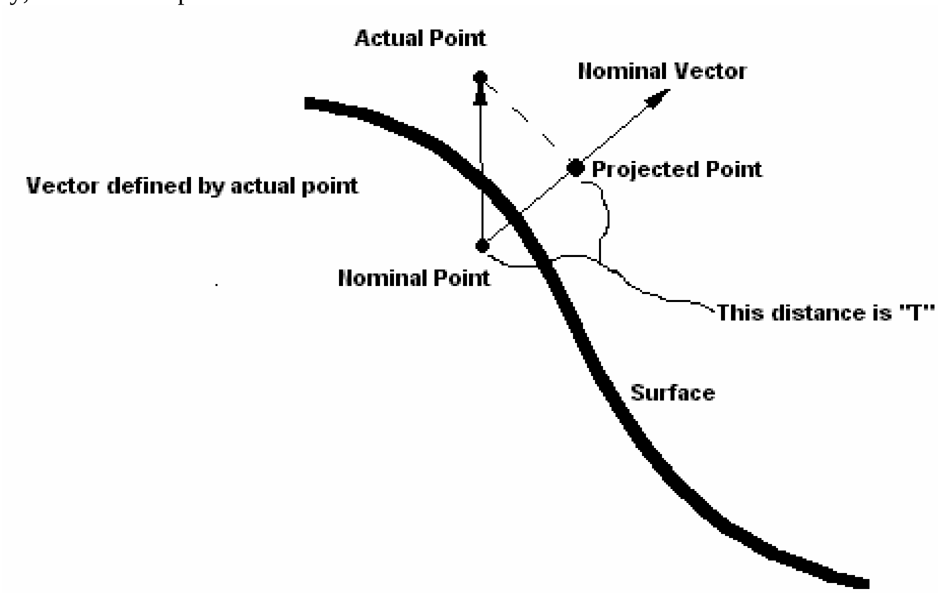
T Value

T represents deviation along a vector. It is quite simply a distance with a nominal value of zero. It is found by projecting a measured point onto a surface normal vector (the "nominal vector") of the associated nominal point. The distance from this projected point to the nominal point is the T value.

Graphically, this can be represented as follows:



If you want to step through a T value by hand, this is what you need to do:

1) Collect your given values.

You will need the X, Y, and Z (x_n y_n z_n) of the nominal point, the I, J, K (i_n j_n k_n)of the nominal vector, and either the I, J, and K (i_a j_a k_a)of the vector defined by the actual point or the X, Y, and Z (x_a y_a z_a) of the actual point.

2) Find the vector defined by the actual point.

You can compute this vector as follows:

$$i_a = x_a - x_n$$
$$j_a = y_a - y_n$$
$$k_a = z_a - z_n$$

3) Unitize the normal vector (a.k.a. shorten its length to 1.0)

PC-DMIS for Windows is a kind and forgiving software package. If you acquired the normal vector from PC-DMIS, then it is already unitized and you need only do a name change...(i_n j_n k_n) becomes (i_u j_u k_u). You then can skip to step 4.

a) find the length of the normal vector

Add up the squares of the vector components and take the square root of that value:

$$length = \sqrt{i_n^2 + j_n^2 + k_n^2}$$

b) use the length to unitize the normal vector

Divide each vector component by the vector length to unitize the vector:

$$i_u = \frac{i_n}{length}$$

$$j_u = \frac{j_n}{length}$$

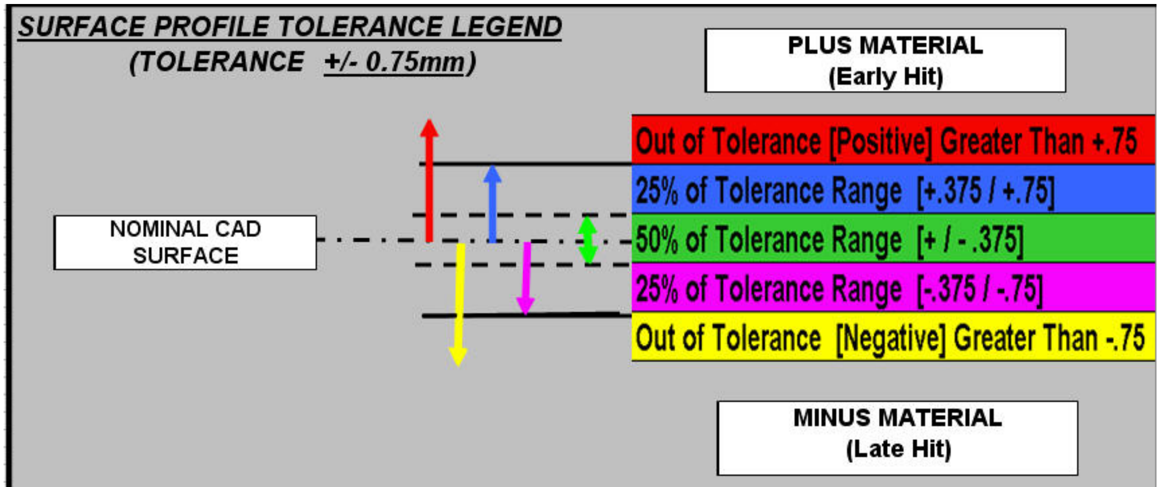
$$k_u = \frac{k_n}{length}$$

4) Project the vector defined by the actual point onto the unitized normal vector.

This is accomplished by computing a dot product of these two vectors. The final answer is a single number which is the T value. A dot product is obtained by multiplying the two *i* components, the two *j* components, and the two *k* components of the two vectors then adding them all together:

$$T = (i_u j_u k_u) \bullet (i_a j_a k_a) = (i_u \times i_a) + (j_u \times j_a) + (k_u \times k_a)$$

Assuming that the surface normal vector is pointing away from the surface on which the nominal point lies, a positive value of T means that the material is too “high” while a negative value of T means that the material is too “low”.



Note

1. An arrow starts from the CAD nominal surface and points to the location of the actual hit.
2. The above graphic applies for bi-lateral surface profile tolerance (form & location)
3. The deviation of individual points can be examined by viewing the scan report (.PDF) file.