White Paper | Wake Frequency Calculator

WIKA Offers Web-Based Thermowell Wake Frequency Calculator

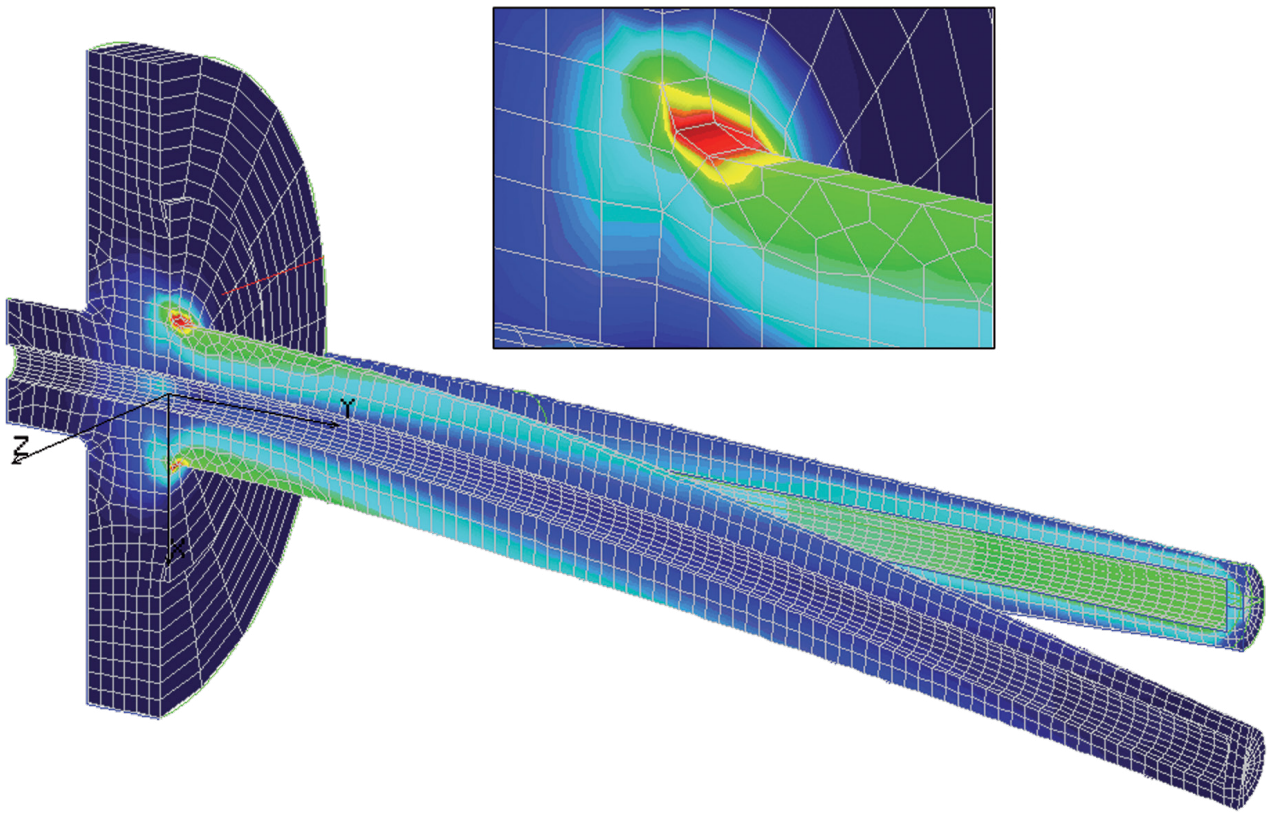
Two wake frequency calculators – a pared-down one and a full version – are free, easy-to-use online tools for determining the diameters, length, thickness, and material of a thermowell.

Thermowells are important accessories that shield sensitive temperature sensors from abrasive or corrosive process media, high pressure, and other adverse conditions that would damage the thermocouple, dial thermometer, or resistance thermometer (RTD). Because these protection devices are installed in pipelines, where the process media could flow at a fast velocity, the stems must have the correct length, root diameter, and tip diameter to prevent the formation of wake-induced vortices that create vibrations and cause mechanical fatigue.

The Importance of Wake Frequency Calculations

Sensor manufacturers offer wake frequency calculators (WFC) to help customers determine the ideal dimensions and other requirements of thermowells for specific applications. Each calculator is slightly different, but in general this tool asks the user to input information about the process (pressure, density, velocity, etc.) and the thermowell (insertion length, material, diameters, etc.). Using this data, the software then determines whether that thermowell is suitable for those process conditions.

The goal is to design a thermowell that will not suffer damage in a particular application. If the specifications fail the calculations for safety, the user can fine-tune the dimensions, stem style, and more until the results are within acceptable limits.



WIKA's Wake Frequency Calculator

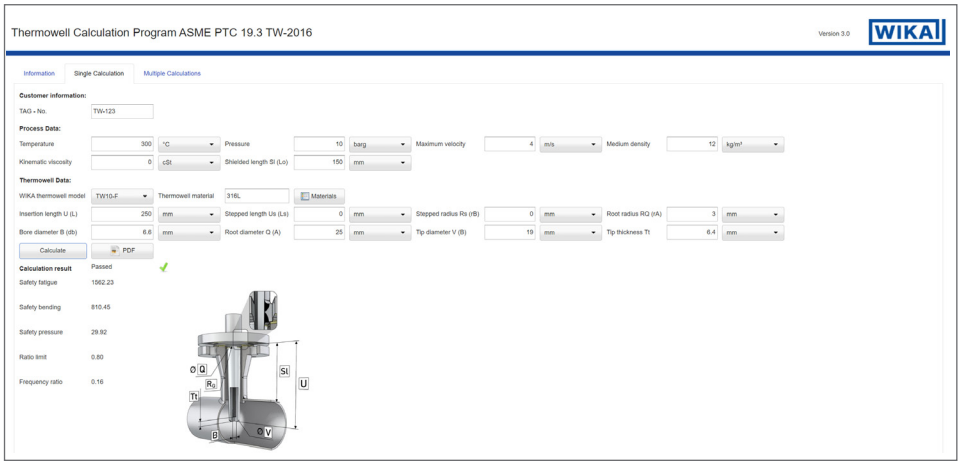
For more than two decades, WIKA's WFC was based on VBA macros in Excel. Thousands of our customers worldwide used this tool to design their thermowells, and each new version of this program added functionalities.

VBA-based applications worked well for many years. But then issues began to crop up, such as growing incompatibility with newer versions of Windows and many companies' concern over the security of third-party software. In short, it was time for an update.

WIKA engineers and programmers have created an online solution with all the attributes of the original Excel version, but with several additional features and the convenience of a browser-based app. Our free web-based wake frequency calculator for laptops and desktop computers is easy to use yet powerful, and comes in two variations.

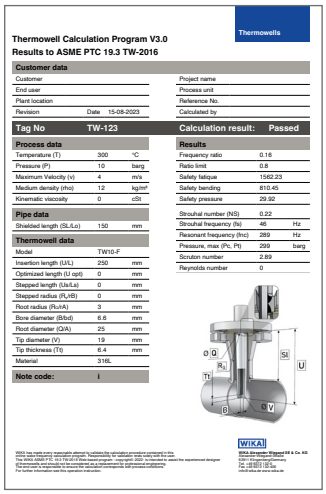
Single calculation

The simplified yet fully functional version calculates the suitability of a single thermowell according to ASME PTC 19.3 TW-2016. After entering the requested data for the process and thermowell, click the "Calculate" button to see all the most important results. (The information displayed is exactly the same as in the old Excel version.)



The dynamic results comprise the frequency ratio as well as the safety factor for flexural fatigue stress, while the static results are the safety factors for bending stress and the pressure load on the thermowell.

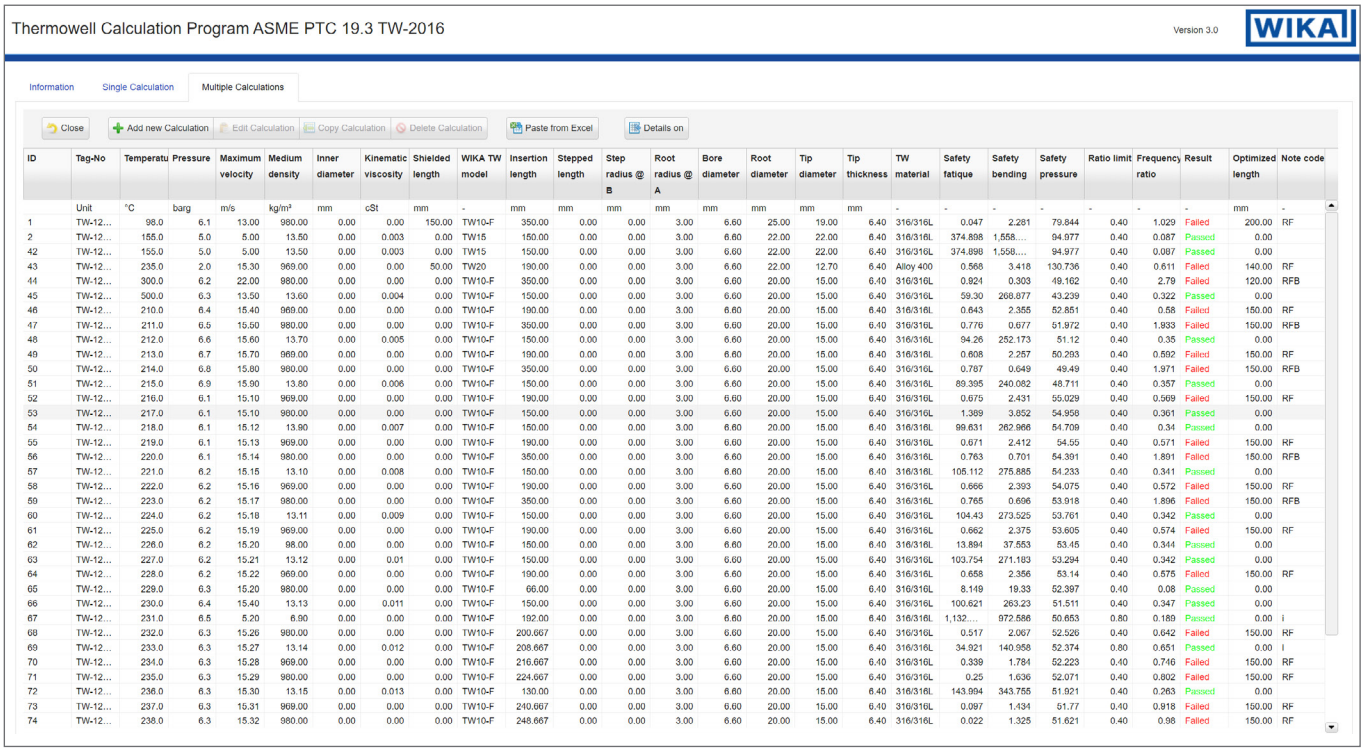
The thermowell is also depicted as a 3D rendering with all the proposed dimensions. To save and share the results, simply click on the "PDF" button to download it. The one-page PDF also includes results not shown on the webpage, such as Strouhal number, Strouhal and resonant frequencies, maximum permissible pressure load, Scruton number, and Reynolds number. Note that this simplified calculator offers the most common materials and calculation results.



Multiple calculations

The full version of the software has the same algorithm and features as the simplified version, but allows users to calculate an almost limitless number of thermowells. Here are the steps:

1. Register and verify the account.
2. Enter thermowell data directly in the webpage calculation form, or use a spreadsheet with all the requested process data and thermowell data in the same order as the online calculator. If using a spreadsheet, copy the data then paste it into the online calculator.
3. Calculations are carried out automatically upon input, and displayed in a table with "passed" or "failed" and all the data and calculations.
4. The calculations are stored in the user's account, with the choices of generating a PDF for each thermowell or exporting the entire table as an Excel file.



ID	Tag-No	Temperatu	Pressure	Maximum velocity	Medium density	Inner diameter	Kinematic viscosity	Shielded length	WIKA TW model	Insertion length	Stepped length	Step radius @ B	Root radius @ A	Bore diameter	Root diameter	Tip diameter	Tip thickness	TW material	Safety fatique	Safety bending	Safety pressure	Ratio limit	Frequency ratio	Result	Optimized length	Note code
	Unit	°C	barg	m/s	kg/m³	mm	cSt	mm	-	mm	mm	mm	mm	mm	mm	mm	mm	-	-	-	-	-	-	-	mm	-
1	TW-12...	98.0	6.1	13.00	980.00	0.00	0.00	150.00	TW10-F	350.00	0.00	0.00	3.00	6.60	25.00	19.00	6.40	316/316L	0.047	2.281	79.844	0.40	1.029	Failed	200.00	RF
2	TW-12...	155.0	5.0	5.00	13.50	0.00	0.003	0.00	TW15	150.00	0.00	0.00	3.00	6.60	22.00	22.00	6.40	316/316L	374.898	1,558....	94.977	0.40	0.087	Passed	0.00	
42	TW-12...	155.0	5.0	5.00	13.50	0.00	0.003	0.00	TW15	150.00	0.00	0.00	3.00	6.60	22.00	22.00	6.40	316/316L	374.898	1,558....	94.977	0.40	0.087	Passed	0.00	
43	TW-12...	235.0	2.0	15.30	969.00	0.00	0.00	50.00	TW20	190.00	0.00	0.00	3.00	6.60	22.00	12.70	6.40	Alloy 400	0.566	3.418	130.736	0.40	0.611	Failed	140.00	RF
44	TW-12...	300.0	6.2	22.00	980.00	0.00	0.00	0.00	TW10-F	350.00	0.00	0.00	3.00	6.60	20.00	15.00	6.40	316/316L	0.924	0.303	49.162	0.40	2.79	Failed	120.00	RFB
45	TW-12...	500.0	6.3	13.50	13.60	0.00	0.004	0.00	TW10-F	150.00	0.00	0.00	3.00	6.60	20.00	15.00	6.40	316/316L	59.30	266.877	43.239	0.40	0.322	Passed	0.00	
46	TW-12...	210.0	6.4	15.40	969.00	0.00	0.00	0.00	TW10-F	190.00	0.00	0.00	3.00	6.60	20.00	15.00	6.40	316/316L	0.643	2.355	52.851	0.40	0.58	Failed	150.00	RF
47	TW-12...	211.0	6.5	15.50	980.00	0.00	0.00	0.00	TW10-F	350.00	0.00	0.00	3.00	6.60	20.00	15.00	6.40	316/316L	0.776	0.677	51.972	0.40	1.933	Failed	150.00	RFB
48	TW-12...	212.0	6.6	15.60	13.70	0.00	0.005	0.00	TW10-F	150.00	0.00	0.00	3.00	6.60	20.00	15.00	6.40	316/316L	94.26	252.173	51.12	0.40	0.35	Passed	0.00	
49	TW-12...	213.0	6.7	15.70	969.00	0.00	0.00	0.00	TW10-F	190.00	0.00	0.00	3.00	6.60	20.00	15.00	6.40	316/316L	0.608	2.257	50.293	0.40	0.592	Failed	150.00	RF
50	TW-12...	214.0	6.8	15.80	980.00	0.00	0.00	0.00	TW10-F	350.00	0.00	0.00	3.00	6.60	20.00	15.00	6.40	316/316L	0.787	0.649	49.49	0.40	1.971	Failed	150.00	RFB
51	TW-12...	215.0	6.9	15.90	13.80	0.00	0.006	0.00	TW10-F	150.00	0.00	0.00	3.00	6.60	20.00	15.00	6.40	316/316L	89.395	240.082	48.711	0.40	0.357	Passed	0.00	
52	TW-12...	216.0	6.1	15.10	969.00	0.00	0.00	0.00	TW10-F	190.00	0.00	0.00	3.00	6.60	20.00	15.00	6.40	316/316L	0.675	2.431	55.029	0.40	0.569	Failed	150.00	RF
53	TW-12...	217.0	6.1	15.10	980.00	0.00	0.00	0.00	TW10-F	150.00	0.00	0.00	3.00	6.60	20.00	15.00	6.40	316/316L	1.389	3.852	54.956	0.40	0.361	Passed	0.00	
54	TW-12...	218.0	6.1	15.12	13.90	0.00	0.007	0.00	TW10-F	150.00	0.00	0.00	3.00	6.60	20.00	15.00	6.40	316/316L	99.631	262.966	54.709	0.40	0.34	Passed	0.00	
55	TW-12...	219.0	6.1	15.13	969.00	0.00	0.00	0.00	TW10-F	190.00	0.00	0.00	3.00	6.60	20.00	15.00	6.40	316/316L	0.671	2.412	54.55	0.40	0.571	Failed	150.00	RF
56	TW-12...	220.0	6.1	15.14	980.00	0.00	0.00	0.00	TW10-F	350.00	0.00	0.00	3.00	6.60	20.00	15.00	6.40	316/316L	0.763	0.701	54.391	0.40	1.891	Failed	150.00	RFB
57	TW-12...	221.0	6.2	15.15	13.10	0.00	0.008	0.00	TW10-F	150.00	0.00	0.00	3.00	6.60	20.00	15.00	6.40	316/316L	105.112	275.885	54.233	0.40	0.341	Passed	0.00	
58	TW-12...	222.0	6.2	15.16	969.00	0.00	0.00	0.00	TW10-F	190.00	0.00	0.00	3.00	6.60	20.00	15.00	6.40	316/316L	0.666	2.393	54.075	0.40	0.572	Failed	150.00	RF
59	TW-12...	223.0	6.2	15.17	980.00	0.00	0.00	0.00	TW10-F	350.00	0.00	0.00	3.00	6.60	20.00	15.00	6.40	316/316L	0.765	0.696	53.918	0.40	1.896	Failed	150.00	RFB
60	TW-12...	224.0	6.2	15.18	13.11	0.00	0.009	0.00	TW10-F	150.00	0.00	0.00	3.00	6.60	20.00	15.00	6.40	316/316L	104.43	273.525	53.761	0.40	0.342	Passed	0.00	
61	TW-12...	225.0	6.2	15.19	969.00	0.00	0.00	0.00	TW10-F	190.00	0.00	0.00	3.00	6.60	20.00	15.00	6.40	316/316L	0.662	2.375	53.605	0.40	0.574	Failed	150.00	RF
62	TW-12...	226.0	6.2	15.20	98.00	0.00	0.00	0.00	TW10-F	150.00	0.00	0.00	3.00	6.60	20.00	15.00	6.40	316/316L	13.894	37.553	53.45	0.40	0.344	Passed	0.00	
63	TW-12...	227.0	6.2	15.21	13.12	0.00	0.01	0.00	TW10-F	150.00	0.00	0.00	3.00	6.60	20.00	15.00	6.40	316/316L	103.754	271.183	53.294	0.40	0.342	Passed	0.00	
64	TW-12...	228.0	6.2	15.22	969.00	0.00	0.00	0.00	TW10-F	190.00	0.00	0.00	3.00	6.60	20.00	15.00	6.40	316/316L	0.658	2.356	53.14	0.40	0.575	Failed	150.00	RF
65	TW-12...	229.0	6.3	15.20	980.00	0.00	0.00	0.00	TW10-F	66.00	0.00	0.00	3.00	6.60	20.00	15.00	6.40	316/316L	8.149	19.33	52.397	0.40	0.08	Passed	0.00	
66	TW-12...	230.0	6.4	15.40	13.13	0.00	0.011	0.00	TW10-F	150.00	0.00	0.00	3.00	6.60	20.00	15.00	6.40	316/316L	100.621	263.23	51.511	0.40	0.347	Passed	0.00	
67	TW-12...	231.0	6.5	5.20	6.90	0.00	0.00	0.00	TW10-F	192.00	0.00	0.00	3.00	6.60	20.00	15.00	6.40	316/316L	1,132....	972.586	50.653	0.80	0.189	Passed	0.00	i
68	TW-12...	232.0	6.3	15.26	980.00	0.00	0.00	0.00	TW10-F	200.667	0.00	0.00	3.00	6.60	20.00	15.00	6.40	316/316L	0.517	2.067	52.526	0.40	0.642	Failed	150.00	RF
69	TW-12...	233.0	6.3	15.27	13.14	0.00	0.012	0.00	TW10-F	208.667	0.00	0.00	3.00	6.60	20.00	15.00	6.40	316/316L	34.921	140.958	52.374	0.80	0.651	Passed	0.00	i
70	TW-12...	234.0	6.3	15.28	969.00	0.00	0.00	0.00	TW10-F	216.667	0.00	0.00	3.00	6.60	20.00	15.00	6.40	316/316L	0.339	1.784	52.223	0.40	0.746	Failed	150.00	RF
71	TW-12...	235.0	6.3	15.29	980.00	0.00	0.00	0.00	TW10-F	224.667	0.00	0.00	3.00	6.60	20.00	15.00	6.40	316/316L	0.25	1.636	52.071	0.40	0.802	Failed	150.00	RF
72	TW-12...	236.0	6.3	15.30	13.15	0.00	0.013	0.00	TW10-F	130.00	0.00	0.00	3.00	6.60	20.00	15.00	6.40	316/316L	143.994	343.755	51.921	0.40	0.263	Passed	0.00	
73	TW-12...	237.0	6.3	15.31	969.00	0.00	0.00	0.00	TW10-F	240.667	0.00	0.00	3.00	6.60	20.00	15.00	6.40	316/316L	0.097	1.434	51.77	0.40	0.918	Failed	150.00	RF
74	TW-12...	238.0	6.3	15.32	980.00	0.00	0.00	0.00	TW10-F	248.667	0.00	0.00	3.00	6.60	20.00	15.00	6.40	316/316L	0.022	1.325	51.621	0.40	0.98	Failed	150.00	RF

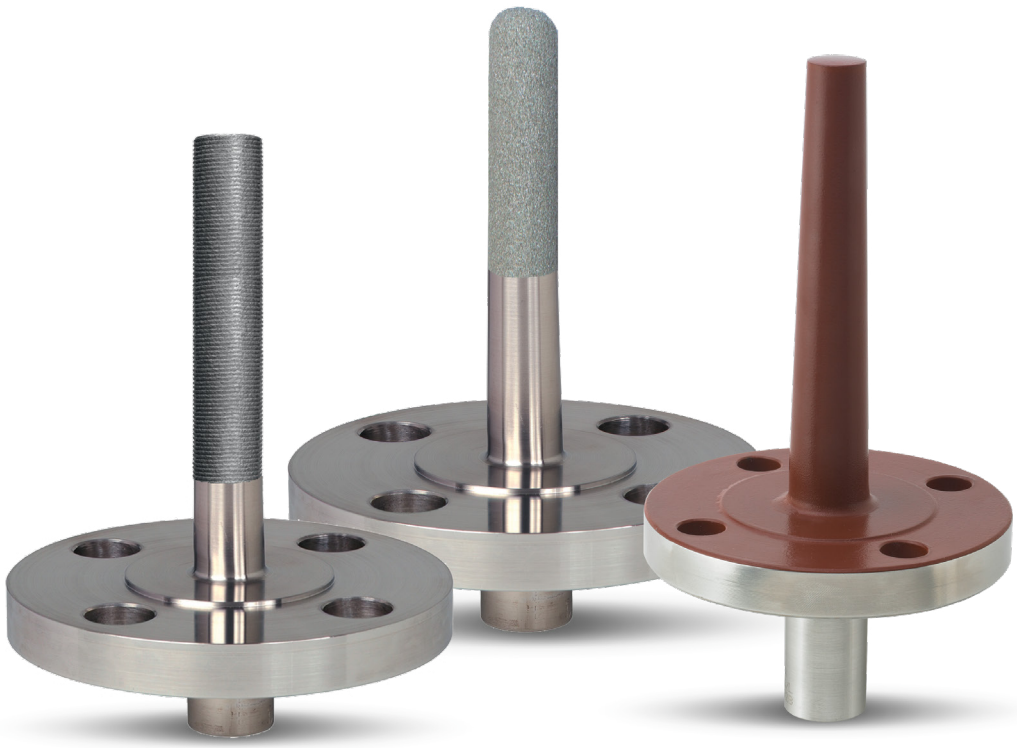
Powerful features

The full version of the WFC is filled with options:

- All stem designs within the scope of ASME PTC 19.3 TW-2016 (tapered, straight, stepped) can be calculated in combination with any type of process connection (flanged, threaded, welded, Vanstone).
- Users can select either metric or imperial units, or a mixture of the two.
- In the database are more than 60 materials with stored data in accordance with ASME BPVC Section II Part D, and we are adding more upon request. Like the single-calculation version, users can select the material based on its ASTM designation, UNS number, DIN number, or standard international designation.
- The hover (mouseover) function displays helpful information, such as explanatory text and detailed description of software features.
- When any input values are outside the ASME PTC 19.3 design specifications, they appear on a shaded background.
- In the event a thermowell calculation fails the thresholds for safety, the program provides a note code and recommends an optimized insertion length. Users can then modify that thermowell's specs and perform another calculation.

WIKA, Smart in Sensing

With so many variables and options, choosing and designing thermowells can be a daunting process. Contact the temperature specialists at WIKA USA for expert assistance in getting the right temperature sensors and thermowells for your unique industrial applications.



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