New Concept of Screws Tightening Technology

by Jozef Dominik

Introduction

It is generally considered to determine the conditions for tightening the screws as the most important design decision. The low-tightened screw connection indicates namely latent danger of disintegration the whole structure and the excessive torque the brittle break or stripping of threads (Fig. 1). Tightening screw connections is a complex process that is dependent on many factors, for example on friction or on the tightening method. The accuracy of the tightening method is defined as the alfa factor αA:

$$\alpha A = FMmax/FMmin,$$

where FM – montage force

The smaller the αA, the more accurate the tightening (Table Nr. 1). The worst is the manual tightening. As shown in Figure 1 in this method using a popular and simply fork wrench according to DIN 911 only the diameters M8 – M12 give satisfactory results. Under M8 the screws are mostly weakly tightened and above the M12 are the screws lightly tightened. It is the result of a human factor failure. Of course, both of these cases are dangerous. More times was it reported in various Fastener Magazines.

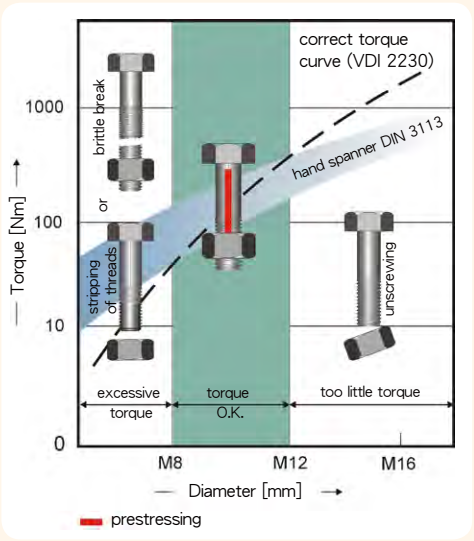

Fig. 1

Table Nr. 1

α_A	Scattering in %	Oversizing in %	Tightening method
1	±5 - ±12	0	Yield strength
1,2 - 1,8	±9 - ±23	20 - 60	Hydraulically
1,4 - 1,8	±17 - ±23	40 - 60	Torque wrench
2,5 - 4	±43 - ±60	150 - 300	per hand

The problem as such is consequently well known. But how to solve it in practice? Exact torque wrenching (Fig. 2) is a good idea but not universal solution. The problem is the high price of torque wrench and certain conservatism in the assembly and disassembly of commonly used screws by classic hand spanner according to DIN 3113 (Fig. 3).

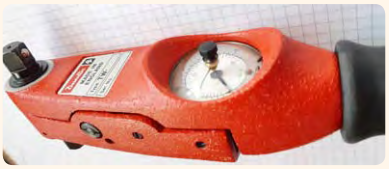

Fig. 2

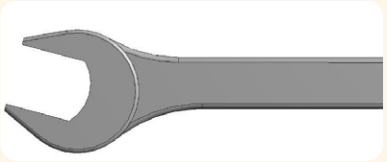

Fig. 3

To resolve this disproportion, it aims at an ambitious project, as is presented in the following text.

Principle of Smart Tightening of Screws

The principle of smart tightening of screws according to Ferodom is shown in Figures 4 and 5. The wrench DIN 3131 is cut by cuts 3 and 4. The length of the cut 4, the location of cut 3 and strength of material determine the size of the torque (s. FEM visualization in software ANSYS and INVENTOR on the Fig. 5).

Another variant of the embodiment for bigger torques suggests Fig. 6. Both versions achieve precision approximately at the level αA = 1,5 – 2. In particular, the version of Fig. 4 and 5 is advantageous because it allows the use of a conventional fork wrench. It has to be emphasized that smart wrenches require precise heat treatment, which modern furnaces with protective atmosphere allow. Each smart wrench must be marked with a symbol for size and strength for example M10 class 8.8.

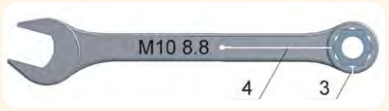

Fig. 4

Fig. 5

Fig. 6

Conclusion

The present submission outlines the essence of the Smart Screws Tightening project. Of course, the examples given here are not the only solutions. There are many other variants, so the development will continue to find the optimal option.

Those interested in the construction and manufacture of the tightening tool or bolting can join the team.

Review

"Screw connections are widely used in mechanical engineering. Correctly dimensioned and assembled, they mostly fulfill their function unnoticed for many years: To connect reliably several parts with each other. This function is particularly sensitive when screw connections are functionally integrated into safety-related components of machines, for example in load-bearing structures of machinery or in securing safety guards. The failure of these screw connections has already led to dangerous situations and serious accidents. Systematic cause research often revealed that the critical screws were not properly tightened and therefore failed. The solution presented in the article captivates by its simplicity and inevitably reliable mechanical effect. This amazingly simple solution whose wide application would increase the safety and reliability of machines."- Alfred Neudörfer, DE