The New Mexico Facetor

Volume 17, No. 2, November-December, 1997

In This Issue

Don't forget: next meeting is January 8, 1998 at 7:00 pm. Dues of $20 are due.

The Prez Sez:

By Moss Aubrey, Ph.D.

I recently saw an advertisement in the December 1997 issue of Lapidary Journal (page 110) for "Sunspar", a registered trade name for what is touted as an "excellent brilliant stone replacement for diamonds". Well, that certainly caught my attention. I have been using white sapphire as a naturally occurring stone, which can also be presented as an alternative to diamonds, and I was interested in this other possibility. As I read on, I began to suspect that "Sunspar" sounded like feldspar. Upon reading further, the material was identified as a gem member of the labradorite family, bordering between andesine and bytownite. Hmm, they market feldspar as a replacement for diamond. Let us examine that claim. In fact, let us compare the physical properties of several white natural gemstones.

Group	*Refractive Index (R.I.)*	*Dispersion*	*Hardness*
feldspar	1.56	0.012	6 to 6.5
quartz	1.55	0.013	7
corundum	1.76	0.018	9
diamond	2.42	0.044	10

The above table refers to three of the properties found in gemstones: refractive index, dispersion, and hardness. The *refractive index* (R.I.) is a measure of a gem's refractive power, a critical contributor of brilliance to a faceted gemstone. The *refractive index* measures the ability of a gem to mirror light. A high refractive index enhances a gemstone's ability to totally reflect the light rays that enter it. *Dispersion* is the ability of a gem to differentially refract the various colors of the spectrum, critical to a stone's "fire". When a white light ray enters a gemstone at an angle, it will have its colors separated and spread out. This spreading is termed *dispersion*. A good example of *dispersion* is the rainbow created by a prism. The higher the dispersion, the more the light will be separated into different colors. *Hardness* has no bearing on optical performance, but it is crucial to a stone's life span if the stone is to be set in jewelry. *Hardness* refers to the power a stone possesses to resist abrasion. It measures the ability of a gemstone to resist damage when a pointed fragment of another material is drawn across its smooth surface. Gemstones are given a specific place in the standard scale of *hardness* called the Mohs scale, 1 for the softest and 10 denoting the hardest. Examination of these characteristics quickly reveals both the similarities and the dissimilarities between these four gemstone materials.

Feldspar is very similar to quartz, except that it is not quite as hard as quartz. I have purchased feldspar and have faceted feldspar. From my experience with feldspar, I caution my customers to treat the material rather carefully. I state that feldspar is not a good choice for rings, especially for a man's ring. I recommend wearing feldspar in earrings, pendants, and pins.

Further examination of this table on gemstone properties reveals that corundum is actually much more similar to diamond than to either feldspar or quartz. I have offered white sapphires as an alternative to diamond, as I believe that they are quite attractive, more brilliant, and more durable than feldspar. It seems that feldspar could be offered as a reasonable alternative to clear quartz, at least in small sizes. However, I have yet to see anyone festooned in fabulous jewelry set with clear quartz.

The advertisement continues to describe "Sunspar" as a colorless to white yellow in small sizes and champagne to straw on larger sizes. I have inspected this material, I have cut this material, and I have seen no pieces that would be water white or near colorless. At best, the color may match the lower grades of white diamond (T or lower), or it could be a good match for champagne or for tan colored diamonds. In my experience, very few customers are looking for a replacement in those colors ranges. Replacement or substitution is usually used for commercial grades of white diamonds, grades J through M. I have not seen feldspar that would be a good color match for any of those.

Economically, feldspar has very little commercial value. The advertisers list faceted stones for $12 to $50 dollars per carat, which seems to be a fair price. The problem is that one can buy well cut white sapphire melee for not much more. I suspect that you could find well cut white quartz in larger sizes for even less than the listed prices for "Sunspar".

What bothers me most about this advertisement is that a customer not knowledgeable about gems could think that they are getting more of a deal than they are really getting. Now, don't get me wrong. I think feldspar is lovely. I have made some beautiful jewelry set with faceted feldspar, and I have been quite proud of the finished product. Facet-grade feldspar renders lovely pendant and earring ensembles. However, I believe it is always best to represent something for what it truly is. In this case, feldspar is a nice obscure gem material with little economic value. If this were my business, then I would promote feldspar as a naturally occurring gem material not often seen outside specialty collections. Everyone who can appreciate what colored gemstones have to offer should definitely add some faceted feldspars to their collections.

I find that an honest approach, eschewing the salesmanship as much as possible, serves all of us well in our dealings with gemstones, both professionally and personally. When dealing with precious commodities of gemstones and jewelry, don't confuse the customer and never misrepresent your merchandise.

Minutes of the NMFG Meeting

November 13, 1997

By Nancy L. Attaway

President **Moss Aubrey** called the meeting to order at 7:15 p.m. and welcomed all members and visitors. Moss asked everyone to introduce themselves. Several new members were present at the meeting.

Treasurer's Report

Treasurer **Bill Andrzejewski** reported:

Heading	*Total*
Previous Balance	$829.24
Expenses	$258.65
Deposits	$262.00
Balance Forwarded	$832.59

Old Business

Guild Librarian **Susan Wilson** brought many publications from the Guild library for members to check out and enjoy. Susan also displayed the fine reference books that were donated by **Edna Anthony**, Guild Gemologist. Susan keeps all of the books and publications of the Guild library in a computerized data base.

Guild Editor **Nancy Attaway** mentioned that some back issues of the Guild newsletter are available.

Elaine Weissman and **Louie Natonek** plan to meet soon to perform an audit of the New Mexico Faceters Guild treasury account books. The audit report will be presented during the January meeting.

New Business

Heidi Ruffner reminded the Guild that the New Mexico Regional Science and Engineering Fair is scheduled for February of 1998. Several Guild members will be asked to serve as judges. The Guild will continue to support the science fair by providing a $100 savings bond to the best entry relating to crystallography and mineralogy.

Mark Guerin, a jeweler involved in the New Mexico Jewelers Association, announced that the "All That Glitters" 1997 jewelry and gemstone competition raised over $3,000 for the New Mexico Museum of Natural History. This amount will go toward future purchases of gems and minerals to add to the museum collection. All entries from the "All That Glitters" competition are currently displayed in the New Mexico Museum of Natural History, along with several traveling exhibits featuring award-winning gemstones and jewelry and beautiful antique jewelry.

Heidi Ruffner announced the dates for the next Albuquerque Gem Artisans Trade Expo's annual show (AGATE). The AGATE Show will be held at the Continuing Education Center on University Blvd. November 29th and 30th. The Show features original work rendered by local artisans, including some members of the New Mexico Faceters Guild.

Vice-President **Susan Wilson** organized the Guild Christmas Party this year. The Christmas Party Chairman, **Eileen Rosson**, now **Mrs. Troy Smith**, was involved with preparations for her wedding and honeymoon and asked Susan to reserve a time-slot at a nice restaurant. The Guild Christmas party will be held at the Rio Grande Yacht Club on Yale Blvd. December 13th from 3:30 p.m. to 7:00 p.m. Dress up, bring a gift, and join the fun! The Christmas party is our big social event of the year.

Several members mentioned that they read on the Internet about a type of irradiated brown cats'-eye chrysoberyl from southeast Asia that has been circulating the gem and jewelry market. Tests revealed the gem stones to contain very dangerous levels of radiation, more than fifty times the U.S. safety limit. Guild mineralogist **Paul Hlava** thinks that the stones were bombarded with neutrons in a nuclear reactor. However, the story given to some vendors claims that the gemstones were merely heat-treated.

Show and Tell

The show and tell case displayed many glittering gems and jewelry. Santa's elves have been very busy.

Waylon (Dick) Tracey brought a lovely ladies' necklace he cast in sterling silver. Waylon used a matt gun to form the wax design and cast the piece with his centrifuge. He set cabochons of green agate and red carnelian in sterling silver bezels at the center and the clasp of the necklace.

Moss Aubrey brought a Russian hydrothermal synthetic alexandrite he faceted in an emerald cut, along with several representative pieces of the rough. Moss also showed a man's gold ring with a beautiful steely blue Montana sapphire he faceted in a flasher cut round.

Larry Plunket displayed a large oval New Mexico labradorite he faceted in an Easter egg design with a cross in the culet area. He left the cross unpolished and used a 3,000-grit pre-polish to better show the cross in the pavilion. This faceting design was developed by Robert Strickland. Larry said a large, fat piece of rough is required to successfully render the design because it calls for a temporary preform. Some members thought that this preform requirement could be negotiated by working with both the depth and the girdle perimeter. **Ernie Hawes** will have more to say about preforming in this issue.

Elaine Weissman displayed beautiful earrings she made for a client who wanted earrings that followed the curvature of the ear, rather than dangling from the ear lobe. Elaine incorporated a "C" shape in gold with "C" shaped gold wires tipped with small diamonds following the curvature and a pear-shape blue topaz at the lower end. She named her creation "blue comet".

Nancy Attaway faceted four Pakistani peridots in flasher cut rounds, scheduled for stud earrings. This gem material from Pakistan exhibits a very bright green hue. Nancy faceted five tourmalines from Brazil that ranged in color from bright pink to pink-brown to red-brown; two small flasher cut rounds, two large flasher cut rounds, and one rectangular tablet ready for **Steve** to carve. She salvaged the tablet from a piece that was originally slated for an emerald cut, where the bottom sheared off when faceting the pavilion. Nancy showed three Bolivian ametrines, two faceted as matching triangular tablets with room for Steve to render a reverse intaglio carving. The third ametrine was rendered in a modified barion square cut with a flat culet area. Steve carved a sphere in the flat area, and the sphere shape flashed around the pavilion.

Field Trips

This is a good time to plan field trips for the spring. Contact **Scott Wilson and Merrill O. Murphy.**

Future Programs

Guild Mineralogist **Paul Hlava** will present a lively discourse on the elements responsible for color in gemstones for the January meeting. Paul plans a presentation on gemstone phenomenon later in 1998.

Herb Traulsen has organized his many slides in preparation for an informative slide show on the opal fields and pearl farms of Australia for the March meeting. The slides were taken during Herb and Maria's trip to Australia and New Zealand.

Susan will try to schedule **Jane R. Ward**, who addressed the Guild so well in September on the diamonds of Ghana, to present information on Yogo sapphires for the May meeting. Both Jane and her father, Ken Ward, a facetor, performed inventory counts to help estimate the value of Yogos for Citibank some years ago.

Refreshments

Elaine Weissman and Merrill O. Murphy (thanks to his wife, **Jerry**) brought baked refreshments to the meeting. **Susan Wilson** and **Maria Traulsen** volunteered to bring refreshments to the January meeting.

Program Speaker

Guild member **Will Moats** gave a slide presentation of the geyser activity found in Yellowstone National Park. Besides being an accomplished gemstone facetor, Will Moats holds a masters degree in geology and professes a passion for the rare geo-thermal activity known to exist in very few places on Earth.

Will stated that the recognized bible of geyser information is the book entitled "Geysers of Yellowstone" by Scott Bryan. Will also subscribes to the publication "Geyser Observation and Study Association and receives regular e-mail from a geyser internet organization.

Will Moats defined a geyser as "a hot spring in which eruptive activity is induced by the boiling of ground water at depths within a plumbing system, which forcibly ejects water out of a vent in an intermittent fashion". Because geysers have height, duration, and intervals, perpetual spouts and intermittent sprays are not considered to be geysers. Yellowstone National Park contains over 500 geysers, compared to the 200 geysers on Russia's Kamchatka Peninsula and the 48 geysers in Chile.

Will said that the geysers in Yellowstone Park are grouped into nine major geyser basins: Upper, Midway, Lower, Norris, Gibbon, West Thumb, Lone Star, Shoshone, and Heart Lake Geyser Basins. Most of the geysers are located in the southwest quadrant of the park. Six of the major geysers can be predicted: Old Faithful, Castle, Grand, Daisy, Riverside, and Great Fountain Geysers. Geysers tend to occur in groups, but exceptions do exist, such as the Lone Star Geyser.

John Colter is considered to be the first mountain man to view the geyser basins of Yellowstone during his visit in 1807 or 1808. Visits by other famous mountain men inspired incredible stories of hot water shooting into the air, which were often thought to be very tall tales. Investigations by exploring and surveying parties revealed the true existence of marvelous geologic features. The images created by painter Thomas Moran and photographer William H. Jackson conveyed these natural thermal wonders to the public. Congress created Yellowstone National Park in 1871. Park visitors may enjoy the many geysers and the diverse animal population most of the year.

Susan Wilson Earns Perfect Score

From Gems and Gemology Fall 1997

Nearly four hundred persons from all over the world participated in the Gems and Gemology Challenge, a written exam that tested knowledge of gemstones. Some received a perfect score, including one person from New Mexico who was listed as Susan M.G. Wilson, Ph.D., New Mexico Faceters Guild Vice-President and Guild Librarian. Congratulations!

In the News

Russia and DeBeers Again

Source: The Economist October 25, 1997

Russia has agreed to sell most of its diamonds in 1998 through DeBeers' Central Selling Organization. DeBeers is contracted to purchase at least $550 million worth of diamonds from the Russian producer, Almazi Rossiya-Sakha.

More Pearls More Often

Source: New Scientist October 4, 1997

Pearls need time to form inside oysters, and few molluscs survive long enough to produce more than one pearl. Biotechnologists in Massachusetts have extracted animal genes that make growth-promoting proteins and placed them into pearl-growing oysters. This makes the oysters mature faster and promotes the production of pearls sooner. The first set of oysters to undergo this new treatment grew two and one half times faster than current technology. The new treatment also yielded larger pearls in less time.

New Emerald Treatment

Source: Colored Stone November/ December 1997

Disgusted with the quality and consistency of emerald treatments, Arthur Groom developed his own treatment for enhancing the color and clarity of emeralds. He claims that Gematrat, his new technique, is consistently colorless, stable, and permanent. Gematrat treated emeralds can be steam cleaned, placed in ultrasonic cleaners, and easily recut.

New Life for Red Beryl Mines

Source: Colored Stone November/ December 1997

Utah's Gemstone Mining, Inc. acquired a one-year option extension to evaluate the feasibility of mining red beryl from the Ruby Violet Mine in Beaver County, Utah. All cut and uncut stones produced by Kennecott, their production records, and their marketing data were acquired in the new agreement. One of the major concerns in mining the red beryl is the guarantee of a supply.

Tanzanite Simulant Legalities

Source: Colored Stone November/ December 1997

A legal battle ensued over the trade names for two tanzanite simulants. Cortanite, produced by Gemstones International, and Coranite, produced by the Lannyte Company, were considered to be too similar in wording. Gemstone International decided to change its tanzanite simulant trade name to Chortanite. Confusion exists with a synthetic garnet, Coranite, sold as two different stones. Coranite-blue, more blue than purple, is marketed as Coranite. Coranite-purple, more purple than blue, is marketed as Tanavyte.

Radioactive Gems for Sale

Source: JCK December 1997

Reports warn of dangerous radioactive cat's eye chrysoberyl being sold at shows in Bangkok, Hong Kong, Japan, and the U.S. The discovery began with a dark chocolate brown cat's eye oval that was measured to contain more than 52 nanoCuries per gram, fifty times the U.S. radiation safety limit. The stones appear to have been bombarded with neutrons in a nuclear reactor.

Peach Colored Gold

Source: Modern Jeweler November 1997

A newly patented 18-karat gold alloy from Hoover and Strong features a peach hue. The company enjoyed success with their 14-karat gold peach alloy and decided to develop a peach tone in 18-karat.

New Digs for America's Crown Jewels

Source: Modern Jeweler November 1997, JCK November 1997, and Lapidary Journal December 1997

Sixteen million dollars bought a new twenty thousand square foot hall in the Smithsonian Institution's National Museum of Natural History in Washington, D.C. to better display America's crown jewels. Visitors now enter the new Janet Annenberg Hooker Hall of Geology, Gems, and Minerals through the Harry Winston Gallery, new home of the 45.52-carat Hope Diamond. The crown jewels include: the turquoise and diamond Marie-Louise Diadem, the 263-carat Napoleon diamond necklace, the De Young red and pink diamonds, the 127-carat emerald-cut Portuguese diamond, the 858-carat Gachala emerald, the Hooker emerald, the 15th century Inquisition necklace, the 432-carat Logan sapphire, the Hall sapphire and diamond necklace, the Marie Antoinette diamond earrings, the Rosser Reeves ruby, and the Star of Asia and Star of Bombay sapphires.

Fraud Found in Hawaii

Source: National Jeweler November 1, 1997

Reports speak of some unethical dealers at trade shows in Hawaii who were found selling underkarat jewelry and mislabeled gemstones. White gold and sterling silver jewelry were reported sold as platinum and without proper hallmarks. Fracture-filled and other treated diamonds were also sold without any disclosures. However, the Federal Bureau of Investigation is not labeling the case a priority.

GIA Researches Ideal Cuts

Source: National Jeweler November 16, 1997 and JCK September 1997

New research at the Gemological Institute of America reveals that other cuts for diamonds are as brilliant or more brilliant than the ideal cut label of diamonds. The findings from the GIA study is part of a major GIA project researching diamond cuts, identifying treatments of natural diamonds, investigating quality grading issues, and evaluating instruments. A full report will be published an issue of Gems and Gemology sometime in 1998.

Ametrine Promo on QVC

Source: National Jeweler November 16, 1997

The QVC home shopping channel ran a promotion of ametrine jewelry, calling the naturally-occurring quartz “sunrise ametrine”. QVC gemstone buyers and a film crew made the twelve-hour boat journey on the Paraguay River to visit the Anahi Mine, the only known ametrine mine, in the Bolivian jungle. Faceters for QVC were asked to create a “kaleidoscope “effect with the colors swirling within the stone, rather than basic emerald cuts.

More on Bolivian Ametrine

Source: JCK November 1997

Situated in the heart of Bolivia’s rain forest, the Anahi Mine remains the world’s only quantity producer of large amethyst and ametrine. Mine owner, Ramiro Rivero, and his group, Minerales y Metales del Oriente, forecast tighter control over supplies. They plan to introduce a new line featuring unique and high quality faceted stones that showcase the diverse hues found in their mine.

Buyers Beware of Dyed Type-B Jadeite

Source: National Jeweler December 1, 1997

Reports from Hong Kong state that dealers are selling large quantities of partially dyed type-C jadeite as the more expensive type-B grade of jadeite. Because both jadeites show similar specific gravities, detection is difficult. Treaters now use very sophisticated dye techniques and are more skilled at hiding treatment by blending the colors. The type-A grade of jadeite is all natural with no chemical treatments or enhancements of any kind. The type-B grade of jadeite is bleached and impregnated with polymers. Since type-A jadeite is so rare, the type-B jadeite has become widely accepted.

Testing may be accomplished in three ways. A microscope can detect the dyes that tend to concentrate in fissures between grain structures. A prism spectroscope can detect the presence of dye in much smaller concentrations. A Fourier Transformation Infra-Red Spectrometer can distinguish between both type-A and type-B grades of jade.

Cyclone Destroys Black Pearl Farms

Source: National Jeweler December 1, 1997

On November 1, Cyclone Martin struck the Cook Islands with high winds, powerful waves, and torrential rains. The cyclone destroyed more than one hundred black pearl farms and many villages, killing twenty people. Local farmers still hope that underwater shell beds, where oysters are strung with anchored lines, survived.

Argyle Underground

Source: JCK December 1997

Underground mining operations are on hold for now, as decided by the joint venture between Argyle Mine RTZ-CRA and Ashton Mining. A feasibility study found the proposed block caving technique very costly and containing serious technical risks. The mine reports being the largest producer of rough diamonds in the world in terms of volume for the last twenty years. Ore reserves inside the open pit should continue until 2003, and the open pit may then be expanded.

Moissanite Poised to Sell

Source: JCK December 1997

The North Carolina company, C3, Inc., plans to offer its first commercial supplies of moissanite early next year as a substitute for diamond. Moissanite is a lab-grown silicon carbide with the hardness, appearance, and thermal conductivity all similar to diamond.

Fine Cabinet Makers Don’t Use Chain Saws*

by Stephen W. Attaway, Ph.D.

When Nancy and I began faceting, we were plagued with scratches. It was not until we heard a presentation several years ago by Scott Wilson, Ph.D.

that we were able to correct our scratching problems.

Scott was an optical component fabrication engineer (now he builds machines that measure the size of the fine lines found on computer chips). To obtain the exact shape of a mirror, he used an ion beam to remove very thin layers and correct the surface contour of the mirror to within a small number of atoms in thickness. Any subsurface damage would cause problems for his ion beam process, the evidence showing as pits and surface defects that became progressively worse as material was removed from the surface. The ion beam process literally “uncovered” the subsurface damage and left it exposed on the surface of the mirror.

In his talk to the New Mexico Faceters Guild, Scott discussed techniques for measuring damage caused by the grinding process. Using special optical techniques based on light scattering from internal fractures, Scott and his colleagues were able to estimate the depth of the damage caused during grinding. He showed that grinding damage could extend approximately 4 to 10 diameters of the grit size below the surface.

This damage can only be removed using the next smaller grit size. For example, if you are grinding with an 220-grit lap, (0.06 mm. grit diameter) approximately 0.6 mm. must be removed to insure that no damage is hiding below the surface. Enough material must the removed with each finer grit to insure that all the damage from the previous grit is ground away.

Often, the micro-cracks caused by the grinding process are not visible. The cracks will be there. However, they will be very hard to see because no stress is holding the cracks open. Scott showed examples of optical flats used in the ring laser gyroscopes that form the core of the navigation system on jet aircraft. The surfaces appeared to be perfectly polished when examined under a normal microscope. Using his light scattering technique on what appeared to be a perfectly polished surface, the damage from the sawing and grinding process was clearly visible underneath this nearly perfect surface.

Think about when scratches occur. They appear when you are doing the final polish, applying lots of pressure. If the stone is not perfectly flat with respect to the lap, it is quite possible that a small chunk of damaged material can break loose from the stone and roll across the surface of a facet.

Ever since we began thinking about removing the damage layers left by the previous grinding steps, we do not get any scratches. Getting a good pre-polish means more than just grinding at 1200 or 3000 grit. It means working each grit (i.e. 80, 220, 600, 1200) to remove the damage made by each grinding step. If a grit step is skipped, then the next smaller grit will need to be worked much longer to ensure the proper removal of damage.

Here is an estimate of the damage layer thickness for each grit size (using 4X as the minimum and 10X as the maximum) (For more info on grit sizes see the *Gemstone & Mineral Data Book* by John Sinkankas).

TABLE 1. Damage layer thickness for different size grits.

Grit size	*min thickness (mm)*	*max thickness (mm)*
80	1.04	2.6
180	0.34	0.86
220	0.24	0.60
325	0.12	0.30
600	0.06	0.16
1200	0.03	0.07
3000	0.01	0.03

Often, the coarser grits take more effort to clean up than any time they might save in material removal.

Now, you ask, how can I get a fast cutting lap at these grit sizes?

The Optimal Lap

In addition to the grit size, several other factors affect the depth of the damage layer generated during the grinding process. For example, the grinding force, the lap rotation speed, the type of lubricant, the type of bond, the backing material, and the amount of diamond in the lap can all effect the cutting characteristics during grinding.

Several different bonding materials are used to bond the diamonds to the lap. The “metal-bond” laps attach the diamond by plating the diamond onto a hard metal surface using a nickel plating process. “Sintered” laps are made by pressing and heating a mixture of diamond with metal powders until the metal starts to melt. The popular Dyna laps are made by mixing diamond with acrylic paint. In the optics industry, a “resin-bonded” lap is used. In these laps, the diamond is held in place with an epoxy-like resin combined with another binder.

The tendency in the lapidary industry is to supply harder grades of bonding material under the assumption that they will wear less rapidly. Much smoother cutting, however, can be obtained with a softer lap.

Consider the effect of taking a steel hammer and striking a piece of glass. The high density and high stiffness of the hammer will cause considerable amount of shock in the glass and yield deep cracks. If a rubber mallet is used, then little shock will occur in the glass. A rubber mallet is less dense and not as stiff as the glass. Consequently, it will deform instead of the glass. Likewise, the nature of the bonding material used in a lap will greatly effect the depth of the damage layer generated during the grinding process.

The quantity of diamond in the lap also greatly affects the cutting rate. Obviously, the more diamond there is in a lap, the more points of contact will be at the cutting face, and the faster the cutting rate will be. There is a maximum amount of diamond that one can put into a lap. If we imagine diamond stacked like oranges in a crate, then the maximum amount works out to be roughly 72 carats per cubic inch. Because of economic constraints, most laps have much less than the maximum. If you are curious about just how few diamonds are in contact with your stone, then put your lap under a microscope and count the number of diamonds you see in a given area. For most laps, you won't be impressed.

One of the big problems is that it is hard to hold those diamonds in place. If you try mixing some diamond powder with epoxy, you will find that the diamond has a tendency to pop out of the epoxy. Epoxy does not like to stick to the surface of a diamond. Most lap manufacturers make up for this by adding more binder, meaning less diamond and a slower cutting rate.

I have found one diamond manufacturer, National Diamond Lab (1-817-599-6920), who has solved the problem of how to hold the diamond in place. They coat their diamond with a chromium plating process. The diamond is first coated with a very thin layer of chromium, and a very thin layer of nickel is then plated to the chromium. A very thin copper layer is then plated to the nickel. This series of thin layers is barely visible, however, the diamond is tightly held within the epoxy bond. It seems that some epoxies love to stick to copper. National Diamond Lab presses small ductile copper spheres between the spaces to give added strength and toughness.

I have used resin-bonded tools made by National Diamond Lab for gem carving. With 100 percent diamond in a resin bond, the cut is fast and generates a minimal damage layer. In addition, the high quantity of diamond makes these tools very wear resistant. Unfortunately, National Diamond Lab does not make laps for faceting.

Inland Diamond Products (1-800-347-2020) does make resin bonded labs. Inland manufactures a diamond grinding system used to make lenses for eye glasses. They also made a variety of other diamond products.

I tried Inland's resin bonded "lap-caps". These are six inch laps that have a PSA backed liner that you can press onto a worn out lap. They cut relatively fast and generate little damage. However, in the finer grits, they did not have as much diamond as the products supplied by National Diamond Lab. Consequently, the high-pressure of a grinding a small stone could significantly mark grooves in the laps. In addition, the lack of 100 percent diamond means that they will not cut near as fast.

I'm still looking for the perfect lap. Unfortunately, the large manufacturers of diamond products view the lapidary industry as too small a market. The biggest market for diamond products, surprisingly, is the re-polishing of floors. One representative at 3M estimated the cost of re-polishing marble floors at three dollars per square foot. Just like our stones, the stone floors require working with multiple grits. Now, just think about where all the big banks spend their money....getting a good polish with a minimum of damage.

*The title of this article came from a comment made by Jonathan L. Rolfe on Faceters' Digest. I had posted the grit size table on Faceters' Digest, an internet forum for faceting. His analogy was just to good to pass up. Thanks, Jonathan.

Lets Talk Gemstones

By Edna B. Anthony, Gemologist

Cordierite

A Cyclosilicate

Cordierite was known and used as a gemstone in Sri Lanka long before the French geologist-mineralogist Pierre Louis Cordier accurately described it in 1809. Cordierite was identified as a specific mineral and named in 1813. This othorhombic (pseudohexagonal) hydrous silicate of aluminum and magnesium, where ferrous iron replaces some of the magnesium, is the lower temperature form of the dimorphs indialite and cordierite. This higher temperature hexagonal indialite is isostructural with beryl.

The distribution of aluminum is random throughout its rings of $(Si,Al)_6 O_{18}$. In the ordered six-fold ring structure of cordierite, aluminum occupies the tetrahedral beryl sites, and magnesium and ferrous iron take the octrahedral aluminum sites, while a common oxygen is shared by two SiO_4 tetrahedra. The channels may contain H_2O molecules. In this configuration, with the exception of the shared oxygen, a perfect alternation of the Al and SiO_4 tetrahedra exists in all directions throughout the structure. For this reason, the American mineralogist George V. Gibbs believed cordierite should be classified as a tectosilicate.

This blue gemstone is also known as iolite, dichroite, "water sapphire", "lynx sapphire", and "bloodshot iolite". The Greek word "io", meaning the violet flower, is the source of the name most used. Its distinct pleochroism explains the name dichroite. In Sri Lanka, the lighter colored tumbled pebbles were known as "water sapphires". The term "lynx sapphire" denoted the darker indigo blue stones.

Orientation of the table in faceted stones greatly affects the perceived color of the finished gem. Usually, the optimum color is achieved by placement of this facet perpendicular to the direction where the most intense blue is observed. In volume two of "*Precious Stones*", Dr. Max Bauer describes a cut that exhibits the distinct pleochroism of iolite. "This object is attained by cutting a cube, the faces of which are perpendicular to the three axes of the crystal. The cube is mounted by one corner on a pivot, so as to show the three different colored faces, and forms an interesting and remarkable object." Some iolites cut *en cabochon* display opalescense resembling star sapphires. An excellent picture of the hematite platelet inclusions in "bloodshot iolite" appears on page 164 in the "*Photoatlas of Inclusions in Gemstones*" by E.J. Gubelin and J.I. Koivula.

The ferrous oxide content of cordierite influences its color and causes considerable variation in the specific gravity. With the density, hardness, and double refraction indices so similar to those of quartz, cordierite can easily be confused with quartz. However, these same properties help to distinguish it from other blue gemstones. Praseolite is the unusual leek-green colored cordierite. It is both ironic and confusing that some amethyst from Brazil and Arizona changed by heat treatment to a very similar leek-green color is called Praseolite. Distinguishing between the two could depend on optically locating the interference figures or a more sophisticated analysis. Praseolite (cordierite) is biaxial. Praseolite (green quartz) is uniaxial.

Stubby prismatic gemmy crystals and pebbles occur in the gem gravels of Sri Lanka, Burma, and Madras in India. The especially fine material now comes from Madagascar. Other sources include: Karasburg in Namibia, Babati in Tanzania, Bavaria, Orijarvi in Finland, and the area around Murzinka in the Ural mountains. Gems up to two carats can be cut from some crystals found in Haddam and Guilford, Connecticut. Gemmy nodules occur in Virgolandia and Paraiba of Brazil. Granules are found in regions of metamorphosed pelitic (clay) rock, some igneous rocks, and pegmatites throughout the world. Kragero in Norway and Sri Lanka are sites of vitreous massive material containing the red hematite platelets.

Despite its popularity in Europe during the eighteenth century, iolite is not so well known by the public today. Its pleochroism is especially suited to a brilliant lenticular cut and to a fairly shallow step-cut. Iolite is somewhat brittle, but with its satisfactory toughness and a hardness exceeding that of quartz, it adds a sapphire-hue choice to the array of the less expensive, but more durable stones suitable for rings as well as other jewelry.

TABLE 2. Gemstone Properties

SPECIE	*cordierite*
Composition:	$(Mg,Fe)_2 Al_4Si_5O_{18}$
Class:	silicate (cyclosilicate)
Species:	cordierite
Crystal System:	orthorhombic
Varieties:	iolite, bloodshot iolite, praseolite
Colors:	blue, greyish blue, violet blue, grey, yellow, brown, green (rare)
Phenomena:	some opalescense resembling star sapphire
Streak:	white
Diaphaneity:	transparent and translucent
Habit:	crystals, granules, massive
Cleavage:	distinct in one direction; imperfect in other directions
Fracture:	conchoidal and brittle
Fracture Lustre:	vitreous and often greasy
Lustre:	vitreous
Specific Gravity	varies from 2.53 to 2.78
Hardness	7 to 7.5
Toughness:	good
Refractive Index	alpha is 1.522 to 1.558; beta is 1.524 to 1.574; gamma is 1.527 to 1.578; in material from Sri Lanka, alpha is 1.530, beta is 1.534, and gamma is 1.539.
Birefringence:	0.005 to 0.018
Optic Character	biaxial positive, but often negative
Dispersion:	0.017
Pleochroism	usually strongly trichroic; Mg-rich shows as pale yellow, pale blue, and violet blue; Fe-rich shows as colorless and violet.
Ultraviolet Flourescence	inert
Spectra	weak bands: 4260, 4360, 4560, 4920, 5350, 5850, 5930, 6451
Color Filter	not definitive
Solubility	reacts slightly to concentrated acids, but more readily to HF.
Thermal Traits	avoid thermal shock
Treatments	none known
Inclusions	clouds of very small crystals; zircon crystals surrounded by interference colors rimmed with intense yellow; hematite platelets in parallel orientation.

Planning For Adventures In Faceting

By Merrill O. Murphy

Introduction

If your gem-cutting history runs parallel to that of most faceters, you will have cut a number of gems in the various shapes of rounds, squares, rectangles, triangles, hexagons, ovals, marquises, and hearts, or, perhaps, none of the last three. Have you cut any unusual shapes or exotic designs? Have you cut any soft or difficult materials? Did you cut any specialty collections (all from one county or state, all different varieties of one mineral, etc.), created any gem designs, or cut for competition? You mean that have not done these things? Then, you are safely within the description of the average facetor. If being classed as average anything makes you feel uncomfortable, then the five parts of this article fall right down your alley.

PART 1

Faceting Gems With Real Character

Not all gem designs have equal eye appeal for one reason or another. Some gem materials do not look their best when cut in certain faceting designs. Some designs are used so often that they become boring and sort of old hat. Some gem materials are cheaper than others, and, therefore, are seen so often that we tire of them. You can really perk your cheaper materials up with a striking design never seen before in your local jewelry store. If free cash is your problem, here is a way to compete with other faceters. Choose a design that yields the most from whatever material you can afford. Of course, many of these special designs are more difficult, and that is just fine. In meeting the challenge, you become a better facetor without risking pricey gem material in the process.

Where does one find a good selection of proven designs? You simply save every design you see. If you do not have what you need, then merely ask someone who has faceted for years. Get some computer-operating facetor to download it from the DataVue2 files, as there are around 4,500 designs available. I have 11 loose-leaf notebooks full of them. Give me a call at 505-275-3192. I do not have everything, but, if I have what you want, you may borrow it long enough to make a copy.

I have a number of designs that I find especially attractive. I will list part of that special set below. Be aware, however, that the designs I like most will not necessarily be the same set that you would choose. Nor, should they be. Here are a few of those special designs that ring the bells for me.

ROUNDS

Valentine Cut
By Alton R. Walls
An 8-main design with crown mains cut in a heart shape against a domed top.

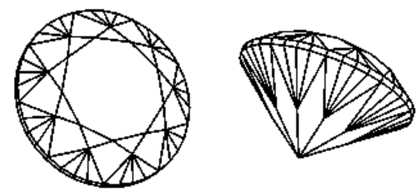
Cartwheel Gem
My copy lists no originator.
Facets on pavilion are vertical bars; girdle is uneven; a bright cut.

Butterfly
by Don Clark
Butterfly pattern on pavilion shows plainly through oversize table.

Round Barion Checker
by Roscoe E. Clark
Apex crown with interesting pattern.

SRB Checker
by Fred W. Van Sant
Apex crown with straight rows of uniform squares - nice.

Cloud Nine
by Louis Natonek
Nine sided design with 36 crown girdle facets.



Mirrored Dome
by Louis Javit
Conventional pavilion where crown facets are floating ovals of various sizes below a small, circular table. Crown, as a whole, is smoothly rounded.

Princess Scintilla Cut
by Perry V. Row
Crown mains are regular hexagons with strange, lacy appearance. Pavilion is too complex, so consider substituting a standard round brilliant pavilion.

The Moon Beam
by Dave Miller
Crown much like the Mirrored Dome, except each oval is made up of eight segments. Pavilion would be better cut as on a SRB.

Eleven Split Mains Brilliant
by Ernie Hawes
Reserve for a fairly large stone; gives lots of twinkle.

TRIANGLES

Trigoda

by Clifford D. Older

An old design that is very modern that uses a rounded triangle with an apex crown.

Cube Illusion Triangle

- by Robert W. Strickland

A remarkable triangle with rounded sides that features an apex crown in a different checkerboard pattern.

Mini Barion Trilliant

- by Alexandre Wolkonsky

A triangle with rounded sides; bright. If your stone size is over 8 mm, I suggest increasing the angle of that pavilion facets 3 and 4 by about one degree and adding facets at indices 16, 48 and 80. For quartz, the angle should be no lower than 41 degrees. (At this point, the design becomes a full barion).

Lucifer

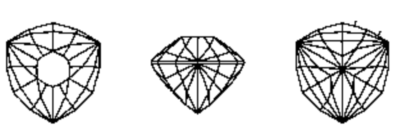
- by Jack Rowland

A cut-corner triangle with a half twist. Again, if your stone is large, add small, full barion facets at pavilion indices 96, 32, 64 at an angle of 41+ degrees.

Tripolar

- by Merrill O. Murphy

Pardon my ego, but I have always liked this one; good for large gems. (*From the Editor: This is one of my personal favorite gemstone designs. I have rendered it about a dozen times in various gem materials with great results, but it never seems to become any easier.)*



Jonanco Sun Cut -

by Vancouver Island Faceters Guild. A modified triangle shape having a crown giving the impression of a circle imposed on a step cut; nice.

Aztec Triangle -

by Merrill O. Murphy

One of my early designs, having chevron facets and an apex crown. The design has fair brightness, despite too many pavilion chevrons that lose light and weaken the triangle corners. The apex crown can be replaced by a conventional table as per the Cardinal-Aztec Triangle, FACETS, Nov. 1987.

Trilliant

by Basil Watermeyer

There are several Trilliants. I suggest Trilliant C. Trilliants are relatively easy to cut and are quite bright.

Tourmaline Triangle 4

- by Sid Word

Bright, especially good for rubellite tourmaline with the table set at right angles to the length of the crystal. Yield is good, since the crystal outline is nearly identical to that of the finished gem.

SQUARES, REGULAR, CUT-CORNER, AND CUSHION

Diamond Checker

- by Fred Van Sant

Very nice checkerboard apex crown with mini barion pavilion.

Diagonal Crown Square

- by Don Serafin

Strange barion with offset facets.

Original Barion

- by Basil Watermeyer (South African diamond cutter)

A design with a design patent. This one has a very interesting background for me. The era was the late 1960's. Donald Fogg of Fogg Jewelry Co. in Albuquerque showed me a recent edition of a trade magazine with a rough drawing of this design. He was interested in buying some diamonds so cut, but wanted to see firsthand what this design looked like in a cut stone. He asked if I would try cutting it in a lesser quality gem material. I worked out the angles and indices and became, I think, the first American to cut the barion design. In 1970, we moved to Winston-Salem, NC. There, I displayed some of my cut stones in a local show. A Virginia lady facetor saw my barion cuts and fell in love with them. At her request, I showed her how it was done. Back home in Virginia, she wrote to me, strongly suggesting that I get the design published. I explained, again, that the design was patented, and that I believed it would not be ethical to publish it. She became much irritated with my stand and eventually published it under her own name in the old Sapphire Faceting Guide. And so it goes.....

Spin-off -

by Norman W. Steele

An interesting, easy cut with a partially rotated table.

Square Bar-barion

- by Robert W. Strickland

This one is a very interesting barion with step-cut crown and rounded corners. The crown corners end up as small areas of square checkering.

Barion Checkerboard

- by Sid Word

The name describes this fine design. The crown is composed of square checkers.

DIAMOND SHAPES AND LOZENGES

A Girl's Best Friend

- by Robert W. Strickland

A cushion-type diamond or lozenge. Pavilion is a simple barion; nice.

FVS-175A

- by Fred W. Van Sant

A very nice lozenge design with a diamond checkered crown and a barion pavilion.

Cushion Lozenge

- by Alexandre Wolkonsky

Brilliant-cut crown and mini barion pavilion.

Endfire 2 -

by William R. Deazley

A brilliant-cut lozenge that looks nice. Cutting data is specified for his unusual machine design. Should be easy to convert to work on most machines.

DESIGNS WITH 5 TO 11 SIDES

Fiver

by Fred W. Van Sant

A five-sided design somewhat resembling the Princess Scintilla (round), having a single-cut pavilion.

Star Of The Northwest

- by Ed Rieks

Five sides; angles for CZ. It has an apex crown covered with diamond shapes. The pavilion is similar, but covered with triangular shaped facets.

Honeycomb

- by Fred W. Van Sant

Six sides, crown made up of small hexagons, table is one small hexagon, and pavilion is a fairly complex barion. The girdle is uneven. Very nice.

Hex-diamonds

- by Fred W. Van Sant

Six sides, apex crown design made up of interlocking diamond shapes. The pavilion is a simple mini-barion.

The Triple Sunrise

by Ruth Bronson

Six sides, with crown of long triangles slanting upward from the corners. The table is a rounded triangle. The pavilion is, also, and made up of long slanting triangles originating from the girdle corners.

Eye Of The Tiger

by Robert Gray

This is a long, canoe-shaped hexagon with a sort of brilliant-cut crown and pavilion.

Septifoil

by Paul A. Head

This one is a seven-sided design, with a brilliant-cut crown. The culet is at the point of a seven-pointed star.

Twirl Agadon

by Don Olsen

An unusual eight-sided design with lots of sloping crown side triangle facets and a flower design on the pavilion.

The Lady Bird

by Don Hartley

The crown of this one uses unusual facet shapes. The pavilion looks like an eight-spoked wheel.

Fancy Octagon Cut

by Q. D. Howell

The table is square. The crown features four half circles with numerous step-cut facets in-between. The pavilion has the same step-cuts abutting against eight wheel spokes. An unusual design!

SDGMGS Logo

by Tom Hicks

With nine sides, this one has an odd shield shape with a, more or less, brilliant-cut crown and a very minimum number of pavilion facets.

11 Spokes

by Walt Heitland

This one has eleven sides, featuring a step-cut crown and a pavilion having triangular facets separating rectangular wheel spokes. An interesting pavilion concept.

Brazen Eleven

by Al Huebler

This one, Al's last design, might be better described as an exotic. However, he designed it as an eleven-sided cut. The crown is partly a horizontally split brilliant, partly step cut. The pavilion, too, has both step and brilliant features. If one looks closely, the pavilion is an exotic bird design. Awesome!

RECTANGLES

Step Top

by Charles Covill

A cut-corner rectangle, this design substitutes a stepped crown for the normal table. The pavilion is an unusual barion. Length to width ratios can be varied.

Ezbar

by Robert W. Strickland

A relatively easy cut-corner barion rectangle, but still out of the ordinary.

Commercial Tourmaline

Reference- Bruce Leininger

This is a very old cut used in Brazil for tourmaline. It is, essentially, a common, but long step-cut, cut-corner rectangle. When used with dark green tourmaline, latest information indicates a single step at about 70 degrees should replace the three steps shown (crown and pavilion) at indices 24 and 72. Dark green tourmaline is opaque when viewed from the ends. The single step at a high angle helps make the blackened ends less obvious.

Step Top # 2

by Charles Covill

This is a variation of the STEP TOP (above). It places a long, narrow bar at a table position.

Barion-type Rectangle

by Jerry W. Carroll

A cut-corner rectangle, this one has a step-cut crown and barion pavilion.

Backgammon Cut

by Robert S. Stepp and Charles Covill

This is a wonderful design, essentially a cut-corner rectangle/barion. The crown sets this one apart. It has a shallow apex crown made up of end-to-end triangular pennants. If you have tired of the usual, cut this one.

CUSHIONS (ROUNDED SQUARES OR RECTANGLES)

1.75 Cushion Cut

by Stephen W. Attaway

This one is long with a brilliant-cut crown. The pavilion is relatively shallow with all facets triangular.

Long Cushion Oval

by Charles W. Covill

With a length to width ratio of 2.19, this is a very long stone design. The crown is cut in a simple, more or less brilliant fashion. The pavilion is more complex and has a keel.

12-Main Cushion Brilliant

by J.W. Carroll

This is a swanky design more or less described by its title. Nice!

Circle Inside A Cushion

by Charles W. Covill

Mostly step-cut, this one presents a fine appearance you have never seen at your favorite jewelry store.

Una Poco Mesa

by Norman W. Steele

This one is a smoothie, with a tiny diamond-shaped table, almost an apex design. The pavilion is an interesting mini barion variation. An definite eye-catcher!

Almost Square Crown Facets

by Charles W. Covill

With a tiny square table, checkerboard and slender diamond shapes on the crown, and a simple pavilion, this one is just plain swanky.

OVAL, MARQUISE, HEART, PEAR

In these categories, I see little leeway for innovation. One exception is in the:

Walter Carss Cut

by Fred W. Van Sant

I would call this one a pear design, but it could be in a category of its own. It is a difficult design, requiring the use of a CAM preform. Girdle facets in the index range between 33 and 63 are on a circle with the center at dop center. Those girdle facets in the index range between 07 to 23 and 73 to 89 are, also, on circles, but the circle centers are to right and left of the dop center. For those who understand the preceding sentences, this is a fine design, but I suggest that you first cut it in quartz.

THE EXOTIC AND THE ODDBALL

The Superimposition

by Merle A. Reinikka

This design features a regular octagonal shape with bars across the crown. One of these bars is in the table position, and all the bars are framed by triangles. Pavilion facets are triangular. This is an imaginative design.

Zebra's Eye and Zebra's TWISTED EYE

by Walt Heitland

These are highly imaginative designs with small tables. Both employ bar facets across the crown width. They are not terribly complex designs, and, with care, can be cut by faceters having a year or two experience. Do it.

FVS-169

by Fred W. Van Sant

This one is a bit tricky and requires a CAM preform. I suppose one would call it a brilliant-cut lozenge with a full barion pavilion. Whatever it is called, it makes a real impression. Your jeweler has probably never seen one.

Signal Flagcut

by Herbert S. Graves

This one is a rectangle with no table. The crown is composed of eight pennant-shaped facets running lengthwise of the stone; half run to the left, half to the right. The pavilion features many conventional step facets.(If you cut this design, trash the pavilion, substituting something more imaginative.) The author gave cutting instructions suited to the old Sapphire machine. This included a 45 degree adapter and much needed cheating. To cut this design, you must work out a new set of angles and indices.

Thunderbird Cut

by Norman W. Steele

This design features a flying bird-like form on the crown of an elongated, seven-sided design shape. It is an easy design to cut, yet distinctive.

Signet

by Wilf Ross

This is a sort of shield-shaped design with a checkerboard apex crown and a full barion pavilion. It is a highly unusual design and well worth trying.

Smiley And Grumpy

by Fred W. Van Sant

This pair of designs are built around a human face shape. One of the facets define a smiling facial expression. The other provides an angry expression. They are really quite attractive and should not be too difficult.

The Eye

by Henry E. Larson

This is a highly imaginative design in the shape of the human eye. There are lots of facets on the crown and not many on the pavilion.

The Lynn Cut

by Mike Drozen

This, also, is a sort of free form eye-shape without many facets. It is not exceedingly bright, but it is unusual.

'S' Curve Modification #3

by Norman W. Steele

This one is similar to the Lynn Cut, but has more pavilion facets.

Symbolic Eye

by Murrary Thompson

Another eye-shape with a few more facets than the Lynn Cut. It is a bit more brilliant.

The Pharaoh's Eye - submitted to SAPPHIRE FACETING GUIDE

by GEMS OF THE WORLD

This is a somewhat simplified eye design with an oval table.

Sun Valley

by Carl M. Unruh

A comma-shaped design with brilliant-cut crown and step-cut pavilion.

ESS Worm

by Merle A. Reinikka

The name just about describes the shape. Both crown and pavilion are step cut. Unusual.

Double Fan And Bar

by Norman W. Steele

A sort of lozenge or rude oval shape. Five bar shapes run lengthwise on the crown, with the center bar serving as a table. The pavilion employs only ten facets, all simple triangles. Merle's Cut, by Merle A.Reinikka, is similar. The Opposed Bar Cut by Gustave Mollin is somewhat similar, but the bar cuts run across the width of the design. All three of these designs do a fantastic job of scattering light flashes in all directions.

That about does it for this article. Part 2 will cover the subject of cutting soft and unusual gem materials.

Heating Rubies and Sapphires; Technical Aspects

by Ted Themelis

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Heating corundum appears to be a fairly simple issue. Just purchase a furnace, place some rubies/sapphires into the heating chambers, heat to some temperature, for some time, and the stones are ready, right? Wrong! Although some results may be produced from the above experiment, the issue is really quite complex, precisely because no two stones exist in nature that have exactly the same chemical composition. Therefore, when these corundums are heat-treated using the exact same parameters, the results will differ.

Temperature

Operating temperature is of paramount importance. The ability to apply uniform temperature in the heating chambers and to maintain such temperature during any given step in the heating process depends upon the engineering and design of the furnace system. An overheating protection (OTP) feature is highly desirable to prevent a possible melt-down of the furnace, should something go wrong with the temperature controlling instruments. Verification of the true temperature is performed using specialized instruments capable of measuring values to within 0.001mV. Maintaining a given temperature value depends upon the type of furnace used. Gas furnaces must maintain constant gas mixtures using appropriate valves and other parts, while electric resistance furnaces must have a suitable power controller, preferably with a thyristor phase-angle control and current limit feature.

Atmosphere Conditions

The type of environment in the heating chambers of the furnace is another very important parameter. The amount of oxygen present during heating greatly influences the results of the process. The terms "oxygen-rich" (oxidizing) or "oxygen-poor" (reducing) atmosphere are external descriptions only, having different meanings. Atmosphere conditions directly influence the operating temperature of the furnace and must be used very cautiously.

When an electric furnace is operated without an auxiliary atmosphere control apparatus, the amount of oxygen in the heating chambers is about 20.9%-balanced nitrogen. If additional oxygen is purged into the chambers, via an atmosphere control apparatus, then the amount of oxygen is increased, creating what is often called "oxidizing conditions". Maximum oxidizing conditions are obtained when the oxygen content in the heating chambers is, theoretically, 100%. Practically, this is not possible, as there are no vendors selling gas tanks containing 100% oxygen. However, technical-grade oxygen (around 99.999%) or lab-grade oxygen (99.995%) may be purchased that will be suitable for heating rubies/sapphires.

Inversely, when the oxygen content in the heating chamber is reduced (usually to less than 1%, balanced nitrogen), then we have the so-called "inert atmosphere". Other noble gases (such as argon and helium) are sometimes used in lieu of the nitrogen. An inert atmosphere reduces the maximum operating temperature in the furnace heating chambers.

Reducing Atmosphere

Reducing atmospheres are obtained by using various gas mixtures. For instance, up to 8% hydrogen-balanced nitrogen, is known as a "forming gas" and may be used. Although the percentage of hydrogen in the mixture seems low, the effect of hydrogen is considerable, especially with extended periods of operation at elevated temperatures. Since hydrogen is traveling very fast in corundum in relation to other atoms, the processing time required for heat treating corundum is much less when compared to other gas mixtures that do not contain hydrogen. An endogas gas mixture (typically consisting of 40% hydrogen, 20% carbon monoxide, balanced nitrogen) generally produces a strong reducing atmosphere effect. The poisonous nature of this mixture reduces the maximum operating temperature in the furnace heating chambers. Application of endogas mixtures as purging gas when heating corundums is very dangerous and is generally avoided. When needed, it should be used only by experienced and knowledgeable technicians. Numerous other gas mixtures, consisting of carbon monoxide, carbon dioxide, hydrogen, water vapor, or any combination thereof, may be composed and used. Each of these have different reducing atmosphere effects and should be used at different temperatures for each specific type of corundum.

Vacuum Atmosphere

Heating rubies/sapphires may be performed in a vacuum environment at a given temperature. A vacuum of up to 10^{-4} Torr may be used at high temperatures using specially made furnaces.

Atmosphere Conditions Using Gas Furnaces

Gas furnaces can produce various atmosphere conditions, while maintaining a fairly steady temperature by controlling their carbon content. For example, if natural gas is used in a gas furnace, oxygen-poor conditions are obtained by increasing the carbon content as follows: $C_3H_8 + 2.5O_2$ -> $4H_2O$+CO+2C (ratio: 3 carbon to 5 oxygen). In this case, the reducing agents are carbon monoxide and some free carbon. If the carbon/oxygen is further reduced, the carbon becomes the main reducing agent (in the form of soot), quite characteristic of many "overcooked" blue sapphires. If the carbon/oxygen ratio is further reduced at ultra high temperatures (over 1900^{o}C), the corundum gradually loses its oxide status and eventually becomes carbonized alumina.

Oxygen-rich conditions may be achieved in gas furnaces by increasing the oxygen content in the gas mixture as follows: $C_3H_8+6O_2$ -> $4H_2O+3CO_2+O_2$. (ratio: 3 carbon to 12 oxygen). Most Thai treaters use gas furnaces to obtain a reducing atmosphere condition when heating blue sapphires. For rubies, they generally use electric furnaces. Of course, the precise amount of the oxygen content cannot be practically determined unless a special gas analyzer is used to monitor the gas mixture during the heating process.

Atmosphere Conditions Using Electric Furnaces

The best method to obtain fully controllable atmosphere conditions is to make use of an alumina muffle, installed vertically in the furnace. The great advantage of using this method is that the heating elements and the corundums are located within the same heating chambers inside two different areas, having two different atmosphere conditions. The heating elements are installed vertically outside of the muffle near the wall of the furnace and exposed to air (20.9% oxygen-balanced nitrogen). The corundums are enclosed in the muffle into which the selected gas mixture may be purged directly. Gas purging is achieved externally, via a separate atmosphere control apparatus consisting of flow meters, pressure gauges, gas valves, etc. Thus, totally controllable, precise, and reproducible atmosphere conditions may be obtained easily using the muffle method.

Effects of Atmosphere Conditions and Additives

Atmosphere conditions are greatly altered when additives, like fluxes, are used in the heating process. For example, when heating rubies in air from Mong-Hsu, Burma (and similar rubies from elsewhere), the results after heating are different when the same type of rubies are heated under identical conditions using borax-based flux additives. Another example is when heating dark Australian blue sapphires. When carbon-based fluxes are used, the results are much different from those produced with hydrogen/nitrogen mixtures. Fluxes may be used in any compatible atmosphere condition. The results vary greatly, influenced by additional parameters. The effect of the atmosphere conditions varies greatly with the gas mixtures used, although the same operating temperature is used. Thus, certain corundums require an oxidizing atmosphere, other corundums (usually rubies) may be heated satisfactory in air, while certain types of sapphires require reducing atmosphere conditions.

Time and Rate

Time is another important parameter when heating rubies/sapphires. Time at the heat-up, processing, and cool-down segments of the heating process, must be computed according to the load being heated and the type of furnace insulation used. For instance, a high temperature rate at heat-up time, say over 200^{o}C/hour, will shorten considerably the life expectancy of the ceramic muffle and peripheral alumina parts (furniture). Rapid heat-up rates (above 250^{o}C/hour) will probably crack the alumina muffle, the crucible, and other ceramic furniture installed inside the heating chambers, due to their unequal thermal expansion. Conversely, during cool-down segments of the process, the rate should be controlled to avoid ceramic breakage. Cool-down rates vary considerably, according to the heating process sought. In some instances, such as when heating corundums to reduce or eliminate their silk, cooling rapidly (30^{o}C/minute) from 1800^{o}C to 1250^{o}C is desirable to prevent re-crystallization of the rutile silk needles. In other instances rapid cooling is not desirable, even at higher temperatures.

Time required for heating specific types of ruby/sapphire at a predetermined operating temperature, depends upon the average size of the corundum, and the atmosphere conditions used in the process. The processing time must be computed using these parameters.

Rubies/sapphires heated in order to reduce or eliminate their silk require that the diameter of the silk to be measured, with the appropriate soaking time to be computed accordingly. Thin silk requires less time to be dissolved in the corundum substance, while thick, stubby-type silk requires a longer processing time.

Furnace Technology

Furnace technology is required to fabricate a furnace capable of performing repeated and predetermined heating processes. Here are the requirements of an ideal furnace:

1. A maximum operating temperature of 1800^{o}C is highly desirable, but not necessary.
2. Type and quality of the furnace insulation used must be able to withstand high-temperatures for long periods of time.
3. An atmosphere control apparatus capable of mixing most of the commercially available gases, along with an appropriate apparatus to safely exhaust the gases from the furnace. A gas alarm is highly desirable.
4. An alumina muffle (preferably gas-tight) installed to insure proper atmosphere control.
5. A cool-down rate control mechanism, usually a mechanical elevator, or similar device.
6. A microprocessor temperature controller/programmer that controls the heating process.
7. A microprocessor temperature limit controller, acting as a "policemen", to prevent melt-down conditions should the primary (programmable) temperature control mechanism fail.
8. A method of cooling the cold sections of the heating elements to prevent premature element failure.
9. Sufficient ventilation to keep the electronic parts cool and clean.
10. A power controller, preferably with thyristor phase angle control and current limit.
11. Some accommodation should be made for unstable power supply conditions. In some countries, the power supply varies greatly. On high-demand, the voltage may be below 208Vac, while on low-demand, the voltage may exceed 240Vac.

Heat-Treatment Technology

Heat treatment technology is developed by the end-user. Developing the proper heat treatment technology for a certain type of corundum requires many years of practical experience and constant experimentation. The following issues must be taken into consideration with each type of corundum:

1. Know the chemical contents of the type of corundum to be heat-treated.
2. Develop a cleaning technique that will not harm the chromophoric impurities.
3. Determine the atmosphere conditions to be used, type of gases to be used, gas flow rate, gas pressure, and purging time at any given temperature for each step of the heating process.
4. Determine the number of heating segments (ramp and dwell) and their rates (T^{o}C/hour).
5. Determine operating temperature.
6. Determine processing time (soaking) at the operating temperature.
7. If additives are to be used, determine the type, mixture, and ratio.

Designer's Workshop for Faceters

By Ernie Hawes

At the November meeting, someone suggested that I reprint "Sister Clement's Cross" by Robert Strickland. Other members said that they would also like this design to cut for Easter gifts. The cross is, of course, a Christian symbol commonly associated with Easter, as is the egg. This design incorporates a well defined cross in the pavilion. The overall shape resembles an egg. Although Easter is months away, I agreed to include the design now to allow Guild members plenty of time to cut their Easter presents.

When Robert Strickland designed "Sister Clement's Cross", he did not create it as a design primarily to celebrate Easter. Rather, he simply wanted to pay tribute to Sister Clement Johnson for her many years of service to the Texas Faceters' Guild. And, he did so most appropriately by creating a design in Sister Clement's name that symbolizing her life's commitment to the Christian faith.

"Sister Clement's Cross" requires cutting a CAM preform, so be sure you understand this preforming technique before you begin. The preforming steps are not given in the Long & Steele database, but I was able to obtain the information from a copy of the original as published in the Texas Faceters Guild Newsletter July 1994.

As indicated on the diagram, this faceting design is meant for cubic zirconia and will not work in any material with a refractive index lower than corundum. (Angles are available for corundum, if someone is interested.) Also, when Walter Carss, of the Texas Faceters' Guild, cut the design, he found that the cross showed to best advantage if the facets composing the cross were left frosted (prepolished only). He recommended this in an article accompanying the design when it was first published. The finished gem is ideal for use as a pendant. While Easter is an appropriate time to give this design, I am certain it would be appreciated for any occasion.

"Sister Clement's Cross" is not the only design to incorporate a cross in the pattern. There are forty- nine designs in the Long & Steele database with the word "cross" in their names. I know of at least one design that has a cross as a central element, but does not use the word in the name. Some of these designs are very complex, while others are quite simple.

One that I personally like is Fred W. Van Sants' "FVS-97 (Frosted Cross)", which he published in his 1989 volume, Star Cuts II. Where Strickland places the cross in the pavilion, Van Sant makes the cross the focal point on the crown. Facets composing the cross are, of course, meant to be left unpolished. I have included this design in this issue, partly to show a different approach to the idea of incorporating a frosted pattern in a design, and also to give some variety in your Easter gifts. This design would look very nice in amethyst, or if you change the angles, a rhodolite garnet.

CAM Preforming

There was also some discussion at the November meeting about CAM preforming and the amount of material required to cut a CAM preform. For those not familiar with the term, CAM is the acronym for Centerpoint Angle Method, developed by Robert Long. This preforming method outlines the shape of the design by first cutting a preliminary pavilion to a common centerpoint, and then cutting the girdle outline at ninety degrees to a level girdle line. Details of this method are addressed in the various Long & Steele faceting books. The CAM method, as originally developed, did indeed waste a lot of material, because the angles used were quite a bit higher than the final pavilion girdle and pavilion main angles. Consequently, older designs using the CAM method for preforming are best rendered in inexpensive materials. However, the CAM method was modified some years back to use angles much closer to the final pavilion angles. Thus, the newer designs using the modified CAM preforming method are much less wasteful.

Now, Robert Long has developed a new preforming method which he calls the OMNI method. The word OMNI is not an acronym for anything, just a name Robert Long chose to call his new method. It is, however, an extension of his original CAM preforming technique. This is described in an article by Robert Long called "The OMNI Preform", which appeared in the September, 1997 issue of the U.S.F.G. Newsletter. We have included it in this issue.

The Omni Preform

By Robert H. Long

From the September 1997 issue of the USFG (United States Faceters Guild) Newsletter in Austin, Texas

A History of CAM Preforming

Very early in the application of mathematics to the design of faceted stones, we realized that generating an exact outline of the stone was critical to the use of mathematics in determining accurate facet cutting angles. The first attempt at cutting an exact preform was the Micrometer Height Adjustment (MHA) method of preforming. While accurate, I quickly realized that this method of preforming was impractical. I would joke, "It requires a Ph.D. in mathematics to generate the data and a journeyman machinist to use it". To arrive at a more practical method, I then developed what became known as the CAM (Centerpoint Angle Method) of preforming. The first version of CAM preforming was what I call the "high angle" CAM. Here, the angles used were high enough to clear any subsequent final facets, and the preform girdle location was the final girdle location. See figure 1a.

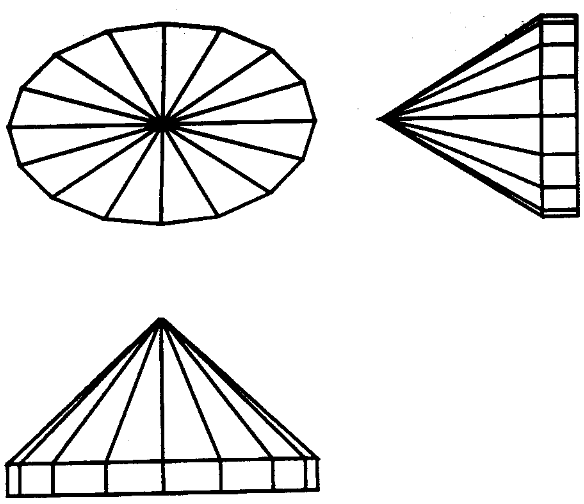


Figure 1a

There were two problems with the high angle CAM. First, the cutters complained that it wasted depth of material, something we never seem to have enough of. Second, it was not practical for designs like the Barion, which has very steep angle facets next to the girdle. So, we changed to the "low angle" CAM preform, the method usually used today. Here, the preforming angles are shallower than any of the final facet intersections. The culet can be made the final culet, but the preform girdle is a "false girdle", as it is not located at the final girdle depth. See Figure 1b.

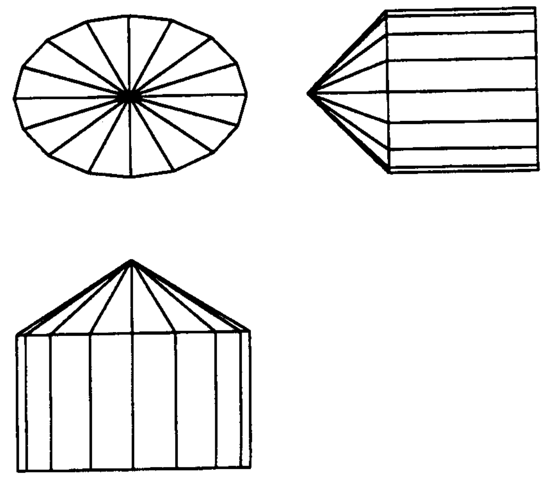
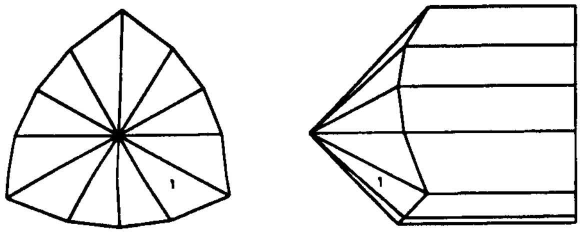


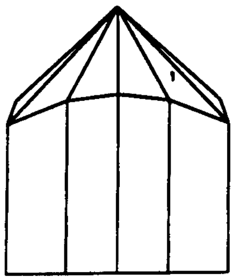
Figure 1b

Note that with the traditional CAM preform, the indexing of the culet facets is identical to the indexing of the 90 degree girdle facets, resulting in a level girdle.CAM preforming led to the use of meetpoint faceting, where the final outline is generated by the total faceting process. Some designs do not lend themselves to a meetpoint sequence. Therefore, the CAM preform is still required in some instances, notably step cuts and designs without fixed meets. We also introduced the CLAM (Corner Location Angle Method), which added a temporary set of facets specifically to locate the corners of cut-corner designs.

The Omni Preform

The Omni method of preforming is an extension of the customary CAM preform technique. It avoids some of the limitations and problems of the traditional CAM preform and adds some important capabilities to the preform design process. The Omni Preform is made as follows: 1) A set or sets of facets are cut to a central point, similar to the CAM preform. 2) Sets of girdle facets at 90 degrees are cut in a meetpoint sequence to complete the preform. It all sounds just like the CAM preform, but there is one essential difference. With a CAM preform, the 90 degree girdle facets are always cut on the same indices as the central girdle facets. In the Omni Preform, the girdle facets are cut to generate the desired outline, but the indexing is generally not the same as the indexing of the central culet facets. The combination of culet facets and girdle facets is still cut in a meetpoint sequence, with the girdle facets cut first. Then, all of the 90 degree girdle facets are cut as a bunch in a meetpoint sequence. The result is a preform with the desired outline, a non-level girdle, and with at least one spot on the girdle being located at the final girdle level. This is contrasted to the traditional low angle CAM preform, where a level but temporary false girdle is produced.





PF1	44	04-12-20-28-36-44 52-60-68-76-84-92
G1	90	06-26-38-58-70-90
G2	90	02-30-34-62-66-94

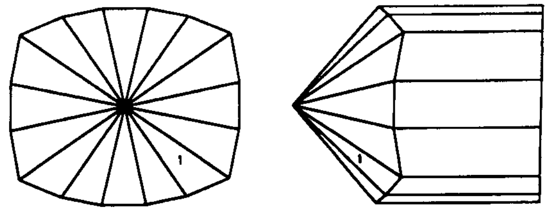
Cushion Triangle OMNI Preform

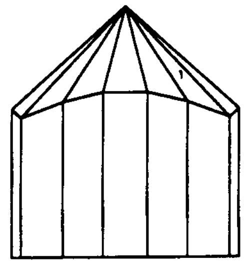
The use of the Omni preform is best illustrated by some examples. Representative Omni Preforms for a Cushion Triangle, a Cushion Rectangle, and a Cushion Oval are herein given. The Cushion Triangle is also shown with a completed new design.

Cushion Triangle Omni Preform

In this preform, the culet facet angles are all equal, and the facets are uniformly indexed. Although these characteristics are not a requirement for an OMNI preform, it is convenient in this case and can result in a very nice cushion triangle design. This outline differs from most previous cushion triangles in that the girdle segments are not quite equal. In the example Double Cushion Barion Triangle 2 design, all of the preforming facets are also final facets in the finished design.

Next, we show a sample cushion rectangle OMNI preform. (Contributed by Fred Van Sant)

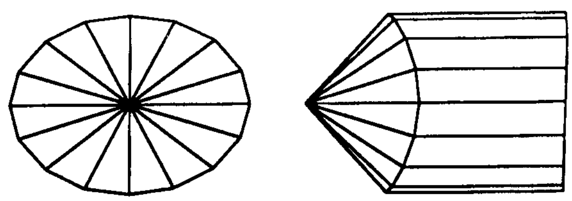


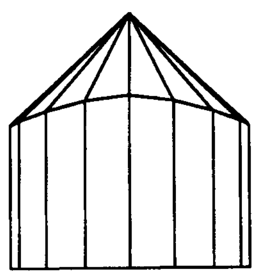


PF1	41	96-07-12-18- 24-30-36-41 48-55-60-66 72-78-84-89
G1	90	21-27-69-75
G2	90	06-42-54-90
G3	90	03-45-51-93
G4	90	96-48
G5	90	24-72

Cushion Rectangle ONMI Preform

Next, we show an oval preform generated using GEM-CAD to derive the integer preforming indexing.





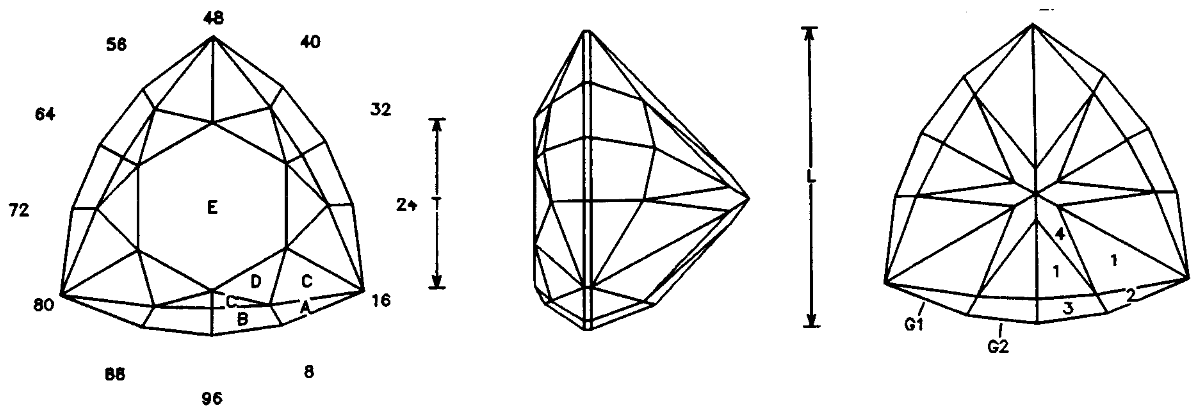
PF1	43	04-11-17-22- 26-31-37-44- 52-59-65-70- 74-79-85-92
G1	90	20-28-68-76
G2	90	13-35-61-83
G3	90	07-41-55-89
G4	90	02-46-50-94

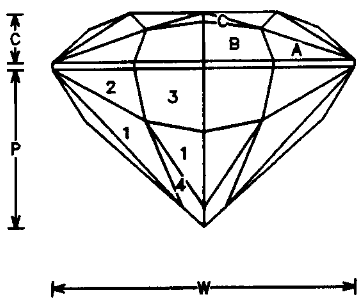
Cushion Oval OMNI Preform

Conclusion

The Omni Preform design and cutting technique opens up and extends the CAM preforming process. It can eliminate some of the CAM preform problems and can minimize waste. With this in mind, we need to take a look at the vast body of existing designs and see if they can be improved by using the Omni Preform technique. I also wish to thank Fred Van Sant for his enthusiastic support of this project.

From USFG Newsletter, Sept. 1997





DOUBLE BARION CUSHION TRIANGLE #2
(DBCT2.GEM)
R. H. Long

Angles for R.I. = 1.54
61 facets + 12 facets on girdle = 73
3-fold, mirror-image symmetry
96 index
L/W = 1.008 T/W = 0.565 T/L = 0.561
P/W = 0.526 C/W = 0.164
H/W = (P+C)/W+0.02 = 0.710
P/H = 0.740 C/H = 0.231
Vol./W^3 = 0.251

PAVILION

1	44.00	04-12-20-28-36-44-52-60-68-76-84-92	Cut to TCP
G1	90.00	06-26-38-58-70-90	OMNI: Set size
G2	90.00	02-30-34-62-66-94	OMNI: Meet 1,1,G1
2	68.00	06-26-38-58-70-90	Level girdle
3	69.37	02-30-34-62-66-94	Level girdle
4	42.00	08-24-40-56-72-88	Meet 1,2,3

CROWN

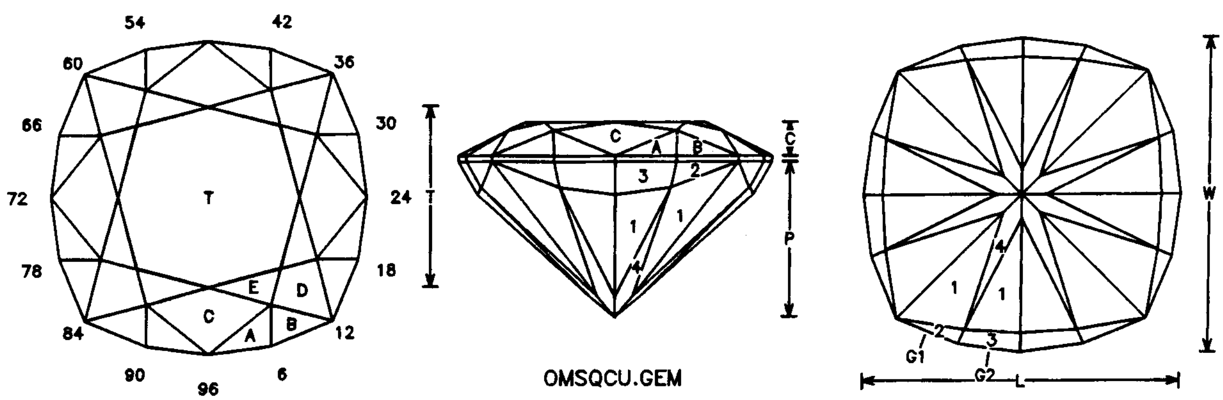
A	54.00	06-26-38-58-70-90	Set girdle thickness
B	55.90	02-30-34-62-66-94	Level girdle
C	30.00	12-20-44-52-76-84, 04-28-36-60-68-92	Meet girdle at corner. (See Note 1)
D	22.00	08-24-40-56-72-88	Meet A,B,C
E	0.00	Table	Meet C,C,D,D

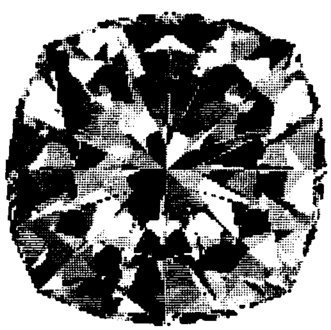
Uses OMNI preform technique: After step G2, girdl outline is established, but the girdle of the preform will not be level.

Same pavilion as 13.123, SFG Dec 96

Note 1. Cut as two sets:
(12-20-44-52-76-84) and (04-28-36-60-68-92)

From USFG Newsletter, Sept. 1997





OMNI Square Cushion (OMSQCU.GEM)
by Robert W. Strickland 9/28/97

Angles for R.I. = 1.54
73 facets + 16 facets on girdle = 89
4-fold, mirror-image symmetry
96 index
L/W = 1.000 T/W = 0.574 T/L = 0.574
P/W = 0.493 C/W = 0.107
H/W = (P+C)/W+0.02 = 0.620
P/H = 0.795 C/H = 0.173
Vol./W^3 = 0.227

PAVILION

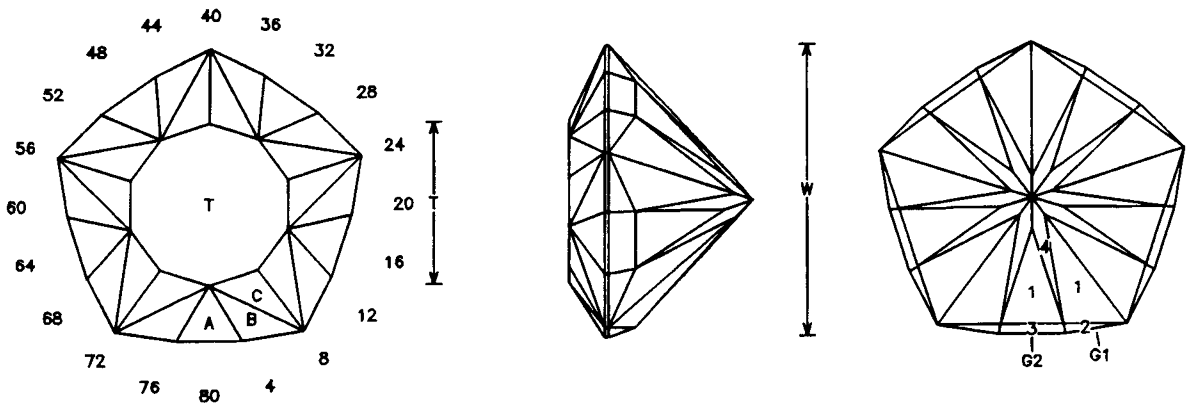
1	42.50	03-09-15-21-27-33-39-45-51-57-63-69-75-81-87-93	Meet at TCP
G1	90.00	06-18-30-42-54-66-78-90	OMNI: Fix size of stone
G2	90.00	02-22-26-46-50-70-74-94	OMNI: Meet 1-1-G1
2	59.15	06-18-30-42-54-66-78-90	Level girdle
3	60.00	02-22-26-46-50-70-74-94	Level girdle
4	41.50	06-18-30-42-54-66-78-90	

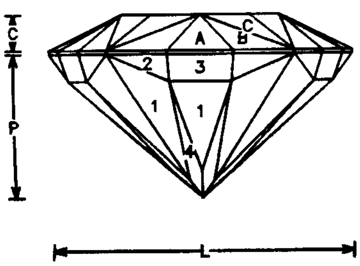
CROWN

A	31.15	02-22-26-46-50-70-74-94	Establish girdle thickness
B	33.00	06-18-30-42-54-66-78-90	Level girdle
C	26.72	96-24-48-72	Meet A-A at girdle
D	24.49	12-36-60-84	Meet B-B at girdle
E	14.74	04-20-28-44-52-68-76-92	Meet A-B-C-D
T	0.00	Table	Meet C-E-E

Steps 1, G1, and G2 make and OMNI preform. The girdle line of this preform will not be level.

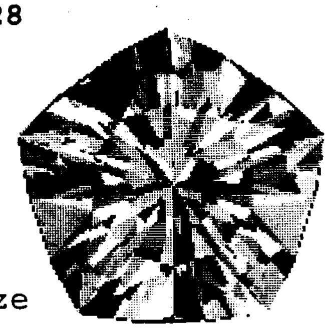
From USFG Newsletter, Sept. 1997





OMNI Pentagonal Cushion (OMSTAR.GEM)
by Robert W. Strickland 9/2/97

Angles for R.I. = 1.63
66 facets + 15 facets on girdle = 81
5-fold, mirror-image symmetry
80 index
L/W = 1.018 T/W = 0.555 T/L = 0.545
P/W = 0.486 C/W = 0.122
H/W = (P+C)/W+0.02 = 0.628
P/H = 0.774 C/H = 0.194
Vol./W^3 = 0.208



PAVILION

1	43.00	80-06-10-16-22-26-32-38-42-48-54-58-64-70-74	Meet at TCP
G1	90.00	02-14-18-30-34-46-50-62-66-78	OMNI: Establish size
G2	90.00	80-16-32-48-64	OMNI: meet 1-2-G1
2	69.72	02-14-18-30-34-46-50-62-66-78	Level girdle
3	70.18	80-16-32-48-64	Level girdle
4	41.70	03-13-19-29-35-45-51-61-67-77	Meet 1-2-3

CROWN

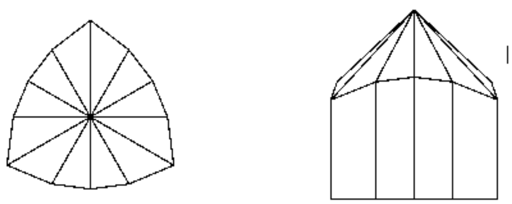
A	33.00	80-16-32-48-64	Establish girdle thickness
B	31.00	02-14-18-30-34-46-50-62-66-78	Level girdle
C	26.43	04-12-20-28-36-44-52-60-68-76	Meet A-B at girdle
T	0.00	Table	Meet A-B-C

Detailed Steps for OMNI Cutting

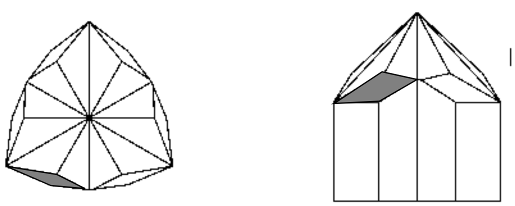
edited by Stephen W. Attaway

Listed below are the detailed steps needed to cut the Double Barion Cushion Triangle #2 by Robert H. Long.

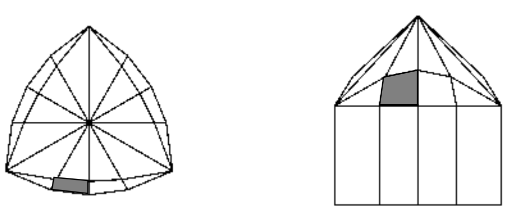
Step 1. Cut the temporary culet point and the girdle. The girdle line will not be level and will form an arc as shown below. It is very important that the temporary culet and girdle meetpoints are accurate. You will not get another chance to correct for any



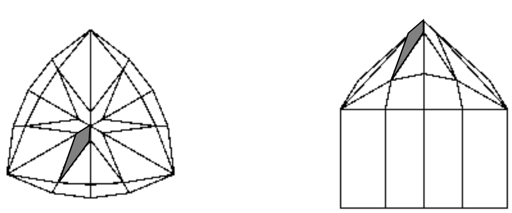
Step 2. Cut the break facets to form a level girdle. Use a meetpoint with the corners of the cushion triangle.



Step 3. Cut the next break facet to form a level girdle.



Step 4. Cut the true culet. This will remove the temporary culet.



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Are we missing your e-mail? If you would like to have your e-mail address listed in the New Mexico Facetor, just send Steve and Nancy Attaway an e-mail. Remember, you will not receive any e-mail if no one knows your address.

If you would like to get daily e-mail on faceting, all you have to do is become a subscriber to the "Faceters' Digest". To subscribe, simply e-mail Jerry and Norma Debre at <nndewbre@popd.ix.netcom.com>. Type a short autobiography and request to be a subscriber, and that's all. The Digest is free and is posted daily. Currently, the digest is sent to over 400 gemcutters.

TABLE 3. Shows of Special Interest

Name	*Location*	*Date*
Mineral-Fossil CO-OP	Tucson, Arizona	Jan. 25 - Feb. 16
Gem and Lapidary Wholesalers, Inc.	Tucson, Arizona	Feb. 1 - 5
Pacifica/A.K.S. Trade Shows	Tucson, Arizona	Feb. 1 - 14
Oracle CO-OP	Tucson, Arizona	Feb. 1 - 14
La Quinta Group	Tucson, Arizona	Feb, 1 - 15
Tucson Showplace	Tucson, Arizona	Feb. 1 - 15
Gem, Mineral, Fossil, and Jewelry Show; Atrium Productions	Tucson, Arizona	Feb. 2 - 15
Arizona Mineral and Fossil Show	Tucson, Arizona	Feb. 4 - 14
Congress Street Gem Expo	Tucson, Arizona	Feb. 3 - 15
A.G.T.A. Gemfair in Tucson	Tucson, Arizona	Feb. 4 - 9
G.L.D.A., Inc.	Tucson, Arizona	Feb. 4 - 11
U.S. Gem Expos' Gem, Mineral, and Fossil Show	Tucson, Arizona	Feb. 4 - 14
Dell. at Tucson' Scottish Rite	Tucson, Arizona	Feb. 4 - 15
Rio Grande Catalog in Motion	Tucson, Arizona	Feb. 7 - 10
Gem and Jewelry Exchange (G.J.X.)	Tucson, Arizona	Feb. 5 - 12
Gem, Mineral, Fossil, and Jewelry Show/ Atrium Productions	Tucson, Arizona	Feb. 6 - 11
Gem and Lapidary Wholesalers, Inc.	Tucson, Arizona	Feb. 6 - 13
Gem and Lapidary Wholesalers, Inc.	Tucson, Arizona	Feb. 6 - 14
Tucson Gem and Mineral Society's 44th Annual Show (wholesale)	Tucson, Arizona	Feb. 12 - 15
Tucson Gem and Mineral Society's 44th Annual Show (retail)	Tucson, Arizona	Feb. 12 - 17
1998 Rockamania	Lordsburg, New Mexico	Feb. 9 - Mar. 4
Albuquerque Gem and Mineral Club's Jewelry, Gem, and Mineral Expo '98	Albuquerque, New Mexico	Mar. 7 & 8
Deming Gem and Mineral Society's Annual Rockhound Roundup	Deming, New Mexico	Mar. 12 - 15