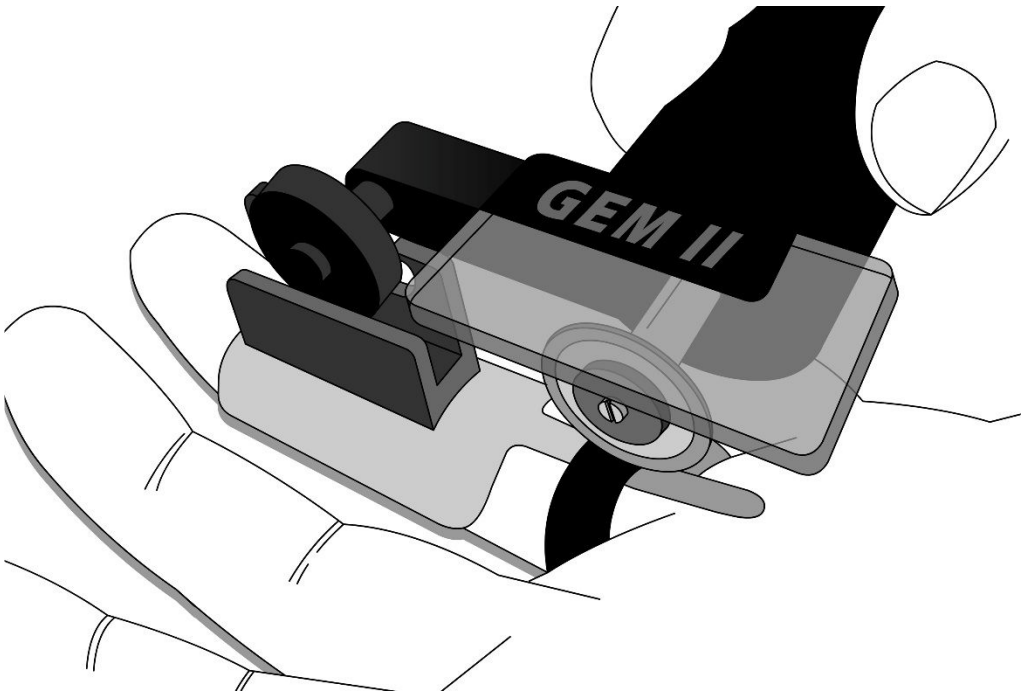


# GEM II

Battery Powered Ring Cutter



## Cutting Procedure For Ultra Hard Metal Rings

Cutting tests carried out using the GEM II battery powered ring cutter on jewellery rings made from Tungsten, Titanium and Stainless Steel.

Source of test rings made from Tungsten, Titanium and Stainless Steel: ARGOS

Non-jewellery ring: Brass – Toolstation

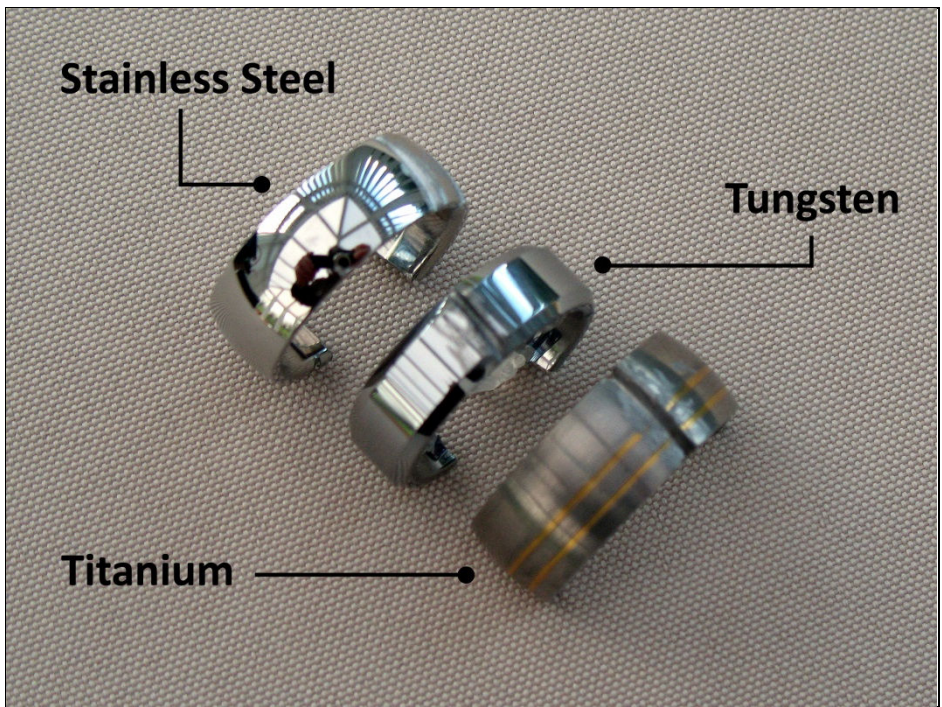
## Ring Material Tests

RING MATERIAL	WIDTH (mm)	THICKNESS (mm)	WEIGHT (gms)
Tungsten Argos Ref: 240/8057	7	2.30	12
Titanium Argos Ref: 240/8909	9.5	2.6	4.4
Stainless Steel Argos Ref: 240/7663	8.0	2.5	7
Brass (Plumbers Olive)	6.4	1.0	N/A

## Ring Material Features

RING MATERIAL	DESCRIPTION	HARDNESS (MOHS Scale)
Tungsten	Highly polished, mirror like finish. Colour similar to cobalt steel ballrace. Densest and heaviest of the metals tested as well as being extremely hard.	7.5 to 8
Titanium	Predominantly supplied in a matt grey finish, very light weight and could be mistaken for aluminium but unlike aluminium it is very hard.	6 to 6.5
Stainless Steel	Highly polished and silver in colour. Quite hard.	5.5 to 6.3
Brass (Plumbers Olive)	Gold/Copper like in colour. Relatively soft.	3 to 4

MOHS Scale	
Soapstone	1
Gold, Silver & Aluminium	2.5 - 3
Copper	3
Brass	3 - 4
Mild steel & Platinum	4 – 4.5
Stainless steel	5.5 – 6.3
Titanium & Jade	6 – 6.5
Tungsten	7.5 – 8
Diamond	10



**Power Source Deployed:**

4 x AA Size 2500 Mah fully charged NiMh rechargeable batteries.

**Procedure:**

For all metals featured in the tests, excluding Brass, the diamond disc was selected. Owing to the high tensile strength of the rings, 2 cuts are required to be made with the diamond disc at opposing sides of the ring. The first cut to a depth of approximately 75% of the thickness of the ring. This first cut is to reduce the tension in the ring. The second cut, at a location approximately 180 degrees to the first cut, is to go all the way through the ring. The blade of the screwdriver, provided in the GEM II kit, will be inserted into the cut and twisted to open the ring.

To reduce the heat in the ring and frictional wear on the cutting edge of the disc, liquid detergent (Fairy Liquid) was repeatedly squirted on to the cutting site. Liquid detergent closely resembles an oil and water mix deployed in engineering during milling and turning to cool and reduce frictional wear on drill bits.

# Tungsten Ring

Tungsten Ring Cutting Test – 3 x Diamond Disc		
Cutting Location No.	Cutting Time (min)	Cooling Time (min)
1	3	-
Disc Replaced	-	-
2	3	-
Disc Replaced	-	-
2	1 (ring cut through)	-
1	2 (ring cut through)	-
	<b>Total: 9 minutes</b>	<b>Total: 0 minutes</b>
<b>No. of discs used: 3</b>	<b>Overall Time Taken: 9 minutes</b>	

Three diamond discs were deployed; all three had virtually no diamond grit remaining on disc's cutting edge.

Due to the very high tensile strength in the Tungsten ring, the tension relieving cut of 75% of the thickness of the ring did not weaken the tension sufficiently to allow the prizing apart of the ring. It was decided to cut all the way through the ring in both locations.

The integrity of the cutting edge of the disc was established at the outset and periodically during the cutting process.

Owing to the fact that the cutting edges of all three diamond discs were virtually completely smooth after the above test a two disc cutting test was abandoned.

# Titanium Ring

Titanium Ring Cutting Test – 3 x Diamond Disc		
Cutting Location No.	Cutting Time (min)	Cooling Time (min)
1	3	-
Disc Replaced	-	-
2	3	-
Disc Replaced	-	-
2	4 (ring cut through)	-
Attached 2 <sup>nd</sup> <i>used</i> cutting disc as this had more grit on cutting edge.	-	-
1	3.5	-
	<b>Total: 13.5 minutes</b>	<b>Total: 0 minutes</b>
<b>No. of discs used: 3</b>	<b>Overall Time Taken: 13.5 minutes</b>	

*\* A fine layer of grit was left on the cutting edge of all three discs, suggesting very limited re-use.*

## Titanium Ring (Continued)

Titanium Ring Cutting Test – 2 x Diamond Disc		
Cutting Location No.	Cutting Time (min)	Cooling Time (min)
1	5	-
Disc Replaced	-	-
2	5	-
-	-	-
Reused disc with most residual diamond grit left on the cutting edge	-	-
1	1.5 (ring cut through)	-
2	2	-
	<b>Total: 13.5 minutes</b>	<b>Total: 0 minutes</b>
<b>No. of discs used: 2</b>	<b>Overall Time Taken: 13.5 minutes</b>	

**\* The cutting edges of the discs were too worn for re-use.**

The actual cutting times between three disc and two disc usage were identical.

In the above tests the tension relieving cutting depth had to be increased from the normal 50% - 75% of the thickness of the ring to 90% due to the high tensile strength of the titanium. This would allow for prizing the ring apart using a screwdriver blade.

## Stainless Steel Ring

Stainless Steel Ring Cutting Test – 2 x Diamond Disc		
Cutting Location No.	Cutting Time (min)	Cooling Time (min)
1	3	-
2	3	-
Disc Replaced	-	-
2	1 (ring cut through)	-
<b>No. of discs used: 2</b>	<b>Overall Time Taken: 7 minutes</b>	

Two discs were deployed, the 2<sup>nd</sup> disc was in use for just 1 minute and as a consequence the disc had ample grit left on the cutting edge allowing for future usage.

Stainless Steel Ring Cutting Test – 1 x Diamond Disc		
Cutting Location No.	Cutting Time (min)	Cooling Time (min)
1	3	-
2	5 (ring cut through)	-
<b>No. of discs used: 1</b>	<b>Overall Time Taken: 8 minutes</b>	

***\* A very fine layer of grit remained on the cutting edge of the disc but it was insufficient to guarantee effective re-use.***

In both tests the tension relieving cut was to a depth of approx. 75% of the thickness of the ring.



## Brass Ring

Brass Olive Ring Cutting Test – Carbide Disc		
Cutting Location No.	Cutting Time (seconds)	Cooling Time (min)
1	20 sec	-
Ring cutting completed	<b>Total: 20 sec</b>	<b>Total: N/A</b>
<b>Overall Time Taken: 20 seconds</b>		

During the cutting process 15% more Stainless Steel and 45% more Titanium was removed compared to Tungsten.

Adjusted Times For Differences In Ring Width And Thickness		
Tungsten	Titanium	Stainless Steel
9.00 min	9.31 min	6.00 min

## Summary

It was possible to reduce the number of discs used to cut through rings from the number deployed in the original tests except for the ring made of Tungsten.

Stainless Steel: Cutting time with 1 disc took longer than cutting with 2 discs by 1 minutes, though no extended cooling off period was required.

## **IMPORTANT:**

- 1. The application of a lubricant in a frequent and liberal manner is essential to the cutting performance of the disc and the GEM II Ring Cutter's motor. This improves the speed and efficiency of the cutting procedure as it reduces frictional resistance. It also reduces the heat generated in the ring, which will in turn prolong the serviceability of a cutting disc.**
- 2. Verification of the serviceability of the cutting edge of the diamond disc is also essential to its performance. To verify, run your finger around the outer perimeter of the disc and if over 80% of the surface feels smooth, replace the disc before proceeding with the cutting process.**
- 3. Operators must be very conscious in the number of minutes of continuous cutting they have performed. Great care must be taken not to allow the GEM II's motor to overheat. Cutting performance diminishes as the temperature within the motor increases and if left unchecked will lead to permanent motor damage. Procedure as follows:**

**MAXIMUM allowable continuous cutting time 15 minutes followed by a MINIMUM 15 minute rest period to permit the heat generated within the motor to dissipate before resumption of the cutting process.**

- 4. In these tests liquid detergent was used as a lubricant because of its oil-like consistency but any water based gel, such as KY Jelly, moisturising hand lotion or anti-bacterial hand wash gel should produce the same results.**
- 5. Our tests were carried out using 2500 MaH NiMh rechargeable batteries. The four rings were cut through using a single set of fully charged batteries. Although tests were not carried out using alkaline batteries, we estimate that for Tungsten and Titanium rings, two sets of fresh batteries would be required.**

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