Torque Wrench Management and Loss Fees

Tohnichi Manufacturing's LC3-G Digital Torque Wrench Checkers (Discussion Paper)

For bolt tightening on an assembly line, tightening torque tolerance is ±1.5 N•m. If this range is exceeded, readjustment is required. The readjustment fee is $2. The torque of tightening should be checked with a torque wrench tester once a week (after every 15,000 tightening operations). The checking fee is $10. If the adjustment limit deviates by 0.5 N•m or more, we will adjust the device's setting scale, and the adjustment fee for this is $20. On average, adjustments should be made every 20,000 tightening operations. The margin of error for the torque meter used for checking is 0.1 N•m.

Question 1

Please tell me the appropriate checking intervals and adjustment limits for the current circumstances, to compare loss under current circumstances and loss under appropriate conditions.

Answer (example): See the reference material quoted below for details.

Adjustments and settings are performed within the following parameters.

A: NG (No Good) loss: $20, B: Fee for measuring product characteristic values: $10, C: Adjustment fee: $20

D_0: Adjustment limit for current circumstances: 0.5 N•m, n_0: Number of tightening operations between measurements, for current circumstances: Every 15,000 tightening operations, u_0: Number of tightening operations between adjustments, for current circumstances: Every 20,000 tightening operations

Δ: Torque device tolerance: ± 1.5 N•m, σ_m: Measuring device margin of error: 0.1 N•m

* Note: These conditions and calculations assume no delay in checking.

Recommended number of tightening operations between measurements (n):

$n = \sqrt{(2u_0 B/A)} \times \Delta/D_0 = 1{,}341$ tightening operations

Recommended adjustment limit (D):

$D = (3C/A \times D_0^2/u_0 \times \Delta^2)^{1/4} = 0.17$ N•m

Predicted value (u) for recommended intervals between measurements and adjustments:

$u = u_0(D^2/D_0^2) = 2{,}312$ tightening operations

Sum (L) for fees and loss associated with quality levels:

$L = B/n + C/u + A/\Delta^2 [D^2/3 + ((n + 1)/2 + I) D^2/u + \sigma_m^2]$

For current circumstance L_0, after calculating n_0, u_0 and D_0: **¢16.8**; whereas under recommended conditions (L): **¢4.1**

The difference (ΔL) is therefore **¢12.7**.

The above calculations assume no delay in checking.

On manufacturing lines today, it is fairly common to see torque wrench checks performed only once a month, or even once a year.

Those check intervals are too long. When intervals are as long as that, loss could be very large.

Therefore, an LC3-G Line Checker for performing checks at the beginning of work is required near the assembly line, in addition to the DOTE3-G torque wrench tester in the measurement room.

Reference material: Measurements, Quality Engineering Study Group 7, Quality Engineering Case Studies, Japanese Standards Association, 1990