Functions, prefixes, and Algebraic Operators

Use Equations and Parameters

You can use equations wherever you can enter a numeric value. For example, you can write equations in the Edit Dimensions dialog box, feature dialog boxes, and the Parameters dialog box. Equations can vary in complexity, and you can use them to calculate feature sizes, calculate assembly constraints offsets or angles, or simulate motion among several components.

Equations can be simple or contain many algebraic operators, prefixes, and functions. For example, here is a simple equation:

2 ul * (6 + 3)

The following complex equation uses internal parameters such as pi:

PI rad / 5 ul + 25 deg * (PI rad / 180 deg)

Algebraic operators

Operator	Meaning
+	addition
-	subtraction
%	floating point modulo
*	multiplication
/	division
^	power
(	expression delimiter
)	expression delimiter
;	delimiter for multi-argument functions. **Note:** Comma was not used because it would conflict with floating point decimal delimiter ("." vs ",") in European countries.

Order of operations

Edit boxes use the algebraic order of operations, shown in the following table in descending precedence.

Operation	*Symbol*	*Example*
parenthesis	( )	(sin(15 deg))
exponentiation	^	width^2

negation (unary subtraction)	-	(-2.00 + length)
multiplication or division	* or /	sin(pi/4 rad) or (0.5 * base * height)
addition or subtraction	+ or -	(-2.00 + height - 0.35 * base)

Syntax

The edit box uses the units specified in the default document properties. If you do not specify units in an edit box, terms and coefficients are assigned default units. An expression is evaluated according to the algebraic order of operations and default unit values.

If an expression contains syntax errors, they are shown in red. If no syntax errors are found, the characters are shown in black.

Syntax errors

Exponents are applied to units as well as the expression, as shown in this example.

2 + 3^3

The edit box assigns default units to all terms unless a unit is specified. The results are in error because dissimilar units cannot be added: 2 mm + (3 mm)^3ul is evaluated as 2 mm + 27 mm^3. Because the units are ambiguous, the expression is shown in red to indicate an error.

Including units and specifying which units are unitless results in the correct evaluation: 2 mm + ((3 ul) ^ 3 ul) * 1 mm.

Typecasting

The edit box does not allow assignment of units to an expression. The following example is not permitted:

(-2.00 + 3^3) m^2

Unit evaluation

Units are evaluated before the arithmetic portion of an expression. Therefore, the power operator applies to a unit before it applies to an adjacent numeric value. For example:

2 m^2

does not evaluate to 4 square meters, but rather means 2 square meters. The correct syntax is:

(2 m)^2 = 4 m^2

Correct syntax

In expressions, assign a unit to each numerical value in the expression. The following expression is in error because the system expects default units:

(2 + 1 * (3^2))

Use "ul" to indicate a unitless value: 2 mm + 1 mm * (3ul^2ul).

When entering an angle, the default unit is degrees. To enter radians, use this syntax:

(-0.25 deg * 3.1415 rad/180 deg) + (2ul * 3.1415 ul) * 1 rad

Units

Autodesk Inventor supports many unit types. This partial list shows some common units. The unit types may be used in all uses where a parameter may be entered, such as equations.

Tip: The complete list of unit types is shown in the Parameters dialog box. When adding a user parameter, click Manage tab ▶ Parameters panel ▶ Parameters to open the Parameters dialog box. Click in the Units column of any parameter to see the list of available units.

Length

millimeter (mm)	centimeter (cm)	meter (m)	inch (in)
foot (ft)	micron	nauticalMile	mil

Mass

gram (g)	lbmass	slug	ouncemass

Time

second (s)	hour (hr)	minute (min) ("min" might conflict with milli-inch)

Temperature

Kelvin (K)	Celsius (C)	Fahrenheit (F)

Angularity

radian (rad)	degree (deg)	grad	steradian (sr)

Velocity

meters / second (mps)	feet / second (fps)	miles / hour (mph)	revolutions / minute (rpm)

Area

circular_mil

Volume

liter (l)	gallon (gal)

Force

newton (N)	dyne	lbforce	ounceforce

Pressure

pascal (Pa)	psi	ksi

Power

watt (W)	horsepower (hp)

Work

joule (J)	erg	calorie (cal)	btu

Unitless

unitless (ul)

Electrical

ampere (A)	volt (V)	ohm	coulomb (C)
farad (F)	gamma	gauss	henry (H)
hertz (Hz)	maxwell	mho	oersted
siemens (S)	tesla (T)	weber (Wb)	

Luminosity

candela (cd)	lumen (lm)	lux (lx)

Substance

mole

Unit Prefixes

Autodesk Inventor supports the following prefixes:

Text	*Symbol*	*Factor*
exa	E	1.0e18
peta	P	1.0e15
tera	T	1.0e12
giga	G	1.0e9
mega	M	1.0e6
kilo	k	1.0e3
hecto	h	1.0e2
deca	da	1.0e1
deka	da	1.0e1
deci	d	1.0e-1
centi	c	1.0e-2
milli	m	1.0e-3
micro	micro	1.0e-6
nano	n	1.0e-9
pico	p	1.0e-12
femto	f	1.0e-15
atto	a	1.0e-18

Prefix symbols are case sensitive. Enter them exactly as they appear in the previous table.

Functions

The following functions may be used in edit boxes.

Syntax	*Return Type*	*Expected Types*
cos(expr)	unitless	angle
sin(expr)	unitless	angle
tan(expr)	unitless	angle
acos(expr)	angle	unitless
asin(expr)	angle	unitless
atan(expr)	angle	unitless
cosh(expr)	unitless	angle
sinh(expr)	unitless	angle
tanh(expr)	unitless	angle

acosh(expr)	angle	unitless
asinh(expr)	angle	unitless
atanh(expr)	angle	unitless
sqrt(expr)	unit^1/2	any
sign(expr)	unitless	any - Return 0 if negative, 1 if positive
exp(expr)	unitless	any - Return exponential power. For example, exp(1 ul) returns 2.718282, or *e*.
floor(expr)	unitless	unitless - Next lowest whole number
ceil(expr)	unitless	unitless - Next highest whole number
round(expr)	unitless	unitless - Closest whole number
abs(expr)	any	any
max(expr1;expr2)	any	any
min(expr1;expr2)	any	any
ln(expr)	unitless	unitless
log(expr)	unitless	unitless
pow(expr1; expr2)	unit^expr2	any, and unitless respectively Can construct unit valid equation that can go invalid "pow(3.0; d12)". Decimal powers rounds at eighth decimal place.
random()	unitless	unitless
isolate(expr;unit;unit)	any	any

Note: Function names are case sensitive. Enter them exactly as they appear in the previous table.
<Also, these don't necessarily match the functions in iLogic.>

Reserved system parameters

Parameter	*Value*
PI	3.14159265358979323846264338328
E	2.71828182845904523536

Unit Types

The unit type that you use with an equation depends on the type of data that you are evaluating. For example, to evaluate a linear or angular value, you typically use a unit type of millimeters, inches, or degrees (mm, in, or deg).

Some equations must return a unitless value, for example, an equation to solve the number of occurrences in a pattern. You designate a unitless value with the characters ul. For example, 5 ul means that the equation has been evaluated and returned the number 5, as in the number of occurrences in a pattern.

Note: Keep units consistent within equations containing parameters that represent different unit types. You can do this using the Isolate function. For example, to calculate the number of occurrences for a pattern that is based on one occurrence for each unit of a parameter named Width, your linear equation would be:

isolate(Width;mm;ul)

The number of occurrences value in a dialog box requires a unitless (ul) result, but you are referencing the unit width, which is a linear value. Convert the Width parameter to a unitless value.

Source:

http://wikihelp.autodesk.com/Inventor/enu/2012/Help/0073-Autodesk73/0733-Design_O733/0736-Paramete736