microtap methodology

microtap is a unique torque controlled tapping machine used for comparative analysis of cutting fluid efficiency and cutting tool geometry. In principle, the advantage of its design gives credible results.

- Electronic torque monitoring directly from the spindle motor.
- Direct link from the cutting tool to the spindle motor.
- Infinitely variable speeds from 300 to 3,000 RPM for optimum flexibility.
- Precision depth measurement and control for consistent operation.
- The floating spindle movement follows the pitch of the tap, thus, eliminating axial force errors as seen in conventional lead screw machines.
- The use of the automatic spindle advance aids in eliminating error by applying the same downward force for each cut.

The **X-Y auto**table provides precise indexing to the next test hole, which maintains the level of consistency required for comparing tests.

Test Bars are arrayed holes, drilled and reamed in a single 14” x 2” x ½” form, available in an assortment of metallurgy and hole diameters.

microtap Win**PCA** software evaluates all measurements by displaying them in a graphic representation, showing the maximum torque, calculating the mean value and standard deviation, then automatically stores the cut data for future reference.

EQUIPMENT

The following equipment is used for the testing procedure outlined below.

- **lab**tap II G8 thread tapping machine (50-700 Ncm torque range) with optional ZAP auto-spindle advance.
- **X-Y auto**table with Pendant and Test Bar fixture.
- Test Bar for M6 cutting tap
- M6 alignment tool
- M6 x 1 spiral point uncoated cutting taps
- Computer with Win**PCA** software
- Data collection sheet
- Dispensing Pipets, one for each fluid
- REFERENCE FLUID as a standard of comparison for the family of FLUID UNDER TEST.
- FLUID UNDER TEST in at least 50ml containers
- Solvent for cleaning oil-based fluids or alcohol for water-based fluids.

TAPPING TORQUE TEST

Initially we will assume that power is applied to the **lab**tap machine and air supply is connected; the **X-Y auto**table controller is operational and set for manual index; the computer is connected to the serial cable from the machine; and all safety precautions are observed and protective eye ware is used.

1. Clean Test Bar with appropriate solution.
   1.1. Tape the backside of the Test Bar where the holes are to be tested, as this will provide the same amount of fluid used in each test.
   1.2. Securely place the Test Bar in test fixture.
2. Line up the first hole with the spindle using the alignment tool.
   2.1. Always set the **Safety Stop** to **0** when changing taps or aligning table.
   2.2. Position the first hole using the alignment tool. From the Pendant disengage drives and adjust the **X-Y auto**table with the hand dials until the length of the tool aligns the first hole. Set the tool by moving the spindle handle up and down manually. Engage the drives when complete.
   2.3. The Pendant should have both X and Y axis set to .500” increments.
3. Select a new M6 tap and place in the 1/4” tap adapter.
4. Enable the computer and start the Win**PCA** program.
   4.1. When prompted to “Use settings from last session -- new or last”, it may be best to select ‘last’, as this will preserve most of your operating information.
5. In Win**PCA**, under PARAMETER enter machine data or open existing parameter test file.
   5.1. Depth to 14.4 mm
   5.2. Speed (RPM) to appropriate spindle speed
   5.3. Start mode:- MANUAL or for AUTOSTART see details in Operation Instructions
   5.4. Reverse:- 100%
   5.5. Torque to 700Ncm
   5.6. Fz Force:- 20Ncm
   5.7. Enter Name and Comment as suitable for test definition.
   5.8. Send parameters to the machine (F9)
      5.8.1. This will update the PARAMETER settings on the **lab**tap display.
      5.8.2. Failure to update means a communication problem. Consult Operation Instructions to determine fault.
   5.9. From the menu, go to FILE > SAVE AS > enter file name traceable to your particular test.
   5.10. Select OK (F10) to return to main screen.
6. Initialize the test requirements from Win**PCA** main screen
   6.1. Select, OPTIONS > WORK WITH MEAN VALUES.
      6.1.1. Under some conditions the user may want to select DISPLAY REVERSE TORQUE.
   6.2. Under Quality Mz set MIN to 0 and MAX to 700.
   6.3. Under DATA ACQUISITION, select START (F2).
      6.3.1. The STATUS window will show the name of the machine as verification of communication.
   6.4. Select EVALUATE!
      6.4.1. Under OPTIONS select TENDENCY and SHORT filter for better graph viewing.
      6.4.2. Select OPTIONS > SCALE > AUTO As familiarity comes about, it may be more advantageous to set graph scaling manually. Select OPTIONS > SCALE > MANUAL and fix DEPTH and TORQUE for more visually recognizable graph changes.
      6.4.3. Select AutoSaveAll then AutoSave.

6.4.3.1. The automatic save function creates a date stamped file folder under the primary WORK folder. Each saved cut file name is time of occurrence.

7. Fill the first six holes and coat the tap with a REFERENCE FLUID.
   7.1. Tape over holes outside this area to prevent contamination from fluid splatter.
   7.2. From the Pendant press TAP to initialize the first cut.
   7.3. The first cut requires Transfer Cut (F2) to initiate the save function. In AutoSaveAll mode all subsequent results are saved automatically.
   7.4. Using a REFERENCE FLUID will allow the new tap to break in on the first six holes and establish a point of reference to compare later readings when looking for tool wear.
   7.5. Record on the Data Collection Sheet –
      7.5.1. CUT is the peak torque value in Ncm.
      7.5.2. MEANVAL is the average torque over the depth of the cut.
      7.5.3. TIME. This is the name of the saved file and will help locate data later.
      7.5.4. Likewise, record REVERSE and its MEANVAL, if monitoring is required.
   7.6. Additional data is available under STATISTICS (F3).
      7.6.1. This MEANVAL is a higher resolution of the evaluation mean value.
      7.6.2. The STANDARD DEVIATION number reflects the smoothness of the cut.
8. The peak torque should not exceed 600Ncm. If 700Ncm is reached the spindle will reverse and restart. This interrupted data will not be valid for test purposes.
9. Complete six cuts and record the data from the REFERENCE FLUID.
10. Clean the test block and tap with solvent before proceeding to the next FLUID UNDER TEST.

Note: Six cut samples for each fluid will allow five for data averaging and provide a throw away cut for samples that fall out of the mean range.

11. Repeat steps seven and eight for each subsequent FLUID UNDER TEST.
12. Finally, repeat a test using the REFERENCE FLUID as validation against tap wear consistency.

CONCLUSION

Results are best analyzed in common computer spreadsheets.

The average of the MEANVAL and STANDARD DEVIATION for each FLUID UNDER TEST can be compared against each other. Considering the average of all FLUID UNDER TEST MEANVALS as 100%, each FLUID UNDER TEST will have a percent value for comparison.

Another method is to create a database around a REFERENCE FLUID, specific to a family of fluids. Then all results are a percentage variation for the REFERENCE FLUID.

The lower mean value of the cut indicates better lubricity and coating of the cutting tool. Fluids with a higher aqueous content show a better cooling contribution. The CUT value is recorded to gage any abnormal peak torque influence.

- Form tapping, as opposed to cut tapping, gives higher stress to the tool and metal. Thus the FLUID UNDER TEST will see a greater definition in results in closely contested cut testing.
- Tests can be done with one fluid on all sixty-nine holes of the test piece to determine other values, build up on the tool edge, effect of the increase in heat and determining wear on the tool.
- The automatic mode of the **X-Y auto**table will cycle multiple holes.
- A fluid dispensing device is available for fully automatic testing.
- The **microtap** Test Bar format and fixture method is able to accommodate a variety of materials for testing and provide easy change over of Test Bars.