



Inspecting Tightening Torque

3-1 Retightening Torque Methods
Retightening torque methods **46**

3-2 Proposal of New Retightening Method
Advanced retightening T-point method **47**

Inspection Method of Applied Torque

Inspecting Tightened Torque Value

Estimate how much torque was applied in the screw tightening, and carry out an inspection of the tightening operation with the following methods.

- Loosening Torque
- Retightening Torque
- Marking
- T-point

Table 3-1. Methods of inspecting the tightening torque

Method	Loosening Torque	Retightening Torque	Marking	T-Point
Measuring method	Loosen the bolt using a torque wrench and read the torque when the bolt starts moving.	Tighten the bolt further to determine the applied torque. Read the torque when the bolt starts moving again.	Mark the position of the tightened bolt, loosen it and read the torque when retightening it up to the marked position.	When continuing to tighten a bolt that has already been tightened with a torque wrench until the bolt begins to turn again, this torque value can be calculated by using the $\theta - t$ wave formula.
Measured torque/ Tightening torque = α	0.6 ~ 0.9 ※ (0.8)	0.9 ~ 1.2 ※ (1.05)	0.9 ~ 1.1 ※ (1.0)	0.9 ~ 1.1 ※ (1.0)
Advantages/ Disadvantages	Relatively easy to measure. It is necessary to retighten the bolt. Often used for sizes of M4 or less.	Accuracy is obtained if the point at which rotation begins is distinct. No further work is necessary after the inspection.	Takes time and labor. After the inspection, the bolt is maintained at its original torque.	Measurement will be most accurate when the test piece is secured. The bolt can be left 'as it is' after the inspection is complete and no individual variations will result.

α : Ratio between measuring torque and tightening torque

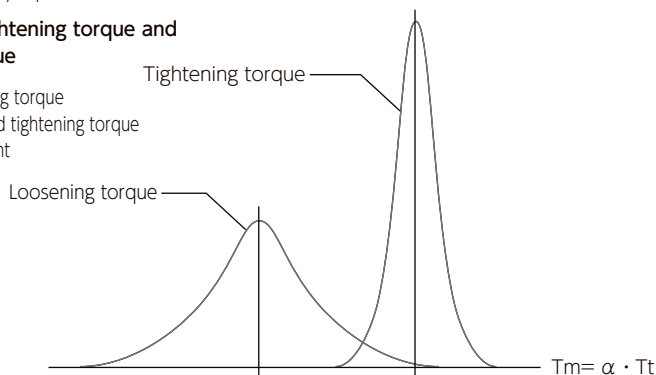
※ : Approximate value obtained by experiment

Figure 3-1. Variation of tightening torque and loosening torque

$$T_m = \alpha \cdot T_t$$

($T_m \neq T_t$)

T_m : Measuring torque
 T_t : Estimated tightening torque
 α : Coefficient



3-1 Retightening Torque Methods

Retightening torque methods

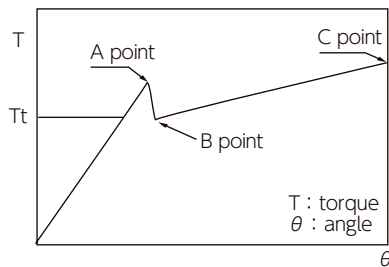
The retightening method requires that additional torque is applied to a bolt or screw which has already been tightened, and then measures the torque value when the bolt just begins to move again. In standard screws:

Point A: Torque when the static friction of the screw is exceeded.

Point B: Torque when screw starts to rotate continuously.

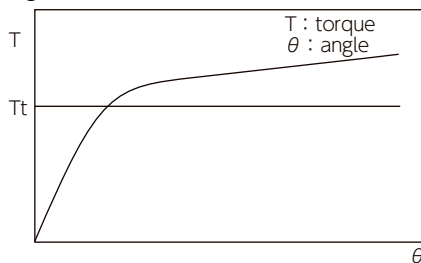
Point C: Maximum torque detected by inspection.

Figure 3-2. Typical torque change on retightening



These measuring methods are used according to the accuracy required.

Figure 3-3.



(1) A-point method

Measurement of the torque when a tightened bolt just begins to move again is relatively easy and there is no much the individual differences. But because this method measures the static friction torque, the value will be higher than the actually applied torque (T_t) and the variance is large and relation is low.

Sometimes the maximum value by static friction (A point) may not exist (Figure 3-3).

(2) B-point method

Technical experience is required to read the lowest peak on the retightening inspection and the reading accuracy is not very high, but the measuring value is close to the tightening torque (T_t). Sometimes a clear minimum torque may not exist.

(3) C-point method

Measurement is easy by checking the maximum torque using a memory pointer. But the measurement value may change considerably depending on the operator's sensation and where they stop when the screw starts turning, so individual interpretation and performance can be a large factor. Generally, tightening torque means the C point method. The C point may sometimes show the A point.

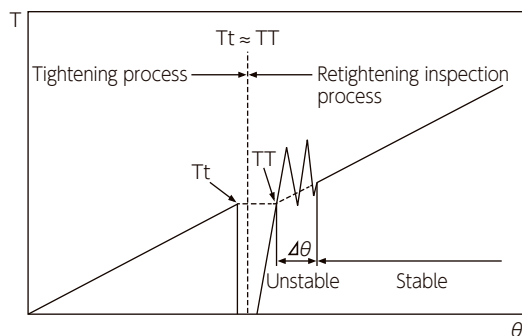
3-2 Inspecting Tightening Torque

Proposal of New Retightening Method

Advanced retightening T-point method

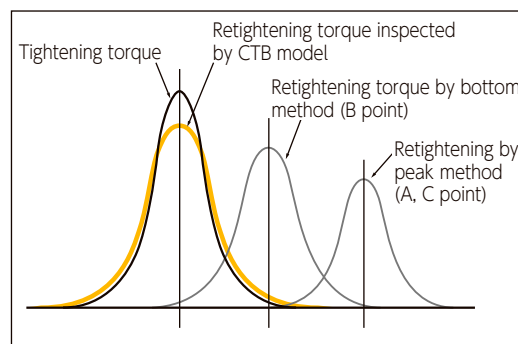
The retightening torque first starts with the rotation of the head only, and then causes the rotation of the screw, shifting from static friction to dynamic friction, before friction whip subsides to become a stable straight line. (Figure 3-4) Basically this straight line is an extension of the torque angle line figure obtained during the tightening.

Figure 3-4. New retightening method



Compared with the conventional A, B, and C point methods, the new retightening method (T-point method) will have less dispersion in the measurements, and in addition its central value will almost match the tightening torque. Unlike the A, B, and C point methods, compensation using offsets will not be required. The general offsets and dispersions of the tightening torque for each method in situations where there is no loosening or galling are shown in Figure 3-5.

Figure 3-5. Distribution of retightening torque



Strong Points

- Easy measurement operation.
- Less individual differences on result.
- Shorter operation time.
- Less dispersion on result.