

## Diamonds

Natural diamonds are mined and in raw form are not useable for drilling diamonds.



To be used in drilling and milling applications the raw diamonds will be put through several "processing" steps.

**Heat**: Some diamonds will crack when heated so raw diamonds are heat shocked as a first step.

**Physical Conditioning**: Diamonds are placed in a planetary conditioner that places up to 100 G force stresses against each other to round off the rough edges.



The more a diamond is conditioned the more carat weight is lost, so the more uniformly spherical the diamonds are the more they will cost. **Chemically Polished**: The final step is to boil in acids to polish the surfaces of the diamonds.



**BLACK DIAMOND HARDCORE**: As natural diamonds are furnaced (2150F) into a bit or mill they will graphitize on their surfaces and this black oxidation shows up as a dull gray or black coating. When these used diamonds are processed through conditioning and polishing the result is a harder, more wear resistant diamond. We call them "Hardcore".



## DULLING:

Natural Diamonds can dull from two causes.

- 1. Frictional Heat that is not dissipated into the drilling fluid. This temp can easily reach 1500F at the diamond/target interface in extreme cases which can graphitize the few thousandths of an inch on the surface which will eventually cause a flat.
- 2. Fractures from impact loads being applied perhaps in interrupted cuts (when diamond is not in compression).



## Processed Natural Diamonds (grade 1)

<b>Natural Diamonds</b>	Diameter (Sphere)	Carat Weight
12spc	.080″	.083 carat
10spc	.090″	.100 carat
7 spc	.100″	.146 carat
5 spc	.110″	.200 carat
4 spc	.120″	.250 carat
3 spc	.130″	.330 carat
2 spc	.150″	.500 carat
1 CT	.190″	1.0 carat

## Manmade TSD Spheres

Manmade Diamonds	Diameter (Sphere)	Carat Equivalent
2.0mm	.079″	12 spc
2.5mm	.098″	7 spc
3.0mm	.118″	4 spc
3.5mm	.138″	3 spc
4.0mm	.157″	2 spc
5.0mm	.198″	1 carat

Manmade Diamonds (TSD and PDC) are both polymorphic in that there are various mesh sizes of diamond grit that are compacted in a <u>pyrophyllite</u> mold that is put under over 1 million psi and over 3600F. At that HT/HP the diamond powders use a small percentage of cobalt as a catalyst that allows diamond to diamond bonding.

In PDC cutters the diamond layers are bonded to a sintered carbide substrate. If re-heated to over about 1450F the cobalt and diamond expand at different rates which will at least damage the diamond layer if not causing a catastrophic failure. This is why PDC cutters must be brazed into the bit, mill, or reamer it is used in.

In TSD (thermally stable diamond) the HTHP is similar but a substrate is not used and the catalyst is silica which is similar in thermal expansion which allows them to withstand heat up to about 1200C so they can be set in matrix products and mechanically held like natural diamonds.

