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Press Release

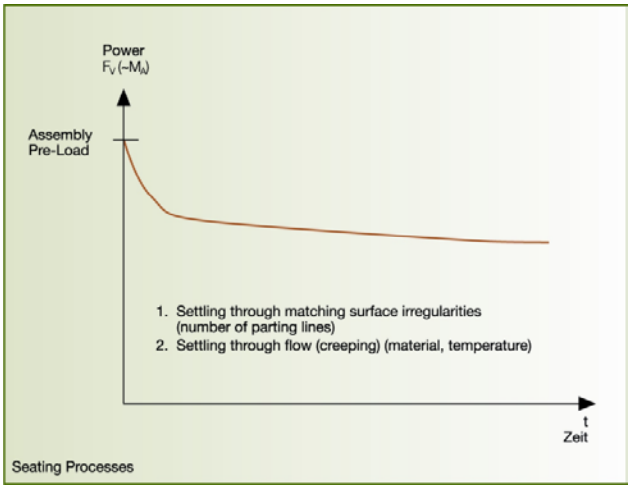
On the hunt for the correct torque!

What does a lipstick, a fridge, a light switch, and vehicle instruments have in common?

Screw joint analysis ensures correct fastening torque parameters

Almost everyone has used one - a lip balm stick that gives relief to cracked and dry lips. Twist the balm out of the practical rotating sleeve; apply balm onto the lips, done! What appears so easy can actually prove to be a brain-teaser for industrial production.

What happens if problems arise in the assembly of the lip balm's plastic components? What if the waste is produced time and again in the screw assembly of the lip balm casing? The error analysis on site may take weeks or even months. This is when a detailed screw joint analysis from the screwdriving specialists pays off.



In his laboratory for screw joint analysis, application engineer Rudolf Schmidbauer is holding three plastic parts in his hands: the casing, the piston, and the spindle for the lip balm. During assembly, the piston is first inserted into the casing. It is actually the second step that leads to most problems. This is what the company DEPRAG SCHULZ GMBH & CO is now about to examine carefully by means of the screw joint analysis ordered by the client: the spindle is screwed into the preset threaded hole of the piston until the snap-on connection to the casing closes. At the same

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time, the piston is inserted into the deepest position in the casing. The next step in the factory would be the filling of the assembled plastic tube with the lip balm and - sealing the tube.

But the question which really matters for the DEPRAG screw joint analysis is: Which is the ideal torque for the screw assembly of the plastic spindle into the pistons? And which rotation speed should be applied? What type of screwdriving tool best fits the task? Rudolf Schmidbauer explains: “In order to find out the best way to screw together a component, I have got to destroy it. I have to consciously apply excessive torque until screws or components are overstressed. Only in so doing, is it possible to determine the overload torque.”

The various DEPRAG screwdriving tools which are used for the laboratory tests are equipped with appropriate electronic measuring equipment and are thus capable of graphically depicting the screwdriving process on a display. By means of the recorded graph, the screwdriving specialist can precisely analyze the screw joint. The test is now repeated ten or twenty times - always with original components. At the end of this test series, after careful analysis, the results are made available for the manufacturer to see which screwdriving parameters and type of screwdriving tool are most suitable for this particular screw assembly task.

What is the difficulty with screw joints? In the technical world, the screw process is the only reversible process with respect to the connection of assembled components. After screw assembly, they can be used as if they were a single part, meeting the highest requirements. The purpose of the screw in this process is to clamp the components tightly together so that they cannot be shifted by external forces. The achieved force is called pre-tension. The screw assembly has to remain within the range of defined tolerance limits: On the one hand, the achieved pre-tension must be sufficient to keep the component together, while on the other hand the screw and component should not be damaged by over tightening.

However, direct methods for the measuring of the achieved pre-tension are not suitable for serial production. Therefore, the industry has to draw on indirect measuring means in screw assembly. Thus, the torque counts as the determining process value in the screwdriving process, as it behaves proportionally to the pre-tension. The angle of screw rotation is also used in the determination of the actually achieved pre-tension.

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The fastening of the screw causes friction, which depends on both the screw's geometry and the component's material. The friction changes the relationship between the torque and achieved pre-tension; it is one of the major unknown dimensions in the specification of the fastening parameters. The engineer in the laboratory gets to the bottom of it by loosening the screw and fastening it again. With the comparison of the torque's graph progression in the first and second screwdriving process, he can determine potential friction losses.

Application engineer Rudolf Schmidbauer also searches for possible seating movements in the screwdriving process. If, for instance, a silicon seal is to be fixed with four screws to a pump, the “seating” process of the silicon leads to a loss of pre-tension, even when 100% pre-tension may be expected due to the fastening torque. In practice, this means the pump leaks.

In such “soft screw assembly” cases the engineer first fastens the screw up to the determined fastening torque. “Seating movements can occur during the screwdriving process itself, some hours or several days later“, explains Rudolf Schmidbauer. Therefore after a certain time has passed, he refastens the screw again. The retightening now provides information about the seating movement and its effects on the pre-tension. “In such an event, it is likely that we would recommend carrying out the screwdriving process in two steps“, the screwdriving specialist tells us.

Let's consider the screw assembly task for refrigerator housings: Two pieces of sheet metal are to be screwed together, whose screw holes are however not exactly aligned with each other. At first, it requires a lot of torque from the screwdriver in order to bring the sheet metal pieces into alignment with each other, whereas the end phase of the screwdriving process, when the screw holes are aligned, requires a lower torque for the final screw tightening. Screw assembly with a constantly high torque, as in the initial phase of this application, would result in unintentionally reaching the destructive overload torque and screws or the sheet metal may be distorted. In this case, too, the screw joint analysis highlights the problem and defines a reliable set of parameters and sequences.

Screws which are designed to form a thread during the screwdriving process are subject to a similar law. During the thread forming process, the screw joint requires a higher prevailing torque and, when the head of the screw begins to clamp the materials, another parameter setting is required. If this is not considered in the screw assembly strategy, the screwdriving task will fail, components and/or the screw will be destroyed, and the desired pre-tension will not be achieved. The screw joint analysis derives the ideal fastening method. Example: For the installation of a plastic light switch two thread forming screws are used. First, the pneumatic screwdriver of the series SENSOMAT® assembles the screws with full motor torque, the shut-off function is activated only shortly before the head of the screw begins to clamp the parts together, and the intelligent pneumatic screwdriver shuts off at the desired torque range. DEPRAG Sales Manager Jürgen Hierold: “As well as the optimal fastening method, we are also able to recommend the most suitable tool to our customers”.

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Another example from experience: Rudolf Schmidbauer: “While some customers only come to us when screwdriving tasks are causing problems, other customers test their product design with us in advance”. A plastic casing is to be installed into a car's instrument display. The design consists of a rear panel, a printed circuit board, a front frame, and a display. The components are to be connected with eight screws. The customer wants to know: which torques do I need in order to install the components reliably? Furthermore, he is interested in learning more about the functional reliability of his design. Once built into the car, the instrument display should not rattle...

In the DEPRAG test laboratory, numerous boxes with components for the plastic housing can be found. After all, the analysis in the screwdriving laboratory requires ten to twenty component-destructive tests to find the correct fastening method. Rudolf Schmidbauer numbers and marks one of the components to be screw analyzed, he then takes pictures of the plastic housing for the documentation of the screw joint analysis, which is later handed over to the customer. Then he selects a suitable screwdriver, which is, in this case, a handheld pneumatic screwdriver. It is important that the screws used are original, unassembled parts too. These are plastic self-tapping screws 3.5 x 14 TXP 15.

Each screw assembly is recorded by means of a graph and evaluated. Rudolf Schmidbauer makes an unexpected discovery in his test series: although the screws and materials are identical, the results depending upon the screw position are different. The four external screws, which provide the connection of the front frame and the rear panel after the board has been inserted, reach the fastening torque at 1.10 Nm to 1.38 Nm. The four other screws used to attach the display require less, namely 0.96 Nm to 1.16 Nm to achieve the ideal pre-tension. Since both

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applications are to be carried out with one screwdriver, it makes sense to use the nominal torque of 1.10 Nm for both screwdriving processes. This is valuable information for the customer - now he is able to organize his production around this.

DEPRAG Sales Manager Jürgen Hierold summarizes the facts: “The screw joint analysis proves to be an economic solution when problems with screw assembly processes occur during assembly. Moreover, it requires relatively little time and cost to provide the best possible screwdriving parameter options and suitable screwdriving tools”.

With a large number of screw joint analyses conducted (1000 plus) DEPRAG SCHULZ GMBH & CO. with headquarters in Amberg, Germany possess a wealth of experience, containing almost every kind of screwdriving problem and from which it is time and again possible to derive individual solutions. The screwdriving specialists have 600 employees in over 50 countries and are, owing to their wide range of knowledge, a renowned contact in regards to screwdriving and measuring technology, automation, air motors, and air tools. With individual consultation, DEPRAG can also offer a wide range of testing tools and measurement equipment for the establishment of in-house measuring laboratories.

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