

Ball Bearing testing

Several devices at AAC are offering testing of ball bearings. For testing over wide temperatures but lower testing durations the devices “SALOTTE” and “HADES” are used. For very long term testing from RT to +300°C the “BBT” is used. Finally, the new BBT2-frames allow to test also very small amplitudes (swivelling). In addition to those devices, two more vacuum tribometers can be adopted to ball bearings: the Cryo-Tribometer (offering RT down to 4K) and the VeryHigh-Temperature-Vacuum Tribometer (offering RT to +700°C).

These facilities enable to measure the torque of ball bearings from air to high vacuum. Environments vary from vacuum, non-aggressive gases (e.g. He, CO₂) under controllable pressures (e.g. to simulate Martian environment) or to air with controlled humidity. The tests can usually be performed in wide parameters at temperatures from -170°C to + 250°C, with some limitation also down to 4K and up to +700°C.

Standard test boxes (housings) are available for paired ball bearings of types 7004, 6006, 676, variants being extended all the time. Preloads are mostly applied by soft-preloading by springs. All setups allow to verify the pre-load using one of our internal tensile test machines. An new bi-axial-housing allows to pre-load a pair of ball bearings by simultaneous axial and radial load. It also allows to change the axial pre-load in-situ (without opening the vacuum chamber).

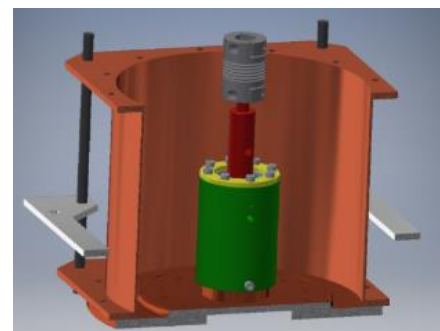
The cages can be manufactured of individual composites (e.g. self-lubricating polymers).

Post-Analysis may cover measurement of wear by profilometry, SEM or microbalance, investigation of surface structure or material transfer by SEM/EDX.



“BBT2”: 4 setups using frameless motor to test a pair of preloaded bearings, for long term and down to swivelling motions.

“BBT”: standard housing to test a pair of axially preloaded bearings from OD 15 to OD 55mm, can be combined with several test devices to run in TVAC.





The devices are fully PC-controlled. Selectable control parameters are, e.g. test duration (revs), speed, motion profiles like unidirectional, oscillating or reciprocating, with predefined angles and even several stops are feasible in one cycle. On-line-data acquisition offers to post-process data, e.g. for automatic calculation of friction coefficients in running-in- or steady state, as well as endurance of solid lubricant coatings.

Measurement of

- Torque
- Angle / Position
- Vacuum, temperature
- Wear (geometric or mass loss, post-test)
- Optional (e.g. residual gas, user defined)

Different options are available (on demand):

- a) Testing from air to high vacuum
- b) Testing controlled gas environment: eg simulating Martian atmosphere (15 mbar in CO₂)
- c) Motion selectable from unidirectional rotation to oscillating motion (Note in some cases torque is measured in an oscillating motion cycle.)
- d) Contamination monitoring: a mass spectrometer to detect on-line contamination (e.g. outgassing of fluid lubricants or their cracks).

*BBT with inductive heating
(very high temperature)*



Figure 2: Images of cages: made of Self-Lubricating Polymer (left and middle), made of copper MMC (Right)

Specifications	
Samples	Ball bearings <ul style="list-style-type: none"> • Size range from OD~10mm to OD~95mm • Already available housings for angular contact BB 7004, 6006, 676, • Thrust bearings • Linear ball bearings Further housings on demand (as part of test campaigns) (For Journal Bearings see separate data sheet.)
Test (Output)	online measurement of <ul style="list-style-type: none"> • Torque • Angle • Environmental Data • residual gas analysis (mass spectrometer of outgassing particles) Pre- / Post-Analysis; <ul style="list-style-type: none"> • Pre-Load (before and after test, ex-situ) • Wear (geometric or mass loss from cage)
Loads	Almost complete range of allowable contact pressures up to 3GPa using soft pre-load (by springs, measured before/after test) or partly also in-situ
Speed / Motion	Motion selectable from unidirectional to reciprocating (angles selectable) 0,1 to 600 rpm (gear available for further speeds)
Vacuum / Environments	Vacuum selectable down to 10 ⁻⁶ mbar Air with controlled humidity Gases with controllable pressure (e.g CO ₂ at 15mbar = Mars)
Temperatures	from -170 up to + 250 °C, thermal cycles available Cryogenic: by adoption of Cryo-tribometer feasible VeryHigh-Temperature (+700 in vacuum): high temperature Tribometer adoptable
Accuracy	Torque ± 0.001 N Angle: +/-1 arcsec Temperature in-situ (several points simultaneously): ±2°C

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