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
D0: Adjustment limit for current circumstances: 0.5 N•m, n0: Number of tightening operations between measurements, for current circumstances: Every 15,000 tightening operations, u0: Number of tightening operations between adjustments, for current circumstances: Every 20,000 tightening operations
Δ: Torque device tolerance: ± 1.5 N•m, σm: 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_0B/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} = 0.17N•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 + l) 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.