

## On Preparation of Advance Ceramic for Single-edge V-Notch Beam Fracture Toughness Test of ISO/FDIS 23146:2008(E) Standard

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**Abstract:** With establishment of fracture toughness test for advance ceramic according ISO/FDIS 23146:2008(E) with the sample test of Single-edge V-Notch Beam/SEVNB, then the researcher related this activity should understand and able to realize how to prepare the sample of advance ceramic in order the requirements of the standard are fulfilled. In contrary with metals and polymers that usually easy to cut as the standard size for testing, the advance ceramics are found much more difficult to prepare since it is very hard and brittle. More even, specifically for fracture toughness test, the level of difficulty is added since the sharp initial crack should be introduced in the edge of the sample. This article introduce method on preparation of advance ceramic for the purpose of fracture toughness test completed with method to introduce the initial sharp V-notch crack which is valid and possible to be measured its length and diameter of the tip that yield valid result of fracture toughness test.

**Key words:** Test, toughness, crack, advanced ceramic, valid

### 1. Introduction

Fracture start in ceramic from flaws which are a form of discontinuity in the microstructure that can assumed as a small crack distributed in the surface or volume. Strength then depends on the largest defect in specimen. In comparison with ductile material such as metal and plastics, Mechanical testing for ceramic is more complicated since misalignment of specimens become more severe. Ceramics are very hard and brittle, machining of specimen is difficult, time consuming and expensive (Danzer *et al*, 2008).

It was initiated by the work of Damani *et al*. (1997) that was introduce the initial crack by polished notch modification. The procedure for introducing sharp notches by involving double notching: first guiding notch (between 100 and 150  $\mu\text{m}$ ) then the tip of this pre-notch is extended and sharpened by careful polishing with a conventional razor blade and diamond paste suitable with alcohol. This work was approved as International standard under ISO/FDIS 2346 (2008) that will be discussed here in detail which is focused in preparation and handling the sample. The ISO standard that is introduced here can be use as an alternative for fracture toughness instead by using ASTM C 1421-99 (1999).

Beside above mentioned two method of fracture toughness method, some laboratories still use several technique which is not standardized yet such us Single Edge precrack beam (SEPM), Single Edge Noched beam (SENB), Chevron notched beam (CNB) (Gotosi, 2003; Yoshimura *et al*., 2005).

As reported by Fischer (2008) The result of fracture toughness testing by using SEVNB is influenced by preparation of the sample. This article inform about how to prepare the sample for fracture toughness test according ISO/FDIS 2346 (2008) in order valid result test will be obtained.

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## 2. Experimental

The advanced ceramic that will be tested should be mounted on the ceramic tile by using glue. The glue is made from thermoplastic that will be melt if it is heated (Fig. 1). The ceramic tile will be sacrificed and consumable because small part will be cut of also by the diamond wheel.

The sample then was ground by using serial diamond grinding wheel as depicted in Fig. 2 until reach the desire size of the specimen.

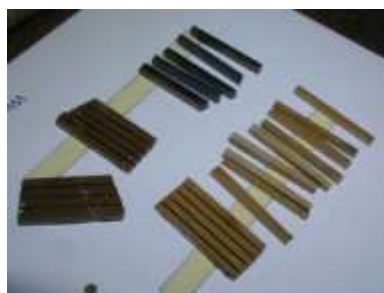


**Figure 1.** Ceramic tile on steel plate for mounting the samples. The sample was glued on the surface of the ceramic tile. The steel plate will hold by magnetic force.



**Figure 2.** Serial diamond grinding wheel, and grinding machine

The sample were repetitively released from the glue and mounted again and again during cutting by using diamond wheel as depicted in Fig. 3. After specimens with precisely size were obtained, the specimen then were cleaned by using acetone (Fig.4)



**Figure 3.** Cutting the sample by using diamond wheel. The sample were glued and released repetitively



**Figure 4.** the specimen then were cleaned by using acetone

The specimens were ready for V- Notching process. The V-notching process were conducted by using Diamond wheel as can be seen in Fig. 5, and continued by sharpening the tip by using razor blade machine as presented in Fig.6. The diamond paste was added in the surface of razor blade

The length of the V-notch was observed and measured by using optical microscope. The diameter of the tip should also note in the result. The jig for four point fracture toughness is suggested as appear in Fig. 7



**Figure 5.** Initial V-Notching Process by using diamond wheel



**Figure 6.** Sharpening the notch tip by using razor blade with diamond paste



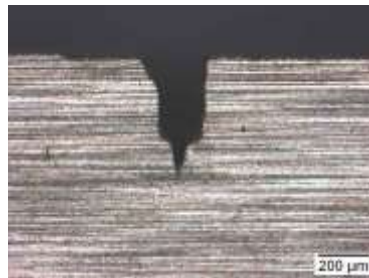
**Figure 7.** Jig for four oint fracture toughness test

### 3. Result and Discussion

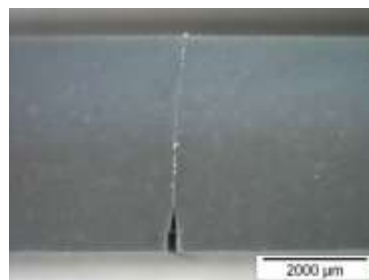
By following the route in preparing the sample for fracture toughness test as mentioned above, the valid sample are obtained as depicted in Fig 8. The specimens are free from crack and the V-notched shape can be seen in Fig. 9. The result after Fracture toughness test of the specimen is depicted in Fig. 10. The crack propagate well from the tip of the V-notched. As noted by Fischer (2008) the influent of preparation for SEVNB specimen on fracture toughness test result can be avoided by following the route suggested in this article.



**Figure 8.** The accurate size of the specimens for fracture toughness tests of advanced ceramic



**Figure 9.** The sharp V Notch shape



**Figure 10.** Condition after fracture toughness test. The crack is well propagate from the tip of the notch

### 4. Conclusion

This article introduce method on preparation of advance ceramic for the purpose of fracture toughness test completed with method to introduce the initial sharp V-notch crack which is valid and possible to be measured its length and diameter of the tip that yield valid result of fracture toughness test.

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