Magazine, December, 2019	Worksheet by Jon F. Monsen		
3				
4				
5			<b>Name of Cell</b>	
6	<b>Given Process Data</b>	<b>Unit</b>	<b>to the right</b>	<b>User inputs</b>
7	Inlet pressure, P <sub>1</sub>	psiA	P_1	100
8	Outlet pressure, P <sub>2</sub>	psiA	P_2	40
9	Liquid vapor pressure, P <sub>v</sub>	psiA	P_v	0.5
10				
11	<b>Valve/Pipe Parameters</b>			
12	Downstream pipe diameter, D	inch	D	6
13	Valve capacity, C <sub>v</sub>		C_v	85
14	Liquid pressure recovery factor, F <sub>L</sub>		F_L	0.7
15	Diff press ratio of incipient cavitation noise, x <sub>FZ</sub>		x_FZ	0.28
16	Valve Style, rw (globe = 3, others= 0)	dB	rw	0
17				
18	<b>Modifiers</b>			
19	Downstream Pipe schedule (40 = 0, 80 = - 4)	dB	ps	0
20				<b>Calculation results</b>
21	<b>Calculated SPL (LpAe<sub>1m</sub>)</b>	<b>dB(A)</b>	<b>SPL</b>	<b>90.4</b>
22				
23				
24	<b>Calculations</b>			
25	X, Pressure ratio		X	0.603015075
26	X at max cavitation, Xy		Xy	0.64
27	A	dB	A	14.7026071
28	B	dB	B	35
29	c <sub>1</sub>	dB	C_1	20.7058824
30	c <sub>2</sub>	dB	C_2	19.9902083
31	c <sub>3</sub>	dB	C_3	0
32	C=c <sub>1</sub> +c <sub>2</sub> -c <sub>3</sub>	dB(A)	C_	40.6960907
33	LpAe <sub>1m</sub> = A+B+C-rw+ps	dB(A)	LpAe <sub>1m</sub>	90.3986978

Screen 1

you should get the calculation results shown in green on Screen 1.

### Calculated results

The formulas for all the calculations rely on the cells in Column D having the names to their left in Column C. To name them, highlight both Columns C and D, rows 7 through 33. Select the “Formulas” tab, select “Create from Selection” then check “Left column” and click “OK.” Now all the cells in Column D, Rows 7 through 33 will have the names in the cells to their left.

This makes it possible for all the formulas to use the actual names of each variable instead of simply cell references. For example, the inlet pressure,  $P_1$ , appears in all the formulas that depend on it as “ $P_1$ ” instead as simply “D7.” You can do this in one step. Excel will ignore any cells that have nothing in them.

Finally, enter the formulas shown on Screen 2 (column D) in the appropriate cells. This requires great care for the Excel-sheet to work properly. If you have accurately entered the process and valve data, and the formulas, you will get the calculated results shown in green on Screen 1.

### Extend the worksheet

As an option you can add an additional column of noise calculations by entering the formulas shown on Screen 3 in Column E. The process and valve parameters for this column of calculations would be entered in Column E.

If you choose to perform the above step, it will be extremely easy to extend the worksheet to include any number of calculations that you choose. For example, if you want to add another eight calculations to the worksheet, do the following:

1. Select Column E, cells 21 through 33.
2. Copy these cells (ctrl + C).
3. Click on Cell F21 and drag the pointer to M21
4. Paste (ctrl + P)

You would then have a worksheet that will calculate hydrodynamic noise for ten sets of conditions.

	D
21	=IFERROR(LpAe1m,"")
22	
23	
24	
25	=(P_1-P_2)/(P_1-P_v)
26	=(1+x_Fz)/2
27	=8*LOG10(D)+12*LOG10(C_v/D^2)+4
28	=35*LOG10(P_1)-35
29	=IF(X>=F_L^2,(30*LOG10(10*F_L^2)),30*LOG10(10*X))
30	=IF(X>=Xy,60*LOG(Xy/x_Fz),IF(X>=x_Fz,60*LOG(X/x_Fz),0))
31	=IF(X>=Xy,120*LOG10(X/Xy),0)
32	=C_1+C_2-C_3
33	=A+B+C_rw+ps

Screen 2

	E
21	=IFERROR(E33,"")
22	
23	
24	
25	=(E7-E8)/(E7-E9)
26	=(1+E15)/2
27	=8*LOG10(E12)+12*LOG10(E13/E12^2)+4
28	=35*LOG10(E7)-35
29	=IF(E25>=E14^2,(30*LOG10(10*E14^2)),30*LOG10(10*E25))
30	=IF(E25>E26,60*LOG(E26/E15),IF(E25>=E15,60*LOG(E25/E15),0))
31	=IF(E25 >= E26,120*LOG10(E25/E26), 0)
32	=E29+E30-E31
33	=E27+E28+E32-E16+E19

Screen 3

a predicted sound pressure level that is 1.3 dB(A) lower and for Example 2, 1.7 dB(A) lower.

### How to construct the Excel-sheet

Reference 1 suggests that the method is simple enough to be implemented with a pocket calculator or one of the many calculator apps available for cell phones. A sample hand calculation is included in the article to demonstrate this claim. Several people have contacted me saying that it would be easier to have an Excel-worksheet for this proposed method. This should be easy to construct, but so far as I know, no one has actually done it, at least not to share with others. The balance

of this article describes how to construct such an Excel sheet.

Reference 1 lists the calculation steps and shows the formulas used in a conventional format. Screen 1 is an Excel-worksheet that implements the calculations described in Reference 1. To construct the worksheet, start by entering the text shown in black, all of which is simply plain text.

Column D, Rows 7 through 9, 12 through 16 and 19 is where the user's process and valve data are entered. The numbers shown in red are the sample process and valve data that were used in the sample calculation of Reference 1. To test the worksheet, if you enter these sample data

### References

Reference 1. Stop cavitation from destroying your control valve trims, Valve World December 2019 pp 61-63.

Reference 1 can be viewed at:

<https://www.valin.com/sites/default/files/asset/document/Stop-Cavitation-from-Destroying-Your-Control-Valve-Trims.pdf>