BEFORE YOU START ASSEMBLY, PLEASE READ THE FOLLOWING USER GUIDE

1 Controlled torque assembly

Table 1. Values of the predicted tensioning from using torque in steps 1 and 2.

	M10	M12	M16	M20	M24
Step 1 [Nm]	30	50	120	240	350
Step 2 [Nm]	55	100	240	470	700
min. $F_{p.C}$ [kN]	28	40	75	118	145

1.1 Tightening – First step

a) Set the key to the torque value provided in "Step 1" in Table 1. (e.g. for the M16 bolt it is 120 [Nm]).

b) Step one of tightening must be carried out for all bolts in one connection before moving onto step two of tightening. Tightening order – see point 4.

1.2 Tightening – Second step

a) Set the key to the torque value provided in "Step 2" in Table 1 (e.g. for the M16 bolt it is 240 [Nm]).

b) Step one of tightening must be carried out for all bolts in one connection. Tightening order – see point 4.

*If you are installing a single set, you can skip step one.

2 Conditions to ensure thread self-locking

In threaded connections subjected to dynamic lateral force (e.g. as a result of wind), displacement of construction elements may occur. If the construction moves with every change in load, it means the friction between the connected elements is too low. In such a situation, the internal loosening torque causes the nut or bolt to turn with relation to each other, which leads to the connection getting loosened, and in the long term to the set coming apart. The internal loosening torque depends on the clamping force and the bolt pitch. The danger is most serious when assembling the connection took place in a chaotic manner without knowing what clamping force has already been created in the connection.

The solution to prevent this phenomenon is to create a higher pre-load in the connection, which will increase the friction resistance between the structural components and reduce the influence of the variable lateral force on the bolt.

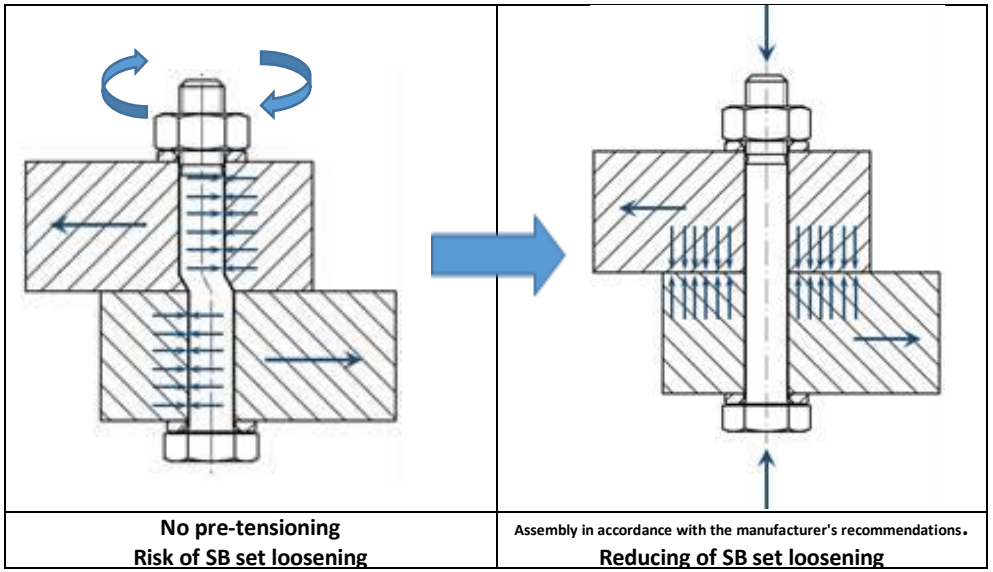


Fig. 1. Diagram showing the loosening of an SB set and the impact of the assembly according to the manufacturer's recommendation.

The most simple and least costly solution is to install the bolts correctly using torque as per the manufacturer's recommendation, which will increase thread self-locking and friction between the components. As shown in Fig. 1, without pre-load the set is prone to loosening, while after the load is added, the risk decreases. The self-locking occurs when the following condition is met: the apparent friction angle ***p'*** is greater than the helix angle ***γ***.

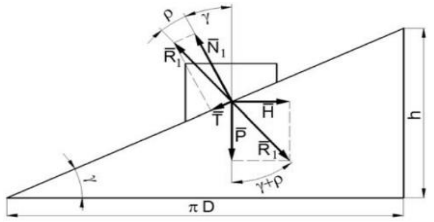


Fig. 2. Distribution of forces in a bolt thread.

3 Certificate 3.1 proving set quality – testing according to EN 15048:2007

The tests are carried out in bolt sets consisting of ISO 4014 or ISO 4017 bolts and ISO 4032 nuts. The test is used to determine the elongation of the bolt and nut set under load and to measure the force in the bolt set during the test. The test is carried out on a materials testing machine. The tests should be carried out on a minimum of 5 test SB sets. The test bolt sets should be arranged in the test set as shown in Fig. 3, so that the clamp length is the maximum available in practice. The end of the bolt should not protrude more than one pitch beyond the free surface of the nut.

Table 2. Minimum tensile load requirements in accordance with EN 15048-1:2007.

Thread	Nominal tension area $A_{saz,\,nom}$ mm²	Grade 8.8
		Minimum breaking tensile load ($A_{saz,\,nom} \times R_{m,\,min}$), w kN
M10	53,6	42,9
M12	84	70
M14	115	95,5
M16	157	130
M18	192	159
M20	245	203
M22	303	252
M24	353	293
M27	459	381
M30	561	466
M33	694	576
M36	817	678

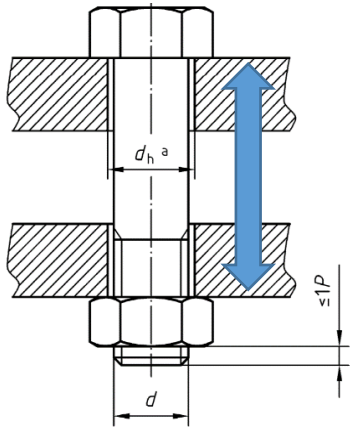


Fig. 3. Diagram of the tensile bolted connection test.

4 General provisions for the installation of SB sets in grade 8.8

a) For both the first and last cycles, tighten the bolts in sequence from the most rigid to the least rigid contact area, as shown in Fig. 4. More than one tightening cycle may be required to achieve even compression.

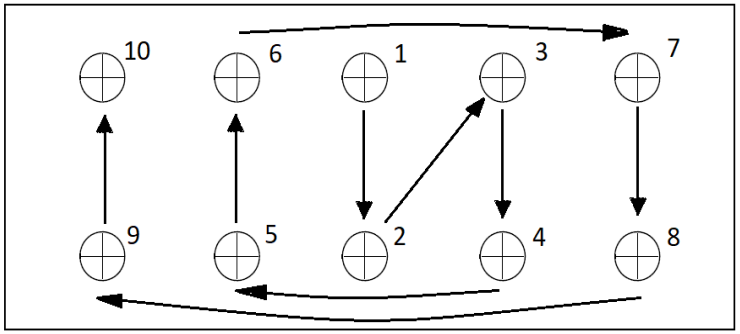


Fig. 4. Example of bolt tightening sequence in a connection.

b) This manual applies to SB sets supplied by Koelner Rawlplug IP.

c) SB sets should only be used in the provided set of bolts and nuts.

d) Before starting assembly, check the label of the SB set and the set properties certificate (certificate 3.1) with the requirements of EN 15048:2007 and confirm its conformity.

e) The set properties certificate (certificate 3.1) should include information on the tests of the set (test referred to in point 3), the mechanical properties of the bolt, the chemical composition of the bolt, including the steel melt and grade, the thickness of the zinc coating, and the test load of the nut.

f) The label of an SB set, as required by EN 15048:2007, should include:

- Set contents (e.g. M16),
- Number of the harmonised standard,
- Type, grade marking and product class,
- Identification number of the FPC and the last two digits of the year the certificate was issued,
- DoP number and FPC certificate number,
- The registered address of the manufacturer,
- Production batch number,
- Information on dangerous substances.

g) The preparation of holes according to EN 1090-2 is recommended.

h) The tightening is done by turning the nut or bolt head in the opposite direction to HV bolts.

PLEASE NOTE: additional lubrication of set components can be applied after consulting the supplier. Additional lubrication changes the friction coefficient values and affects the assembly torque.

Fig. 5. SB set label.

i) In SB connections, the thread projection measured from the nut head to the end of the mandrel should be no less than one thread pitch.

j) For connections using pads on both sides (Fig 6.), it is recommended that D should not exceed 1 [mm]. Where steel sealing plates are provided to ensure that the above limit is not exceeded, their thickness should be no less than 1 [mm]. In conditions of risk of crevice corrosion, a tighter contact fit is required. The thickness of steel plates must be chosen so that the number of spacers does not exceed three.

5 General guidelines for controlled torque assembly

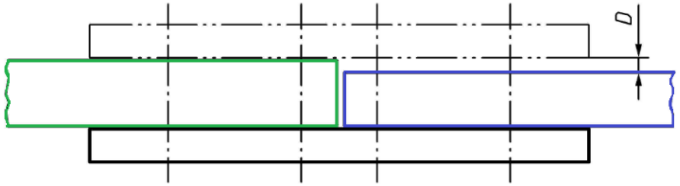


Fig. 6. The difference in part thickness in a connection with pads on both sides.

The following requirements must be met before assembly:

a) Follow the instructions in point 4.

b) Assemble using torque that is continuous and smooth. Do not interrupt installing a bolt until the set value on the wrench is reached.

c) Perform the two tightening steps.

d) Use the assembly torque values provided in Table 1.

5.1 Determining assembly torques

The recommended assembly torques were determined using a Kistler type machine (Fig. 7) designed to test the parameters and values achieved when assembling bolt connections. The test used stringent requirements for SB sets. Among other things, the yield point and maximum clamping force of the bolt connection were examined, as well as the resistance to elongation through the use of a high value of the additional angle. It is worth noting that for grade 8.8 bolts, the main purpose of the tests was to determine the recommended assembly torques to better protect the bolt from loosening. Observe the graph in Figure 8 for a clear point of yield point characteristic of 8.8 bolts. The next step of the test is to elongate the bolt by an additional rotation angle of as much as 400°, i.e. more than one complete turn of the nut after the yield point has been exceeded. Positive test results and graphs showing a stable change in clamping force from the angle of rotation prove product repeatability and its high quality thanks to bolt and nut thread fit, production material monitoring, correctly performed heat treatment, and the homogeneous structure of the zinc coating.

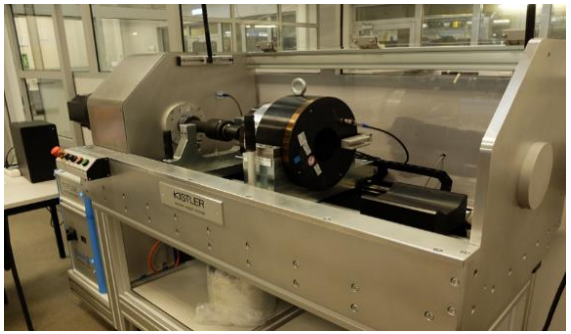
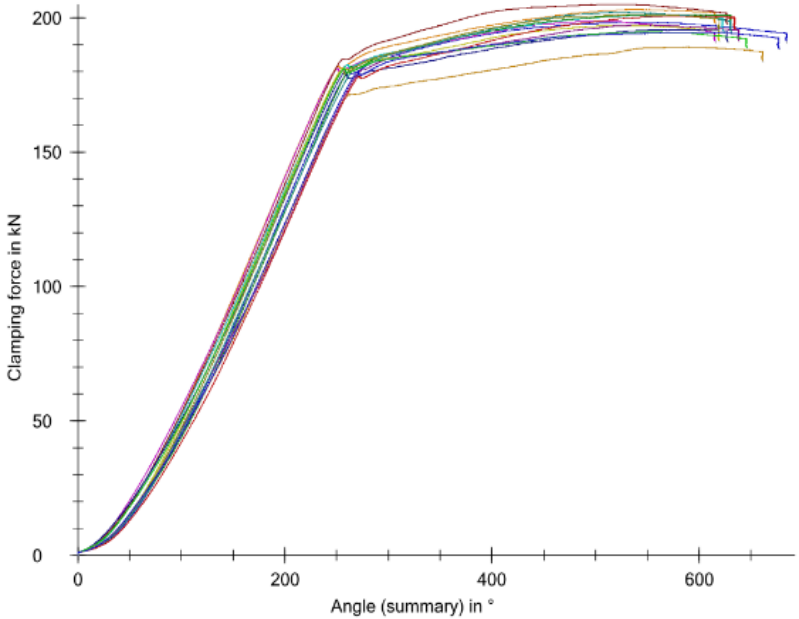


Fig. 7. Kistler type machine for thread connection testing.



6 Technical support

When buying out sets, you can count on support, research and technical consulting.

Contact: support.klfs@rawlplug.com [EN, PL]