MUC1 - Elbow Dinamometer

The MUC1 is a dinamometer for the elbow. It based on a load cell and it can measure force during flexion or extension.

The force measured by the load cell can be used to estimate the torque at the elbow since the lever arm of the load cell is known.

Arm Positioning

The forearm has to be placed in the dinamometer and the positioning system (see Fig. 1) can be moved to fit the most confortable position for the subject.

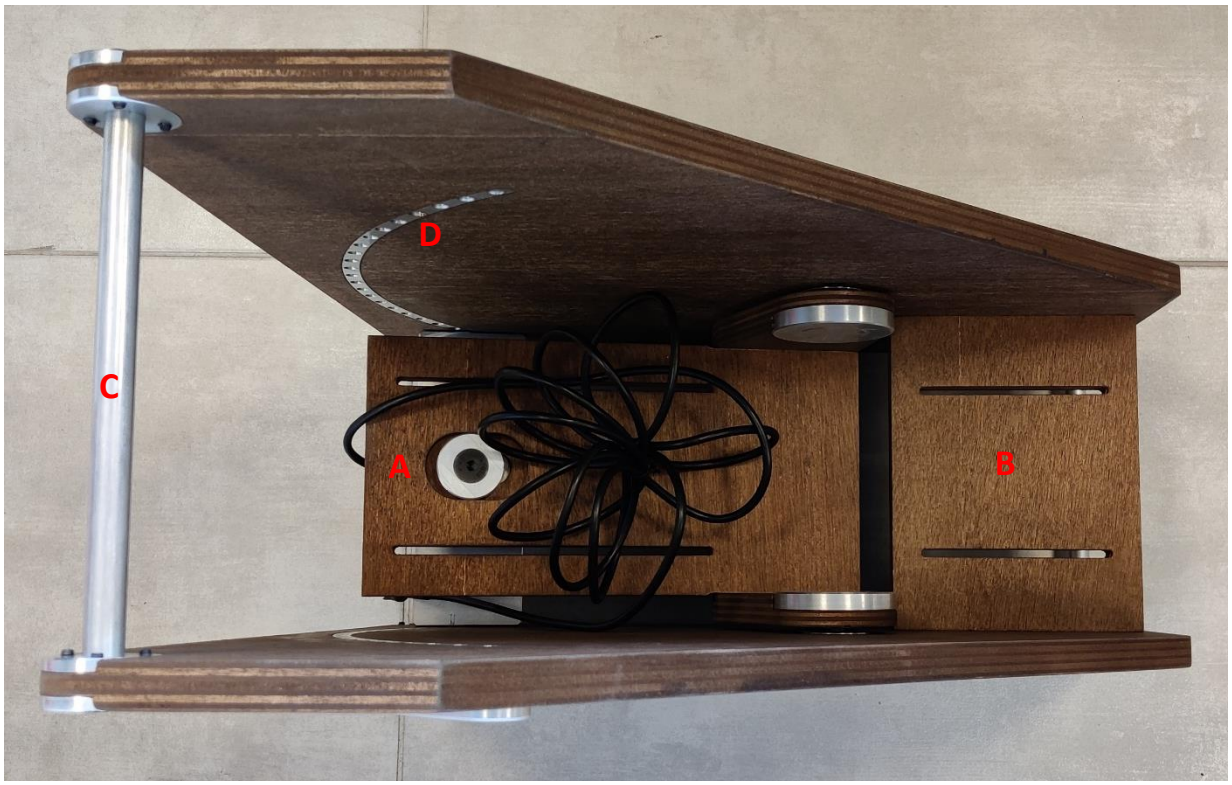

Fig. 1. *The ergometer MUC1. A: the armrest. B, C and D: positioning system for the forearm.*

For reliable measurements it is important that the elbow center of rotation is aligned with the dinamometer center of rotation (see Fig. 2). In case, it is possible to add layers with different thickness between the forearm and the armrest.

The forearm has to be fixed using straps or bands. The armrest has two cuts to allow the fixation of the forearm.

The angle can be changed between 0° and 90° by removing the two knobs and mooving the armrest together with the load cell (see Fig. 3).

Fig. 2. *Alignment between elbow and dinamometer centers of rotation.*

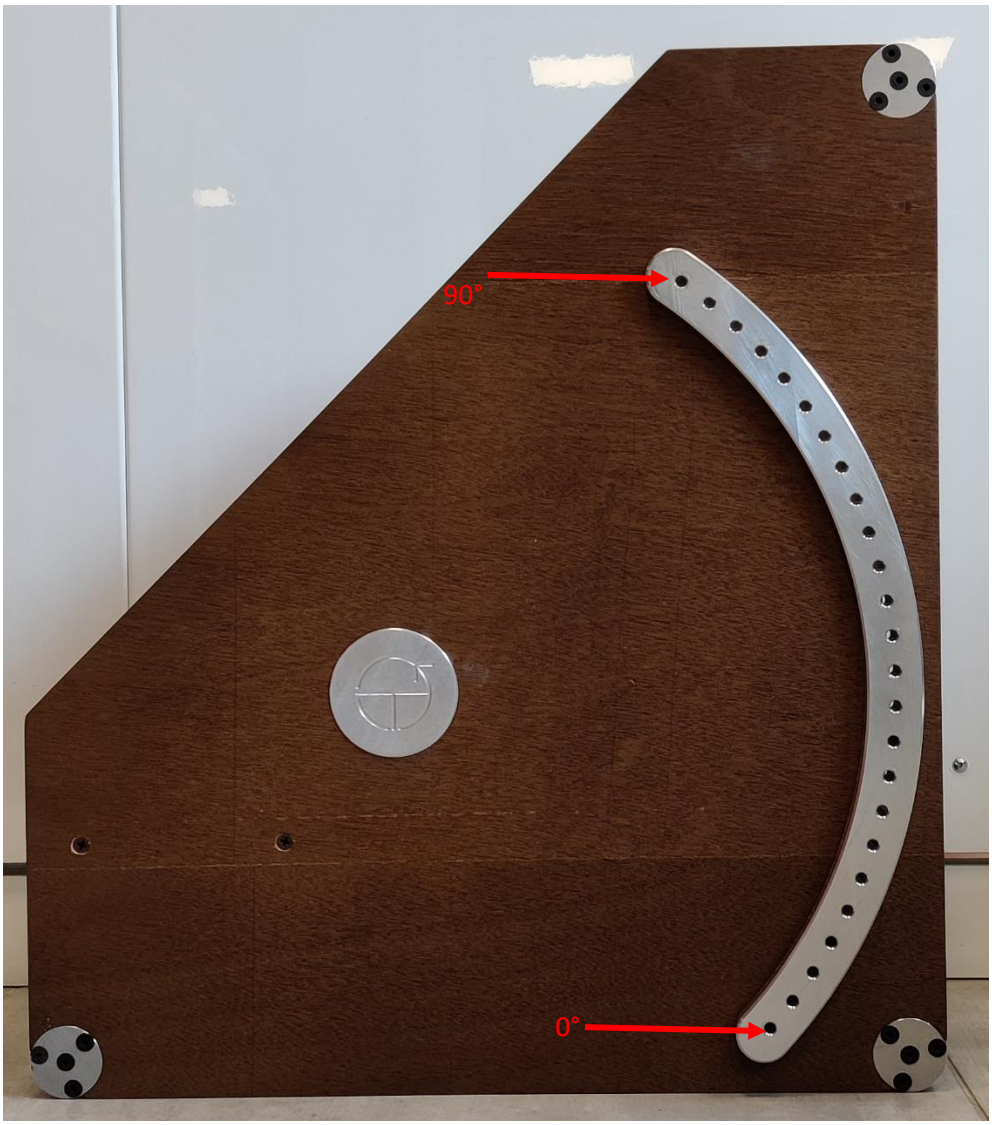

Fig. 3. *Elbow angle set.*

Use MUC1 with forza, forzab and forzaj devices

Forza, Forza-b and Forza-j have been designed to be used as a force measurement device for signal produced by load cells or torquemeters with differential output.

Forza and Forza-b are designed as two accessories of the Quattrocento device while the Forza-j has been designed as an accessory to the Sessatanquattro device.

In all three cases, the following steps must be followed to use the accessory:

- Connect the dynamometer connector to the forza device using the Load Cell Input.
- Connect the device to an acquisition system using the cable called J-BNC cable.
- Adjust the gain of the system using the button/wheel Gain Select.
- Delete the offset using the button Offset.

Fig. 6. *Forzab, forza and forzaj load cell amplifier.*

To calculate the force from the raw data in Volts it is necessary to use the following function:

$$\text{Force [kg]} = \frac{V_{out\ measured}\ [V] * F.S.\ [kg]}{\text{Sensibility [mV/V]} * 5\ [V] * \text{Gain [V/V]}}$$

Where:

- F.S. = Full-Scale, it is indicated on the load cell;
- Sensibility = depends on load cell;
- Gain = depends on how to use, in PC use it's sets on SW, in analog use it's sets with the Gain button.

When using OT BioLab + it is necessary to provide a scale factor, a factor that regulates the conversion between the input force (or torque, angle, speed ...) and the voltage at the input of the auxiliary input. Therefore, for the load cell and its amplifier the scale factor can be estimated as:

$$SCAL_{FACT} = \frac{1000\ x\ LC_{FS}}{LC_{SENS} x\ LC_{SUP} x\ FA_{GAIN}}$$

Where:

- 1000 is needed to get the output in V since the input should be expressed in mV and the gain is a pure number
- LC_{FS} = load cell full scale, 100 Kg
- LC_{SENS} = load cell sensitivity, 2 mV/V
- LC_{SUP} = load cell supply, 5 V
- FA_{GAIN} = forza amplifier gain, sets by the user between 100, 200, 500 and 1000

Torque estimation and technical details

The load cell detects the force, to estimate the torque generated by the elbow, it is possible to multiply the force measured by the cell for its lever arm. In Tab. 1 load cell technical details and mechanical dimensions are reported. Fig. 5 shows the load cell pinout.

	Parameter	**Value**
S-Type Load Cell	Range	100 kg
	Recommended Supply	10 V
	Non linearity	± 0.02 % F.S.
	Sensitivity	2 mV/V
	Lever arm	200 mm

Tab. 1. *Load cell Technical details*