Home Metal Shop Club

October 2010
Newsletter

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http://www.homemetalshopclub.org/

Since its founding by John Korman in 1996, The Home Metal Shop Club has brought together metal workers from all over the Southeast Texas area.

Our members' interests include Model Engineering, Casting, Blacksmithing, Gunsmithing, Sheet Metal Fabrication, Robotics, CNC, Welding, Metal Art, and others. Members always like to talk about their craft and shops. Shops range from full machine shops to those limited to a bench vise and hacksaw.

If you like to make things, run metal working machines, or just talk about tools, this is your place. Meetings generally consist of a presentation with Q&A, followed by ***show and tell*** where the members can share their work and experiences.

President *Vance Burns*	Vice President *John Hoff*	Secretary *Martin Kennedy*	Treasurer *Emmett Carstens*	Librarian *Dan Harper*
Webmaster/Editor *Dick Kostelnicek*	Photographer *Jan Rowland*	CNC SIG *Dennis Cranston*	Casting SIG *Tom Moore*	Novice SIG *Rich Pichler*

About the Upcoming November 13 Meeting

The November general meeting will be held on the second Saturday of the month from 12:00 noon to 4:00 p.m. in the Parker Williams County Library, 10851 Scarsdale Boulevard, Houston, TX 77089. Note: This is a new starting time for an extended meeting that accommodates the Novice SIG's activity after the regular meeting. Visit the Meetings Page for up-to-the-minute details.

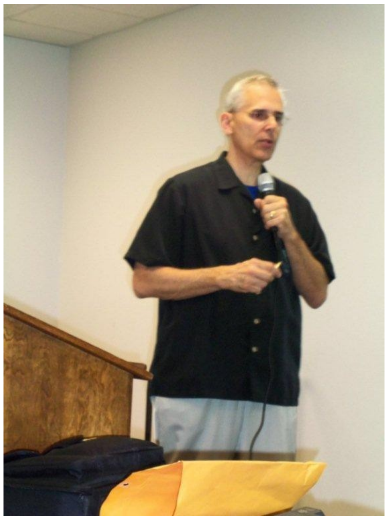
Mike Hancock will speak about "Physical Vapor Deposition."

Recap of the October 9 Regular Meeting

Reported by *Martin Kennedy*, Photos by *Jan Rowland*

Thirty-one members attended the 12:00 noon meeting at the Parker Williams County Library. President *Vance Burns* led the meeting. Dues were collected for the upcoming year, and we currently have 45 paid members. A offer was made by Dick Kostelnicek to make past and current member contact information available on the website. After discussion, it was decided that that information would only be made available to club officers. If someone wants to contact a club member, they should send their request to a club official via the email links on the Membership Page in order to initiate the communication.

Presentation



HMSC member *Lee Morin* spoke on "An Introduction to Metallurgy".
Presentation slides are available here. Meeting video available here.

Lee is a Ph.D. and is a United States Navy captain and NASA astronaut. Lee's presentation was primarily based on the book "Metallurgy Fundamentals" by Brandt & Warner.

Overview

Iron is a metallic crystal that can occur in three basic structures: Ferrite, or body centered cubic; Austenite, or face centered cubic; and Martensite, or body centered tetragon. Ferrites occur at low temperature, while Austenites occur at high temberatures. Martensite is similar to Austenite, but has a rectangular structure. Martensite is body centered like ferrite, but has a rectangular, not cubic structure.

Carbon can be added to Iron in various percentages, depending on the temperature. Iron Ferrite can absorb or dissolve up to 0.025% carbon in its lattice structure.
Adding additional carbon above 0.025% to ferrite will result in making Fe_3C, known as Iron Carbide or Cementite. Pure cementite has a carbon level of 6.67%. This material is very brittle. At 0.83% carbon, we have Pearlite. When looked at under a microscope, it can be seen to have fine layers of Ferrite and Cementite in a distinctive pattern like an aerial photo of ploughed fields.

Compositions above 0.025% and below 0.83% have regions of Pearlite and Ferrite, while compositions above 0.83% and below 6.67% have regions of Pearlite and Cementite.

Ferrite, Pearlite, and Cementite are transformed into Austenite at a temperature of 723°C. Austenite can hold more than 2% carbon. Heated metal glows at a color that corresponds to its temperature. Metal at a temperature of 723°C glows cherry red. Pictures showing the correlation of colors and temperature can be found in a variety of books, as well as here.

If heated and cooled slowly, the structure of a metal will revert to Ferrite, Pearlite, and Cementite. Slow cooling lets the phases come into equilibrium. Additionally, the addition of other trace elements can result in the Austenitic structure being maintained at lower temperatures.

Quick cooling transforms metals to Martensite, which is very hard but very brittle. Because the structure is strained, it is very susceptible to crack propagation.

Controlled cooling can result in transforming the metals into a mixture of Bainite and Martensite.

Grain size is an important predictor of metal strength. Metals with larger grains are more ductile, but cracks can propagate easier. Metals with smaller grains are stronger since the cracks can't propagate as easily.

Iron Carbon Phase Diagram
At this point in the presentation, Lee reviewed the Equilibrium Iron Carbon Phase Diagram. He talked about the Eutectic, or liquid freezing concept, and the Eutectoid, or solid solution concepts. Iron alloys containing less than 2.06% carbon are known as Steel, and greater than this amount are known as Cast Iron.

Lee focused on the lower left quadrant of the Iron Carbon Phase Diagram, and illustrated how steel of a particular carbon composition reacts to heating and cooling. Note that Martensite does not exist on the Equilibrium Diagram – it is not an equilibrium structure. Because it cooled very rapidly, the atoms are stuck in a configuration with trapped energy.

Three types of heat treatment were discussed:

- Annealing, or cooling at a rate of about 100°/hour
- Normalizing, or cooling in air
- Process Annealing, or heating up to just below the transformation temperature of 1050 - 1300° and soaking at that temperature. (Low carbon steels only). For hypereutectic steels, spheroidizing is like process annealing

Isothermal Transformation Diagram

The next diagram discussed was the Isothermal Transformation Diagram, which shows the amount of time required for transformations to take place. Several examples were shown on the diagram of heat treatment programs, which illustrated how the path followed through the diagram resulted in various hardness ratings.

Several other concepts were discussed, such as Tempering, Martempering, Austempering Processes, Steel numbering systems, effects of alloying elements in steel, and the curie point – the temperature where iron loses its magnetism.

The segment ended with a video made from the space station by Astronaut Don Pettit called "Cities at Night"

Show & Tell

Joe Williams showed a Tri-roll thread ID measurement dial indicator (left photo). He also offered thermocouple wire to anyone who wanted any.

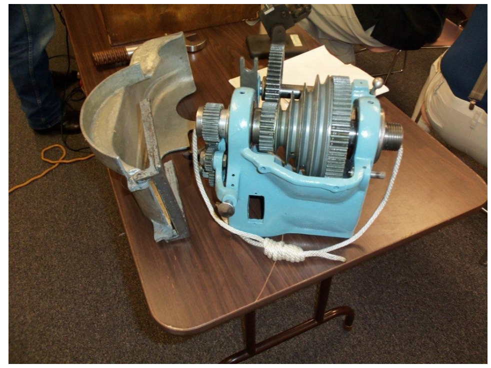
Joe Scott showed a vice with pivoted jaws that could hold irregular objects. He passed around a brochure on a tracing attachment used to create complicated parts on a pre-CNC mill.

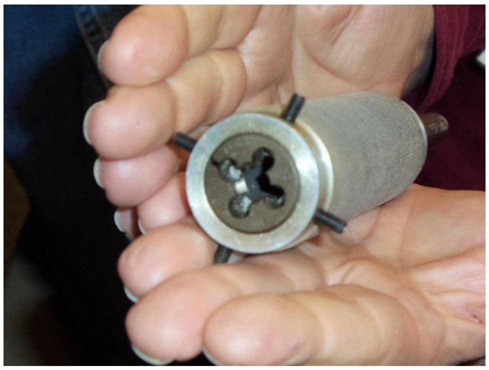
Randy Jacobs asked for help on fixing his Starrett 15" level. Some members thought that the level should be returned to Starrett for repair, due to its high value and degree of accuracy. Others thought he could refill the empty secondary bubble tube and seal it himself.

Ed Gladkowski described a three-point jackscrew adaptor that he made as a proof of concept for a friend. He called it an "all terrain mount" (right photo). Even though it was only made to prove a concept, the part demonsrates Ed's attention to detail and a perfect finish.

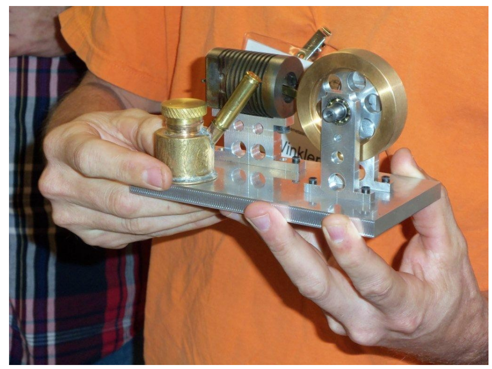
Martin Kennedy showed a video on the manufacture of end mills.

Chuck Rice brought in a headstock from a 1946 Atlas lathe that he was in the process of rebuilding (right photo). He also requested assistance on repairing a few broken pieces on the cast iron cover. Several suggestions were made – grinding and brazing using a fixture, epoxy, finding a replacement part on eBay, and making a new part.





Dean Henning passed around a two-ended threading die holder (left photo). The holder is used in a lathe to assure thread alignment.



Mike Winkler demonstrated a Vacuum Flame Eater Engine that he recently completed, based on plans by Jan Ridders (right photo).

Dick Kostelnicek went through a series of calculations where he figured the equivalent gas mileage of his wife based on energy consumption and work. He plans to show it to his wife to prove she does not need a new car. We'll all watch from a safe distance, but good luck!

Inventions

Gene Rowan showed his invention of a lightweight portable boat motor for short trips made from a trolling attachment powered by a cordless drill.

Extra batteries for the drill motor are relatively inexpensive and available at most hardware outlets.

Problems and Solutions

- There was a question on how the 14-inch gun barrel lining was replaced on the *USS Texas* battleship. These liners can be made from up to 8 sleeves on the large guns, and must be replaced after a number of shots. The liner is a shrink fit, with locking rings. Old liners were machined out. Joe Scott said that he'd bring a brochure on these guns to the next meeting.

- A member was experiencing vibrations on a large boring bar and on his parting tool, and wanted to know how he could reduce the vibrations on his 13" lathe. Recommendations were: use a rounded tip on the tool steel in the boring bar, make sure the tool is at the exact centerline, some detailed suggestions on how to grind the tool steel, and honing the parting tool after each use.

- A member requested that someone bring in a refractometer to check his cooling fluid in his CNC mill. Lee Morin said that he'd bring one in next meeting.

- A question was asked on how to use the pointed end of the edge finder. The point is used to find the center of punches or holes on the work piece. This is illustrated in the video on finding edges on the website.

- A member was having trouble because the magnetic base on one of his dial indicators was not holding, and wanted to know if it could be strengthened. Although it was thought that this was not possible, it was suggested that a good cleaning of the mechanism might help. It was also noted that when storing a magnet, it was better to use a keeper or to leave it attached to metal to retain the magnetism.

Novice SIG Activities

SIG coordinator *Rich Pichler* completed a demonstration started last month on how to set up the feed for threading on an Atlas lathe. He showed how to make a trial fit of the machined thread with a nut.

Articles

Aligning the Z-Axis on a Square Column Mill

By *Dean Henning*

The mill I'm working with is an Industrial Hobbies square column CNC mill. I've had a problem with the mill since I purchased it about a year ago. After marking a hole with a spotting drill, I would change to a regular length drill and the newly drilled hole would be to the left of the spotting hole. I knew the quill was lined up to the vise properly. This could only mean my Z-axis was not perpendicular to the X–Y axis. The Z-axis casting is mounted to the X–Y axis with 4 cap screws. The screws are approximately 9 inches apart in the X-direction and 6 inches in Y.

I decided to use a hole drilling method of lining up the Z-axis. I drilled a 3/16-inch hole in a piece of aluminum plate with a 12-inch long 3/16-inch drill bit mounted in a collet. I removed the 12-inch long bit and installed a stubby 3/16-inch drill bit. I moved the Z-axis

10-inches down and drilled 2 more holes one 0.75-inch in the X-direction and one 0.75-inch in the Y-direction measured with the DRO. I then measured the center to center of each hole by installing stubby drill bits in the holes and measuring from inside to inside of the drill bits and outside to outside. I then added the numbers together and divided by 2. The numbers were 0.783 in the X-direction and 0.744 in the Y-direction. The conclusion is that my Z-axis was leaning to the left 0.033-inches and tipped forward 0.006-inches for every 10-inches traveled in the Z-direction. For me, shimming is a trial and error process, so I started with 0.030-inch shim under the two left cap screws and 0.003-inch under the two forward cap screws. I then retightened the cap screws and proceeded to check my quill alignment. This check allows you to verify that the added shims are producing the movement you desire. I then realigned the quill before drilling any more holes. I went through this procedure several more times until I determined that I needed to replace my 3/16-inch long drill with something more rigid.

I obtained a ¾ by 14.5-inch piece of 1018 cold rolled round stock. I proceed to mount this in my lathe with a ¾-inch collet. I center drilled each end. I also drilled a 3/16 by 1-inch deep hole in each end. I also cut 0.005 of an inch from each end of the rod to insure the OD was parallel to the drilled holes. The cut on the shaft was 2.75-inches long to insure fit in a ¾-inch collet. I mounted the shaft in the mill and checked the run out at the end of the shaft and by moving it around in the collet and checking each end I was able to get the run out within 0.004-inch. I mounted a ¼ - 20 set screw on the high side of the run out. This allowed me to mount a stubby 3/16-inch drill in the end of the steel rod. I ground a flat place on the drill bit to keep it from turning.

Now, I was ready to take what I hoped would be my last alignment measurements. I drilled my first hole in the aluminum plate with the collet mounted 14.5-inch steel rod. The 3/16-inch drill bit mounted in the end. I again switched to the 3/16-inch stubby drill bit mounted in a collet. This time I moved down 12-inches and drilled two holes one 0.750-inches in the X-direction and 0 .750-inches in the Y-direction measured with the DRO. This time, I measured 0.753-inches in the X-direction and 0.748-inches in the Y-direction. I was satisfied with the last measurement as this was about as good as I could get with this setup.

Tool Height and Threading Bit Positioner

By *Dick Kostelnicek*

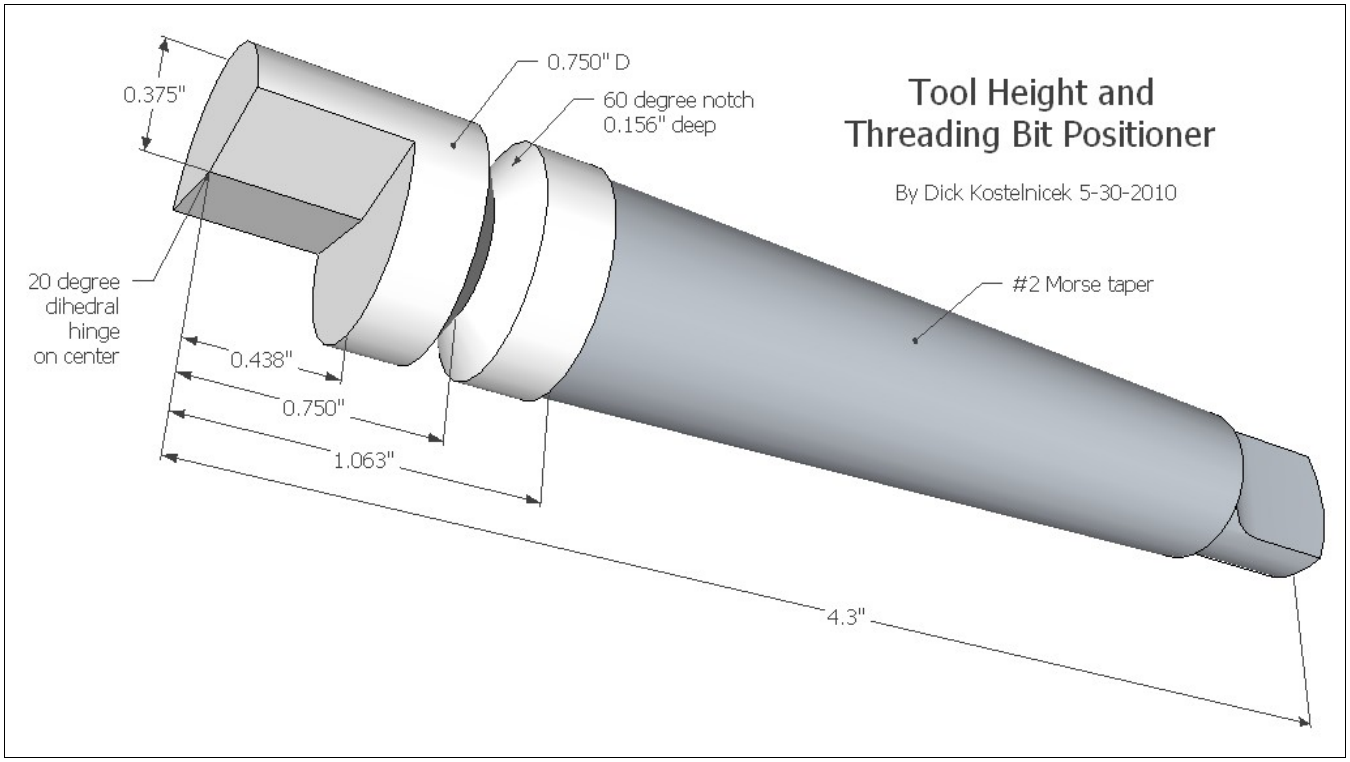
Cutting well-formed screw threads in the lathe requires accurate positioning of a single-point threading bit. First, the height of the bit's point must be exactly on-axis and second, the threading bit's centerline should be perpendicular to it. These two requirements are usually accomplished with the aid of a horizontal line scribed on the side of the tailstock ram, and a threading center gauge. Additionally, the top surface of the bit should be horizontal, without back rake.

The positioning tool, shown below, can ensure both accurate height and bit alignment when it is placed in the lathe's tailstock ram. It is machined from a commercially available 2MT to 3JT drill chuck arbor.

How to use it

Raise the cutting bit untill its top face touches the centerline hinge of the positioner's dihedral surfaces (left photo). The 20° dihedral angle allows for ± 10° rotational mispositioning of the tool (drawing below).

Nest the threading bit's point in the 60-degree V-notch to align it perpendicular to the lathe axis (right photo).



Using a dihedral hinge to gauge height and a V-notch to set bit alignment are certainly not a new concepts. What I've tried to do here is combine setting height and bit alignment into a single tool that slips into the tailstock ram's socket.