

## Significant Figures

### How to determine?

How do you determine significant figures in a number? The significant figures are digits used to establish the value of the number. Zeros shown to merely locate the decimal (regardless if the decimal is shown) are typically not included as significant. Examples:

Number	Significant figures	Zero's:		Number	Significant figures	Zero's:
7000	1	Locates decimal		7001	4	Significant
$7 \times 10^3$	1	None		0.2300	4	Significant
$7.00 \times 10^3$	3	Significant		0.0023	2	Locates decimal
7.000	4	Significant		1.0023	5	Significant

### What do they mean?

Since virtually all numbers used in engineering are based on measurements, they have inherent uncertainty. The number of significant figures implies the magnitude of that uncertainty. Reporting the weight of an object as 4572 pounds implies an uncertainty on the order of a few pounds. Reporting the weight as 4570 pounds implies an uncertainty on the order of a few 10's of pounds.

### How good is good enough?

No number is perfect, only "good enough." Typically, in mechanical and civil engineering, 2 or 3 significant figures would be appropriate. RARELY, does an engineer work with more precision than that! To illustrate how precise a number with three significant figures is, consider two numbers (3 sig figs, compared to 8 sig figs): 12,300,000 and 12,345,678. Compare the difference between these:

$$(12,345,678 - 12,300,000) / 12,345,678 = 0.0037 = 0.37 \%$$

These numbers differ by less than one-half of one percent! I challenge you to think of anything designed by mechanical or civil engineers where everything is known to a higher degree of accuracy than 1 percent.

### So what? Who cares?

What does it hurt to report a number with excessive significant figures? First of all, it shows that the engineer doesn't understand what numbers are. Numbers are merely our way of quantifying the world. As measurements are never perfect, numbers used in engineering are **NEVER** perfect! Don't fool yourself. Engineers must recognize and acknowledge uncertainty. False confidence is evil! Avoid it! Excessive significant figures communicate a level of precision that is not present. Miscommunication is evil! Avoid it!