In today's multi-megawatt wind towers, various types of bolting equipment are used to tighten the thousand or more bolted connections in each wind tower. The time when most of these bolts need to be tightened is during the site installation, and the bolting equipment used requires generators and lifting equipment in order to be operated.

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RAD Torque Systems

Smart Bolting Tools for the Wind Power Industry

The two conventional bolting methods used in the wind industry are torque tightening with hydraulic wrenches at 700 bar and bolt tensioning (stretching the bolt with hydraulic cylinders at up to 2,000 bar pressure).

Both methods have their pros and cons but ultimately both systems apply a certain clamping load to the bolted joint. In general, most bolts in wind towers are torque-tightened with common size bolts such as M24, M36, M48, M56 and M64 requiring torque values from 2,000 up to 15,000NM.

Torque Tools

In recent years, high-torque bolting equipment in the wind industry has seen a shift from conventional hydraulic torque wrenches towards the use of electric torque wrenches based on multiplier gearbox technology.

The advantages for the wind industry are obvious; electric multipliers are up to five times quicker because of their continuous rotation and can have more features, such as angle of turn tightening, torque presets and data logging. Besides that there is no high oil pressure involved, which has always been a safety concern with hydraulic bolting equipment. However, they cannot be used everywhere as multiplier tools require more space above the joint so they do not always fit where hydraulic wrenches can fit. Fortunately in wind towers there are few problems with this as tower flanges and blade bolts (which account for most bolted connections) allow enough space for these tools.

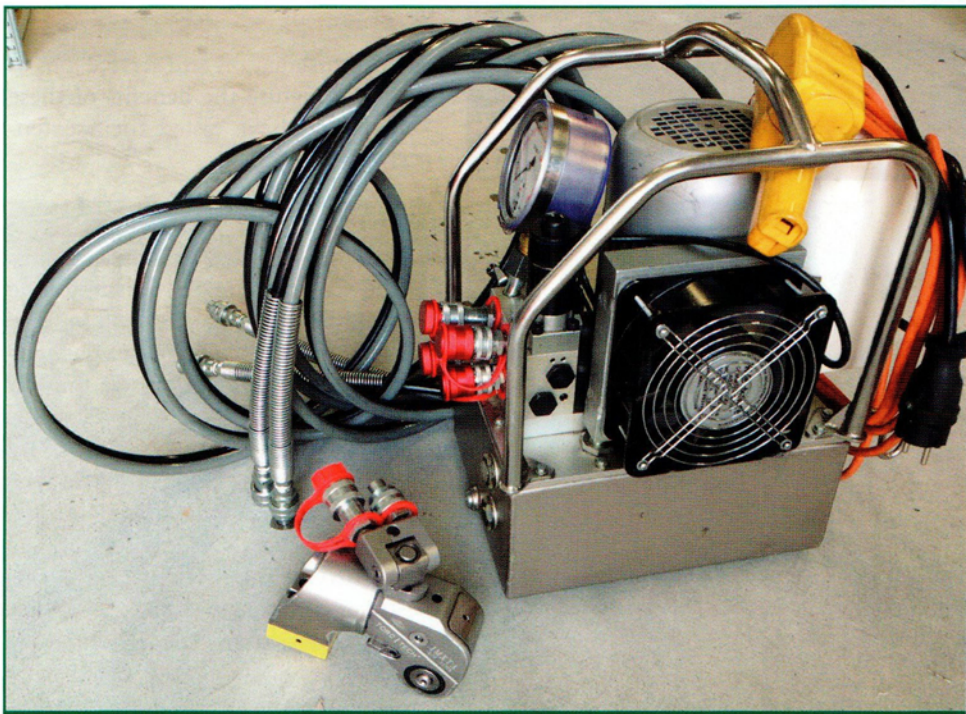

Figure 1. A conventional hydraulic torque wrench and pump system

In the past, electric multiplier wrenches have had a reputation of being unreliable and inaccurate in torque output and repeatability. In recent years, however, sturdier design and new technology have eliminated these concerns and now more advanced torque tools have entered the wind industry and are setting new bolting standards.

Smart Bolting Tools

All controlled bolting tools are calibrated on test benches that simulate a real-life bolted joint connection, which is set at a certain joint rate. The joint rate is commonly expressed in terms of soft, medium or hard joints. Faster-rotating tools are an especial problem because they have more dynamic inertia, which is absorbed by the fastener during the tightening process. Therefore, although the same amount of energy is used during the torque cycle, the actual torque applied to the fastener can deviate depending on the type

Figure 2. Tightening blade bolts – torque + angle of turn

Figure 3. Pass/fail indication on tool

Figure 4. RAD Smart Socket series

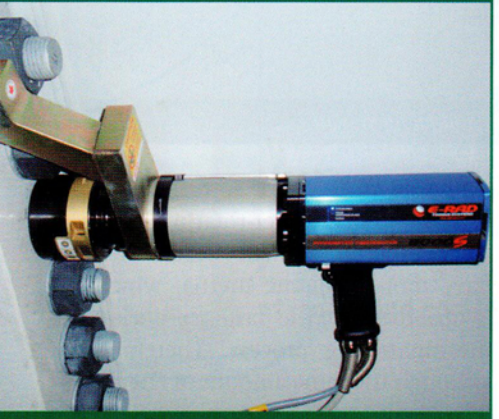

Figure 5. Tower flange – tightening M48 bolts at 6,500NM

of joint fastener being used.
Conventional torque tools cannot recognise the joint type and therefore will reproduce the torque based on the joint rate from the calibration bench on which they were calibrated.
Newer versions of electric (digital) multipliers work with sophisticated algorithms and built-in transducers to recognise the joint type and correct their output precisely accordingly and reach very high torque accuracy levels. Besides this, these digital torque tools work with torque values rather than a conversion chart value (X bar = X torque) so the torque can be set much more precisely because the value is set by typing it rather than by turning a valve towards a desired pressure gauge reading.
In recent years most major wind turbine manufacturers have approved the use of electric multiplier wrenches for installation and service jobs as they recognise the benefits of these tools and have tested them extensively in the field.

Smart Socket

Until recently, it was not easily possible to measure the exact torque applied on the actual bolted joint of the application but this has changed with the introduction of the so-called 'Smart Socket'.

Apart from the obvious LCD display, the Smart Socket resembles a normal impact socket as widely used in the industry. However, internally this socket is packed with high technology. Modern strain gauge technology enables the socket to measure very accurately the applied torque (to less than ±0.5% deviation). It displays the torque value on the LCD screen and is also able to communicate this via Bluetooth to an Android device or a computer. The socket itself can store about 750 logs in its internal memory.
The Smart Socket is therefore ideally suited for 'on-site' verification of the actual applied torques on the fasteners and to check if the bolting tools are set correctly for the job.

One Step Further

However, with the introduction of the E-RAD BLU, RAD Torque's latest electric torque wrench, this technology goes one step further. In this case the Smart Socket can be connected with the E-RAD BLU wrench via Bluetooth and communicates its precise measurements to the E-RAD BLU during the torque cycle. Internally the E-RAD BLU compares the torque values with its own measurements and, if needed, it can adopt its torque or calibration values according to the Smart Socket's measurements. With this system, the E-RAD BLU torque tool offers transducer-controlled accuracy and is always adjusted to the particular joint type on the application.

The E-RAD BLU only requires two torque cycles with the Smart Socket to calibrate itself to the specific joint type. The Smart Socket can then be removed and the E-RAD BLU continues to torque at the setting until instructed otherwise by the operator. The E-RAD BLU offers very precise and repeatable performance thanks to its servo motor technology.

Although the Smart Socket and the E-RAD are high-tech, they are very simple in use and do not require expert bolting knowledge to operate them. Besides this, their menus (controlled via a touchscreen interface) offer password protection so it is possible to set up the tool with the correct torque presets for the

Figure 6. Touchscreen control interface for torque, angle and preset selection

job and allow access for the operator only where needed. This greatly reduces the risk of operator errors. With increased pressure on the wind industry to become more cost-competitive, smart bolting equipment can play a significant role in cost reduction. During new tower installations electric multiplier wrenches can reduce installation time by 40–50% according to various installation contractors. Besides the higher wrench speed, electric multipliers are always single person operated, increasing safety and saving additional man-hours. In addition to this, and maybe even more interesting, substantially less crane time is needed and installation projects can be finished more quickly. ■

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Figure 7. E-RAD BLU torque system