1120 Via Callejon ■ San Clemente ■ California ■ 92673 ■ USA
Telephone: (949) 492-2600 ■ Fax: (949) 492-1499
e-mail: info@southbaytech.com
www.southbaytech.com

Cutting Steel / Chromium Alloy using Various Diamond Wheels

1.0: Purpose

Metallographic sectioning of metals has long been used in industry to facilitate failure analysis, analyze microsctructure, and for quality control of metal products. The Model 650 Low Speed Diamond Wheel Saw has become a common instrument used for metal sectioning of a wide range of materials, from copper to hard steels. This application note describes some cutting results obtained from tests using a very hard carbon steel/chromium alloy. Three different diamond wheel types were tested and evaluated based on cutting time, surface finish, and cutting accuracy.

2.0: Experiments and Procedures

A small rod of 100 steel: 6 chromium 15mm in diameter by 35mm in length was obtained for cutting tests. Three cuts were made to evaluate cutting time, surface finish, and accuracy of the cut (parallelism) using different diamond wheels. The surface of the part following cutting was inspected using an inverted optical microscope at low magnification to qualitatively compare surface roughness. The width of the sample following cutting (the thickness) was measured to determine if any significant variation was observed in the specimens. Finally, a comparison of cutting times was made to compare the wheel cutting efficiency as well.

The sample rod material was cut using similar conditions for each diamond wheel. The sample was mounted onto the Model 650 Low Speed Diamond Wheel Saw using a Model 65006 Vise sample holder. A water-soluble coolant was used to prevent excess heating during the cutting process, and was replenished after each cut. Cutting load was applied to the specimen directly onto the arm mechanism, and the counter-balancing weight was used to prevent wheel binding during the cutting process. A total cutting load of approximately 600 grams was used with the diamond wheel saw during each cut, and dressing of the blade was done periodically every hour during the cutting process.

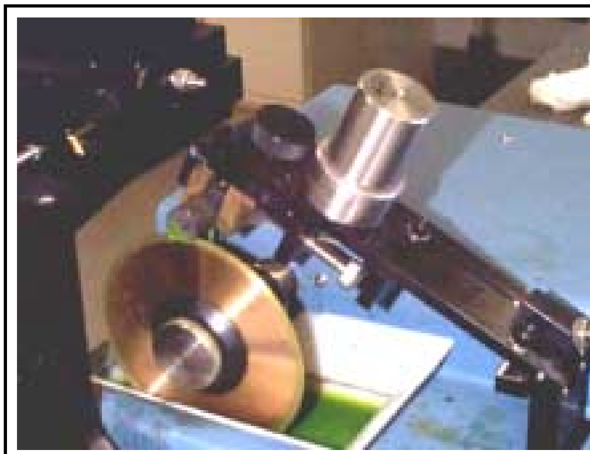

Figure 1: Model 650 Low Speed Diamond Saw cutting the steel sample. The Model 65006 Vise sample holder is used for fixing the specimen to the saw during the cutting process, and the coolant is seen contacting both the diamond wheel and the sample simultaneously.

1120 Via Callejon ■ San Clemente ■ California ■ 92673 ■ USA
Telephone: (949) 492-2600 ■ Fax: (949) 492-1499

e-mail: info@southbaytech.com
www.southbaytech.com

DIAMOND WHEEL	CUTTING TIME	THICKNESS (MM)	VARIATION (MM)
DWH4123	12 hours, 20 minutes	1.850 – 1.910 mm	0.060
DWH4121	13 hours, 12 minutes	1.370 – 1.540 mm	0.170
TEST Diamond wheel	8 hours	1.940 – 2.070 mm	0.130

Table 1: Cutting times and thickness variations of diamond wheels cutting 100 Steel: 6 Chromium sample

3.0: Results

Cutting times of the samples were found to be quite long. Each diamond wheel cut the sample well, however some differences in surface roughness and cutting times were found. Each diamond wheel and the subsequent image of the surface under the optical microscope is given below.

DWH 4123

This diamond wheel is classified as high concentration, fine diamond particle size (320 mesh). Cutting time was 12 hours, 20 minutes. The surface finish produced was very uniform and relatively smooth. No large variation in surface scratches were found, and no diamond particle embedding, grain pullout, or other artifacts were observed in the specimen.

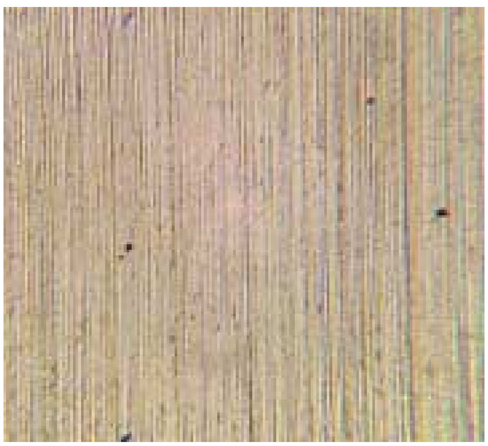

Figure 2: Optical microscope image of surface following cutting on the Model 650. The scratch pattern produced is extremely uniform with no evidence of grain pullout or diamond embedding. Inverted microscope, reflected light image, 200x magnification.

DWH 4121

This diamond wheel is classified as high concentration, coarse diamond particle size (120 mesh). Cutting time was 13 hours. The surface finished produced was quite rough in comparison with the DWH4123 surface. Some pullout or diamond embedding can be observed, and is indicated by the arrows. The scratches produced in the surface are also much rougher than seen in the fine diamond wheel case.

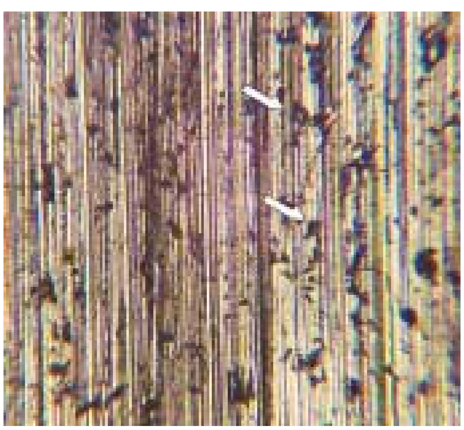

Figure 3: Optical microscope image of surface following cutting on the Model 650. The scratch pattern produced is rough and some material pullout is observed. Inverted microscope, reflected light image, 200x magnification.

1120 Via Callejon ■ San Clemente ■ California ■ 92673 ■ USA
Telephone: (949) 492-2600 ■ Fax: (949) 492-1499

e-mail: info@southbaytech.com
www.southbaytech.com

Test Diamond Wheel

This diamond wheel is a test wheel from a different manufacturer. The diamond particle size is approximately 120 grit, and the concentration is high. Cutting time for this wheel was 8 hours. The surface of the sample appeared much rougher than with the fine diamond wheel used in previous cutting experiments. Also, diamond pullout and embedding appears to have taken place on the surface of the specimen, causing some artifacts as a result.

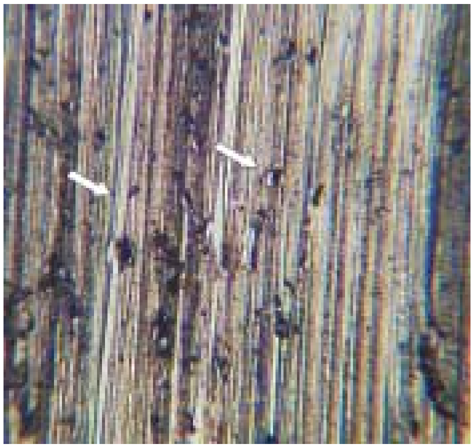

Figure 4: Optical microscope image of surface following cutting on the Model 650. The scratch pattern produced is much rougher as compared with the fine diamond wheel cut surface. Arrows indicate areas of pullout that may be due to the diamond wheel cutting process. Inverted microscope, reflected light image, 200x magnification.

4.0: Conclusions

The Model 650 is an excellent tool for cutting a wide range of materials, including hard steels such as the material cut in this experiment. Fine diamond wheels were found to produce excellent surfaces in the as-cut condition, with a noticeably long cutting time. Variation in section thickness changed depending upon the diamond wheel used, with a significant difference seen with the coarse diamond wheels.

Cutting a very hard material such as the one discussed in this paper can be done with excellent results using the Model 650. Although the cutting times were longer than with traditional, high speed cut off machines, reduction of heat damage at the specimen / wheel interface was observed using the low speed diamond saw. With the proper selection of dimaond wheels, it is possible to produce a relatively uniform surface finish with little damage.