

3. Inspecting Tightening Torque

3-1 Methods of Inspecting Tightening Torque

First, approximate how much torque was applied for the screw tightened and do an inspection of the tightening operation.

- Loosening Torque
- Retightening Torque
- Marking
- T point

$$T_m = \alpha \cdot T_t$$

T_m is not always equal to T_t .

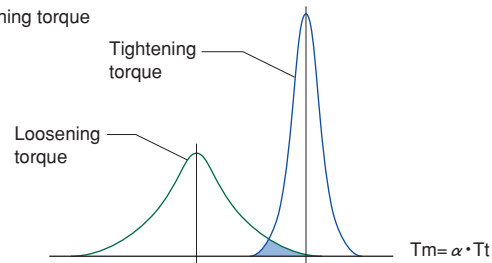
T_m : Measuring Torque
 T_t : Presumed Torque
 α : Coefficient

Table 3-1 Methods of inspecting tightening torque

| Method | Loosening Torque | Retightening Torque | Marking | T-Point |
|---|---|--|---|--|
| Measuring method | Loosen or breakaway the bolts by torque wrench and read the torque when the bolt starts moving. | Tighten a bolt further to determine an 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 re-tightened up to 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 θ -T wave formula. |
| Measured torque / Tightened 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 and disadvantage | Relatively easy to measure. It is necessary to retighten the bolt. | 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. | It can be measured with the most accuracy when the test piece is secured. The bolt can be left "as is" after the inspection is complete and no individual variations will result. |

α : Ratio between retightening torque and tightening torque
 ※: standard value

Variation of tightening torque and break away torque



3-2 Retightening Torque Method

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.

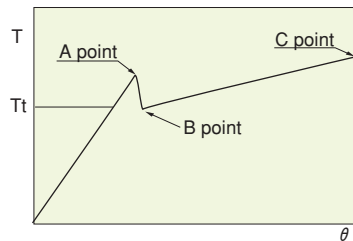
On the standard screw

- Torque to overcome against statistic friction of the screw (A point)
- Torque the screw starts to turn continuously (B point)
- Maximum torque for the inspection (C point)

These laws are used properly by necessary accuracy.

Typical torque change on retightening

Figure 3-1 Typical variation of retightening torque



① A point method

It is relatively easy to measure and is not affected so much by the personal interpretation or performance. But this method measures the torque value on statistic friction; the value will be higher than tightening torque (T_t) and relevance is not so clear. Sometimes maximum value on statistic friction may not exist for some screws.

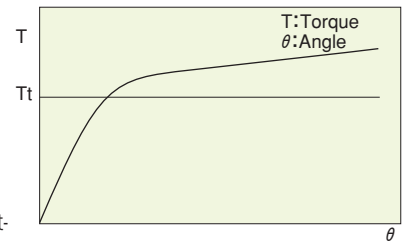
② B point method

Technical experience is necessary to measure this point. The retightening torque will reduce temporarily and the reading accuracy is not very high, but this value is the closest to the tightening torque (T_t). Sometimes a clear minimum torque may not exist for some screws.

③ C point method

It is easy to measure by checking maximum torque using a memory pointer. But the measurement value may change a lot depending on how the operator may feel and stop when the screw will start to turn, so personal interpretation and preference can be a large factor. Usually tightening torque vaguely means C point method. C point method sometimes shows A point method.

Figure 3-2



3-3 Proposal of New Retightening Method (Utilizing CTB series torque wrench)

For retightening, at first it will start with the rotation of head, and then will gradually cause the rotation of the screw, then move to statistic friction to dynamic friction, finishing friction whip and then will become a stable straight line. (Figure 3-3) Basically this line is an extension of the torque-angle line of tightening.

The torque (T_r) of the point of intersection on extension line of measurement torque - twisting angle line and retightening line of stable screw can be calculated by stable range torque, unstable angle ($\Delta\theta$), gradient of torque-angle ($dT/\alpha\theta$).

The torque (TT) of T point is close value to tightening torque (T_t).

The torque of T point is relatively stable and measurement of small measurement error ($\pm 5\%$) of tightening torque (T_t) can be achieved.

This new retightening method will use data in a more stable range, so the personal interpretation and performance factor involved in the measurement is less compared with conventional A, B, C point method.

Advantages of the New Retightening Method

- Anyone can measure the tightened torque
- No personal interpretation or performance variable involved in measuring the torque
- Requires less time to perform the measurement
- Dispersion of data is small.

Figure 3-3 New retightening method

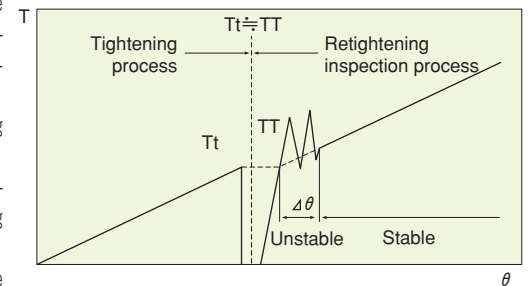


Figure 3-4 Distribution of retightening torque

