

**labtap - G8**  
**Laboratory comparison measurement system**

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## **FLUID TESTING EQUIPMENT AND PROCEDURES**

### **microtap USA - METHODOLOGY**

microtap Germany has designed and developed a unique torque controlled tapping machine with a special PC software. Win**PCA** is an control and data acquisition software used with this calibrated spindle and electronics. This system is 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 performance.
- Precision depth measurement and precise control for consistent operation.
- The floating spindle movement follows the pitch of the tap, thus, eliminating axial force errors in conventional lead screw machines.
- The use of the automatic spindle advance aids in eliminating error by applying the same down force for each cut.
- The test fixture provides precise indexing to the next test hole, which maintains the level of consistency required for comparing tests
- microtap WinPCA software evaluates and records all measurements, converting them into a graphic representation that can be stored for future reference.

### **EQUIPMENT**

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

- Thread tapping machine: **labtap II G8** (50-700 Ncm torque range) with optional ZAP feeding system, auto-spindle advance. <sup>1</sup>
- microtap X-Y axis positioning table with test piece fixturing. <sup>2</sup>
- Sixty-nine hole test pieces (2in. x 1/2in. x 14in.)
- M6 centralising bit
- 6mm spiral point cutting taps
- Computer with WinPCA software
- Data collection sheet

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1. Without the foot switch operated ZAP, manually position the tap and press the start button to activate the spindle.
2. A test bar in a secure clamping device can be held and positioned as the X-Y axis table.

## **TESTING PROCEDURE**

### **1. Clean test piece with solvent and place in test fixture.**

- 1.1. Tape the backside of the test piece where the holes are to be tested as this will provide the same amount of fluid used in each test.

### **2. Line up the first hole with the spindle using the tap blank.**

- 2.1. To pick up the first hole use the tap blank supplied with the 1/4" collet. Move the dials of the X-Y table until the length of the pin engages the first hole. The pin is engaged by moving the spindle handle up and down manually.
- 2.2. Once the pin is engaged set the X & Y inner dimensioned dials to "0".
- 2.3. Set the front Scale to a .500" increment.
- 2.4. The holes are spaced at .500" increments, which require five revolutions of each handle.

### **3. Select a new 6mm tap and place in the 1/4" tap adapter.**

### **4. Enable the computer and start the WinPCA program.**

### **5. In WinPCA, under parameter enter machine data or open existing parameter test file.**

- 5.1. Depth to 14mm
- 5.2. RPM to 1,000 for Spindle speed
- 5.3. Start mode:- autoFz
- 5.4. Reverse: 100%
- 5.5. Torque to 700Ncm
- 5.6. Fz Force: 20Ncm
- 5.7. Send parameters to the machine (F9)
- 5.8. From the menu, go to file > save as > enter file name traceable to your particular test.
- 5.9. Select OK (F10) to return to main screen.

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**6. Initialize the test requirements from WinPCA 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).
- 6.4. Select evaluate!
  - 6.4.1. Under options select tendency and short filter for better graph viewing.
  - 6.4.2. 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.

**7. Fill the first hole and coat the tap with a reference fluid.**

- 7.1. Press the foot switch to initialize the first cut.
- 7.2. Allow the tap to wear in on the first six holes.
- 7.3. Select evaluate and press transfer cut (F2) to download latest machine data to the screen. Record values for each cut.
  - 7.3.1. The value for cut is the peak torque and meanvale is the average torque over the depth of the cut.
  - 7.3.2. Likewise, record reverse and its meanvale, if monitoring is required.
- 7.4. Additional data is available under statistics (F3).
  - 7.4.1. This meanvale is a higher resolution of the evaluation mean value.
  - 7.4.2. The standard deviation number reflects the smoothness of the cut.

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**8. Each graph can be saved for more extensive evaluation and spreadsheet analysis.**

8.1. From the menu, go to file > save as > data single cut.

8.1.1. Typically, call out the fluid M, N, etc. and the hole number on the test bar.

8.1.2. For example, "Mb4.cut" would be M fluid used in hole at row b column 4.

8.1.3. Note: WinPCA Version 2.7 and higher will save each cut file automatically as follows.

The automatic save functions below create a date stamped file folder under the primary Work folder. Each saved cut file is time stamped.



**AutoSave:**

The initial selection requires Transfer Cut (F2) for the first cut to be displayed and then prompt "Save this cut data?" requires a response. Subsequent cuts are displayed and prompted.



**AutoSaveAll:**

For saving each cut file without prompts, first select AutoSaveAll and then AutoSave. The first cut requires Transfer Cut (F2) to initiate the save function.

**9. 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.**

**10. Complete six cuts and record the data from the reference fluid.**

**11. Clean the test block and tap with solvent before preceding 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.

**12. Repeat steps seven and eight for each subsequent fluid under test.**

**13. Finally, repeat a test using the reference fluid as validation against tap wear consistency.**

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## **CONCLUSION**

Results are best analyzed in common computer spreadsheets. The mean value for each component of the fluid under test can be compared against each other and the reference fluid. The lower mean value of the cut indicates better lubrication and coating of the cutting tool. The higher the aqueous content, the better cooling contribution.

Tests on six holes will give information to determine the lowest mean value, thus suggesting the better fluid.

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.

An automated X-Y axis table and SME fluid dispensing device is available for fully automatic testing.

The microtap fixture method will be able to accommodate a variety of materials for testing, providing user-friendly change over of test pieces.

## **FACTORS FOR PRODUCING QUALITY THREADS**

Today we are witnessing the use of exotic alloys and non-metallic materials in the manufacturing process. When selecting a method of tapping, special consideration should be taken in choosing the optimal thread tapping process. Thread tapping is the most common point of failure in a manufacturing process, needless to say "tap breakage is a loss in time and money". Machining tasks have become highly specialized operations, thread tapping having to meet these new standards. To aid in your thread tapping concerns we will address the following factors; method of tapping, choice of taps, and type of lubrications. Fluid testing methodology will be addressed for the benefit of fluid manufactures. This methodology can be used for the development of taps.

## **LUBRICATION**

Lubrication is as important as the selection of the type of tap. Lubricating fluids are made up of different ingredients to maximize the lubrication during a tapping operation. The better the lubricant the longer the tap will last and you will have less chance of seizing the tap in the hole. Companies that manufacture fluids will be able to compile ingredients to meet your needs for special materials or tapping operations.

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**METHOD**

Most technically oriented people are familiar with using a "T" wrench for tapping. This method is fine for modest quantities of tapping, but needs special attention for small diameter taps. The use of this method requires years of experience, especially for exotic alloys and small taps. Special care has to be applied to maintaining the tap in perpendicular alignment to the hole.

There are various methods for machine tapping, ranging from drill presses to rigid tapping on CNC centers. CNC centers tap holes using a computer program to match spindle feed to the pitch of the tap. Tapping mass production holes on a CNC center is placing the machine in a high wear environment, due to the fact of the large spindle having to do so many forward and reverse operations. The CNC machine has no ability to sense torque, this creates a problem when the tap "cold welds" to the part or jams on a chip. The CNC operator needs to be alert to avoid tap breakage and should constantly monitor the tapping operation for each part as well as observing the cutting edge of the tap.

A common type of thread tapping machine is the lead screw taper. This machine uses a pre-determined pitched lead screw for the specific tap that you are using. Normally the machine is used in high production, typical in the fastener industry. The lead screw taper requires a different lead screw for each pitch change that is used. These machines use different methods of spindle speed control ranging from belt drives to geared heads. Different types of torque control are implemented to try and avoid tap breakage these range from pneumatic to slipping clutch devices.

Common practice in machine shops is to use a drill press or Bridgeport type machine for tapping holes. This method requires an operator that has experience and needs some luck in the hope that the tap won't seize or jam in the part. A relatively new method on the market uses electronic torque control. This method allows an inexperienced operator to pre-select torque according to tap size and application. The selection of torque, depth and spindle speed is done through a digital display. By being able control torque to this high degree of accuracy, tap breakage is eliminated. No secondary devices are used to monitor the torque providing a simple maintenance free system. Monitoring the torque allows the operator to select from the menu a mode for detecting holes undersize and oversize. The depth scale measurement provides an actual depth measurement that has the accuracy of holding tolerances within two thousands of an Inch. The spindle is free floating applying no perpendicular force on the tap; this method allows the tap to draw itself in the part proportional to the pitch providing perfect threads. The method is further enhanced with software that allows the operator to monitor and record tapping operations for quality control purposes.

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## TYPE OF TAPS

**Straight flute taps:** These taps have straight flutes and are for general-purpose applications

**Spiral pointed taps:** These taps have straight flutes with the cutting edge of the first few threads ground at an angle to force the chips ahead of the tap

**Spiral pointed only taps:** These taps are made with the spiral point feature, only without longitudinal flutes and are suitable for thin materials

**Spiral fluted taps:** These taps have right hand helical flutes with a helix angle of 25-35 degrees, designed to withdraw chips as they enter the hole

**Fast spiral fluted taps:** These are similar to spiral fluted taps except the helix angle of the flute is from 45-60 degrees

**Thread forming taps:** This tap has no flutes but forms the threads by material displacement

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