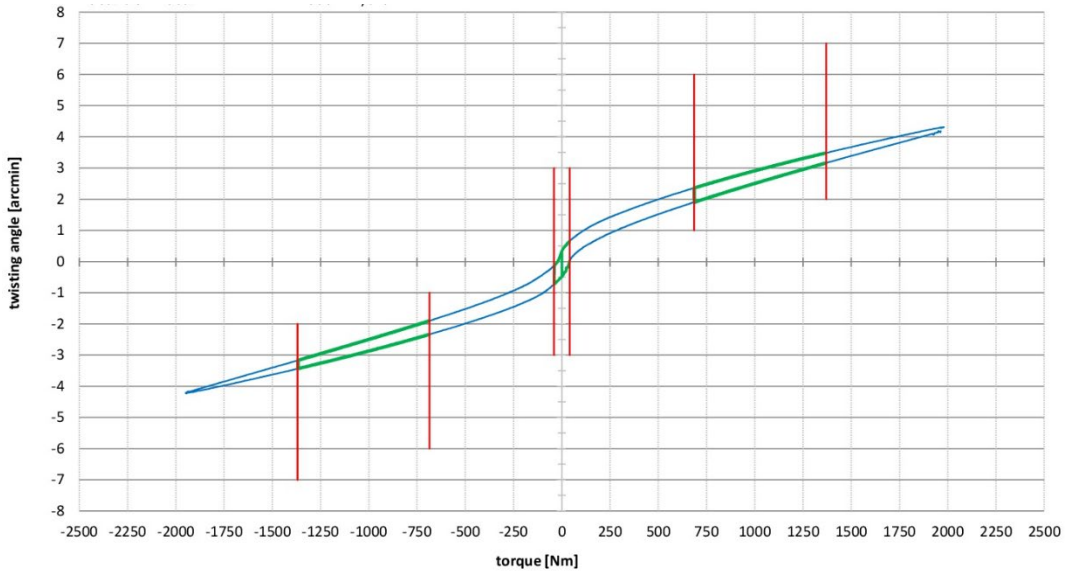
GAM Gearbox Accuracy Definitions

Torsional Stiffness

The torsional stiffness is defined as the quotient of the externally applied torque and the resulting twisting angle at the output of the gearbox. This characteristic value is given in Nm/arcmin.

In order to determine this parameter, the gearbox is loaded with a continuously increasing torque up to the nominal value while the input shaft is locked. The applied torque and angle of deflection at the output flange are recorded (see the hysteresis curve below) and the value range between 50% to 100% of the nominal load is evaluated.

Torsional Stiffness = Applied torque / Deflection at output



Hysteresis curve for sample GPL-F-160 – torsional stiffness (practical test)

Backlash

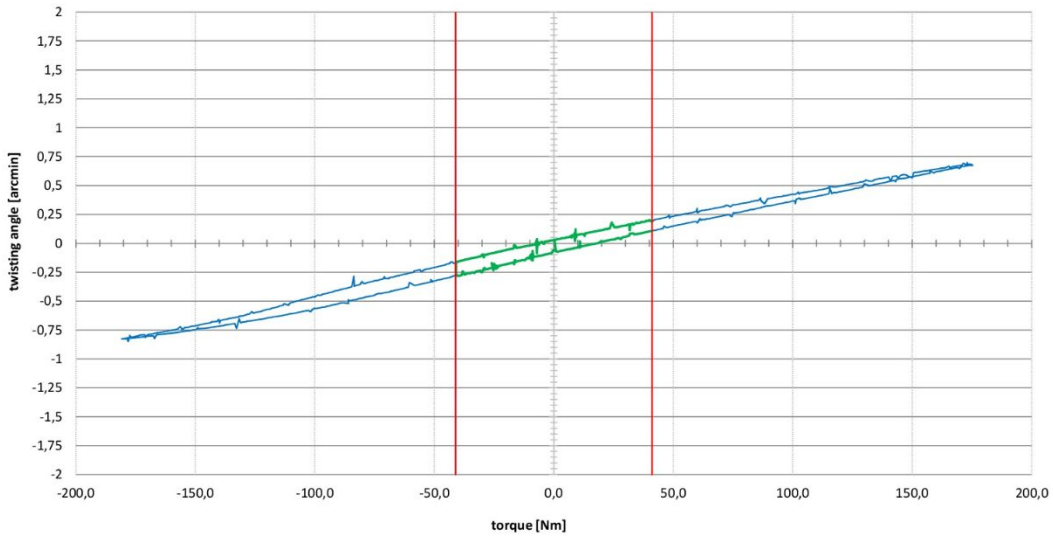
The torsional backlash is the error of the output shaft position in relation to the input shaft at zero torque. The measurement is done with the input shaft locked. The torsional backlash can also be observed in the hysteresis curve.

Backlash = Maximum deflection – Minimum deflection at 0 Nm of torque

Lost Motion

Lost Motion, also called positioning error, is the deflection resulting from internal gearbox forces. The measurement is taken at +/-3% of nominal torque.

Lost Motion = Maximum deflection – Minimum deflection at +/- 3% of nominal torque



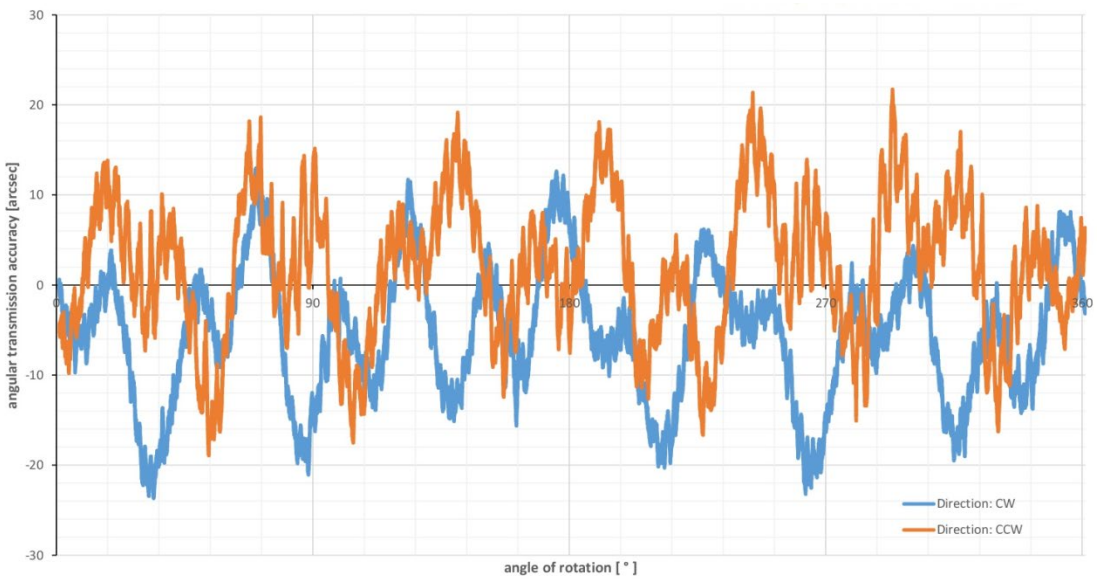
Hysteresis curve for sample GPL-F-160 – backlash, lost motion (practical test)

Angular Transmission Accuracy

The angular transmission accuracy defines the maximum transmission error (maximum amplitude of the variation) of the actual output position relative to the theoretical output position according to the transmission ratio. This parameter is specified in angle seconds [arc sec].

For the determination of this parameter, the gearbox is rotated without load during drag operation. The input and output positions are recorded. The value range over a full revolution of the output is evaluated to determine the angular transmission accuracy.

Angular Transmission Accuracy = Maximum position variation - Minimum position variation



Measurement of angular transmission accuracy for sample GPL-F-160 (practical test)

GAM Gearbox Accuracy Definitions

Positioning Accuracy

The positioning accuracy is determined by the difference between the target position and the actual position. It is influenced by the angular transmission accuracy, the backlash, and torsional stiffness.

For torque (T) ≤ 3% nominal torque (T_{nom}):
Positional Accuracy = Angular transmission accuracy + Backlash

For torque (T) > 3% nominal torque (T_{nom}):
Position Accuracy = Angular transmission accuracy + Torque / Torsional stiffness

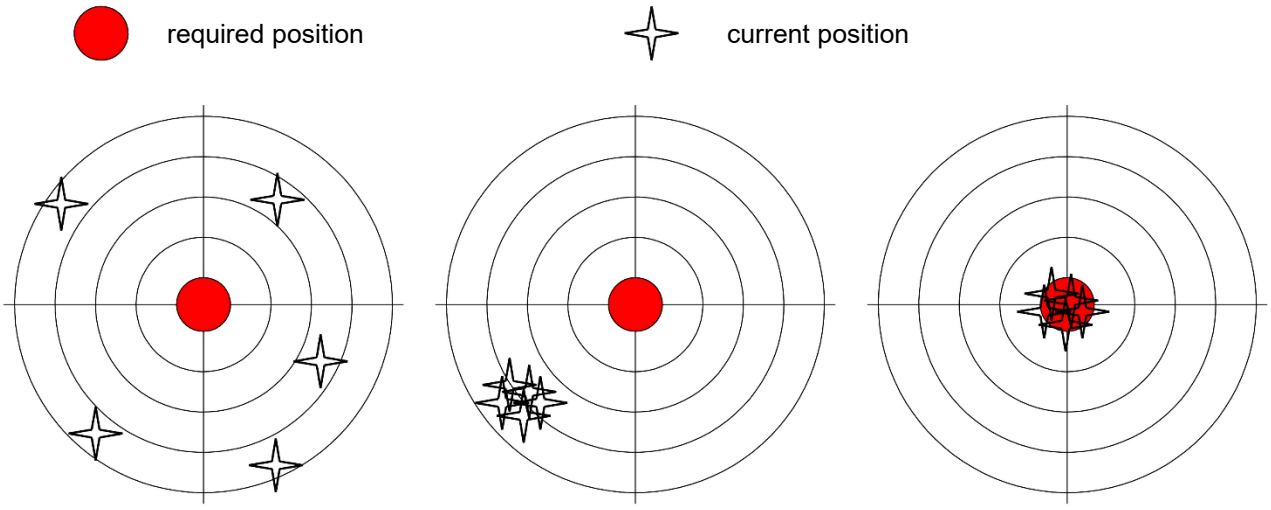
Repeatability

Repeatability refers to the deviation when the gearbox is repeatedly turned to the same position under the same load.

In the repeatability, the errors from the angular transmission accuracy and the torsional stiffness are constant, so that any deviation is solely the result of lost motion.

For torque (T) = 0 Nm, Repeatability = backlash

For torque (T) ≥ 0 Nm, Repeatability ≤ lost motion



poor positioning accuracy
poor repeatability

poor positioning accuracy
good repeatability

good positioning accuracy
good repeatability