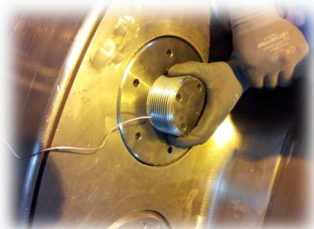


# Control of the tightening force by ultrasonic technique



Hydraulic turbine



Hydraulic turbine



Hydraulic turbine



Trunnion / Nuclear application

Controlled tightening force is one of ULTRA RS specialties. Our State-of-the-Art technology allows accurate measurement of tightening force on bolts or studs by ultrason.

Principle: real time measurement.

Quality: 5% accuracy or better in measured force, Adaptable for different type screws and stud bolts, Practical and fast.

The device consists of:

- Torque meter or hydraulic torque wrench,
- Socket instrumented by ultrasonic sensor,
- and the tailored ultrasonic device.

Depending on the need of our customers, we either perform controlled tightening on their behalf or tailor-make a device and provide necessary training and hotline assistance to our clients. Moreover, Ultra RS can supply tailormade hydraulic torque tool and combine the two devices for an efficient and accurate execution.

We engage with our customers in the following steps in each project:

- \* Study and advice on project specification and requirements,
- \* Development of measuring device adapted to the application,
- \* Parameterisation of our proprietary measurement software,
- \* Control and fine-tuning of the end-to-end arrangement using real scale mock-ups,
- \* Qualification test campaign and associated reporting,
- \* Organization of training and hotline support.



# Control of the tightening force by ultrasonic technique



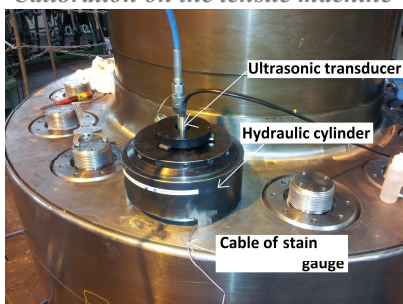
Calibration on the mock-up



Calibration on the mock-up



Calibration on the tensile machine



Calibration on the real assembly

When a screw is tightened, two effects will increase the travel time of the ultrasonic wave. Firstly, the acoustoelastic effect, which is caused directly by the tensile stress in the screw. It tends to decrease the propagation velocity of the wave and, therefore, increase its travel time. Secondly, the effect of lengthening of the screw increases the wave path and thus increases the travel time.

### Formula used :

$$(t_{11} - t^{\circ}_{11}) / t_{11} = K_1 \cdot F$$

$t^{\circ}_{11}$  : travel time of the wave before tightening screw in the axial direction,

$F$  : Tightening force (kN),

$t_{11}$  : travel time of the wave after tightening screw in the axial direction,

$K_1$  : calibration coefficient determined on a screw

### Two calibrations:

1.  $K$  : on the Mock-up representative of the real assembly
2.  $t^{\circ}_{11}$  : on the screw before tightening

Nota :  $K$  can be determined on the real assembly or on a mock-up.