

# The NEMES Gazette

*The Newsletter of the New England Model Engineering Society*

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## The Editor's Desk

Mike Boucher

As I sit back to write this, it is just a few days before Christmas. For me, it's hard to believe another year has come and gone. The older I get, the more I realize that "time flies" isn't just an expression

For me, its been quite a year of changes. Last year, I was single, unemployed, and renting an apartment a few blocks from the Museum. This year, I'm married and in a new house 50 miles further away, and have a new job. Here's hoping that next year will be less stressful!

On a slightly different note, those of you not interested in astronomy might have missed a celestial event this past week. On Tuesday, Dec 17<sup>th</sup>, the planet Saturn was as close to Earth as it will be for another 30 years, a mere 750 million miles away. In addition, the rings are at such an angle they are quite visible. The last time Saturn was this close, the rings were very flat in relation to earth, making them difficult to see.

Armed with this information, and a 4½" Newtonian telescope, I went to my backyard to see if I could find Saturn. It was very easy, even with almost a full moon. To say it was an incredible sight would be an understatement. The rings were clearly

## Next Meeting

**Thursday, January 2, 2003**

The Charles River Museum of Industry  
154 Moody Street  
Waltham, Massachusetts

Annual dues of \$25 covers from Jan to Jan.  
Please make checks payable to NEMES and send to our treasurer. (Address in masthead).

**Reminder: Dues are due!** Check your address label to see if you owe your 2003 dues!

Missing a Gazette? Send mail or email to our publisher. (Address in masthead).

visible, and I could see the blackness of space between the planet and the rings. I believe I also saw one of the moons, but I can't be sure of that. I can only imagine the view that a previous speaker, the gentleman who built a 32" telescope, is getting.

I spent about 30 minutes looking at it, with some of my neighbors, and it was well worth the purchase price of the scope. If you have a small telescope, or even a very good set of binoculars, it might be worth going to your backyard to try to find Saturn.

For the next few weeks, Saturn will rise in the east around 6:00PM, getting earlier every day. To locate it, find the constellation Orion. Hold your hand out an arms length, and look about 2 hand widths to the north of Orion's belt. You'll see a very bright star there, brighter than most in the sky. There are other ways to spot it. It's also about 1/2 way between the Pleiades and Castor and Pollux. Also, a right triangle is formed by Saturn, Orion's belt, and the Pleiades, with Saturn at the right angle. With the moon on the wane, there will be a lot less light pollution by the beginning of January.

C'ya  
Mike



### *President's Corner*

Norm Jones

### *The Meeting*

The January meeting continues the tradition of a "Poster Session", where everyone who wishes to bring something to "show and tell" is welcome to do so. The Poster Session presents a unique opportunity for us to be able to engage in conversation for an entire evening. January is also the month that Annual Dues are due. Please send your check for \$25 to Rob ahead of time so that he might be able to enjoy the evening as well. Rob also requests that those of you who have

signed up for the Cabin Fever Bus Trip send him a check for \$62.

### *Meeting Cancellation*

December 5th marked the first time that we have not had a meeting due to inclement weather. We will continue to rely on Northeastern University canceling evening classes as the benchmark for canceling our meeting as well. A small percentage of our group can be alerted by E mail, but it really boils down to exercising good judgement when contemplating travel in poor conditions.

### *Cabin Fever Bus Trip*

January also marks another one of our major events of the year. I equate this event to that of a child's anticipation of Christmas morning. I really love it! I am sure that there will be more details covered within this edition relating to the bus trip, but I would just like to remind everyone to arrive early at the departure location so that we can load our displays. The bus does leave at 9:00AM.

See you on Jan 2nd

Norm



### *NEMES Show Door Prizes*

by Steve Cushman

Each year at our annual show, we try to award a series of door prizes to the exhibitors. Many of these prizes are contributed by various businesses that have supported us generously. Others have been contributed by members. We all know that the current financial climate is not the best it's ever been and the contributions from businesses are much reduced. It would be great if we could all look around our shops and see if there are any items we are no longer using which would make good door prizes. Please let me know what you find.

Steve



## Ship Launching 101

Ron Ginger

In the last newsletter, there was a note about a recent ship launching at The Bath Iron Works (BIW) in Maine. There were a couple of minor errors in the article, so I thought I'd fill in some of the details.

Norm Jones and I just attended BIW's first ship launch from their new Land Level Transfer facility. We also attended the last launch using the traditional inclined ways. The inclined way launches are much more exciting, but with the size of ships now being built at BIW, it is necessary to modernize the launching.

Ships were always built on an inclined area at the water's edge. The launching ways are a pair of parallel surfaces leading to the water's edge. These surfaces are wide and flat, not simply a railroad type of track. As the ship is built, it is supported by various blocks and shores placed under its keel and bottom. The launching ways do not carry the weight of the ship during construction.

As launch date nears, a launching cradle is built under the ship on the ways. The ways are first greased with a very thick, waxy kind of grease. This grease must withstand the entire weight of the ship without squeezing out, remain slippery in whatever weather during the launch, and provide a very smooth, slippery surface.

On the layer of grease, a series of big wood timbers are laid out like a skid or runner. A big latch mechanism built under the ways prevents these timbers from sliding away. A cradle of wood timbers is built up to the ship's hull on top of the skid timbers. It takes several weeks to build this cradle under a ship at BIW.

On the morning of the launch, a crew of several hundred is assembled under the ship. Wedges of 6x6 timber 6 or 8 feet long are placed all along the cradle, between the bottom skid and the rest

of the cradle. There are several hundred wedges. In a coordinated, rhythmic session, these wedges are driven into the cradle, lifting the cradle until it contacts the ship's hull, then lifting the entire ship to transfer its weight from the building blocks and shores onto the cradle. As the weight is transferred, the shores and braces that have been carrying the weight are removed. At this point the entire weight of the ship is now on the cradle, which is setting on the greased ways, held by the trip latch.

Launchings are great occasions. The Navy brass, the company execs and every politician in the state are in attendance. There is a period of speech making, but 'Time and tide wait for no man' and the speeches must end when the tide is right. Everyone watches as the ship's sponsor – usually a woman somehow related to the ship's namesake – smashes a bottle on the bow. But the real action is down under the ship at the latch trigger. The custom was to select some member of the shipyard crew, often a long time worker just about to retire, to pull the trip that releases the ship.

BIW ships are in the range of 400 feet and 6000 tons. The launch is a free, uncontrolled slide. Once the pin is pulled there is no stopping it and no control over it. The ship moves slowly at first, but it accelerates rapidly and by the time the stern hits the water, it's moving at several miles per hour. As the stern hits the water it is being driven down at the angle of the incline and it begins to submerge, but slowly its buoyancy starts to become effective and the stern begins to lift.

Now it gets tricky. The stern is in the water, free to be driven sideways by wind or tide, and being driven deeper by the weight of the sliding ship. As the stern rises, the mid ship area lifts out of its cradle and for a time, the ship is balanced on just a single point at the bow and its relatively narrow stern. The ship has tremendous loads on it as it acts like a bridge only supported at each end, holding its entire weight in the center. The stress on the bow is enormous, and that is the primary limit on how large a ship can be to be launched this way.

Finally the ship completes its slide, the bow drops off the edge of the way and into the water and the ship is floating on its waterline and all is

well. Except, of course, the ship is moving backward at 5 or 6 miles per hour, and is totally uncontrolled. It is considered 'a bad thing' to have the ship coast across the river and go aground on the other side, or to drift sideways and hit the Carleton Bridge where several thousand spectators are watching the launch. A fleet of tug boats moves rapidly around the ship to get it under control, while a couple of smaller tugs start to corral the floating debris of the cradle.

BIW was lucky and never had a major accident at a launch, but other yards have had problems. One of the most embarrassing was a launch in England in the late 1800s. I don't recall the ship's name, but it was the biggest ship launched to that time. Something hung it up and it was stuck fast and required about a year to rig and get it launched. Ships have also tipped over right at the point where its stern is floating while the bow is still on land.

The new Land Level Transfer Facility is much more controlled and much less exciting to watch. The ships are now built on a flat surface a few feet above high water. Working flat is a major productivity improvement over the old inclined building surface. Ships can be much more complete before launch, and there are no stress on the hull in launching.

When the ship is ready for launch, a series of wheeled jacks, about 6x10 feet and 4 feet high are rolled along tracks under the ship. These jacks support beams placed under the ship and jack the ship up onto the wheels.

The dry-dock is essentially a huge barge, about 100 ft wide and 800 ft long. It has two narrow wing decks along each side, but it does not have any form of gate at the ends. The dock is floated to the end of the building surface and dragged sideways by huge chains until it aligns with the ship's tracks. The dry-dock is then flooded and sinks to a foundation under it. This places the dry-dock deck exactly at the level of the building surface and the ship can be rolled onto the deck of the dry-dock. It moves very slowly and takes several hours to make the trip.

Once the ship is centered on the dry-dock, braces are placed between the wing decks and the ship to keep it from tipping over. The lifting jacks and

beams are removed and the ship is left on just some keel blocks on the deck of the dry-dock. The dry-dock is then pumped out until it can float off the foundation.

The dry-dock is towed into the deep water of the river, anchored and slowly flooded until it sinks under the ship. The ship can then be towed out of the dock, the dock pumped out and returned to shore. It takes several hours for the dry-dock to sink enough for the ship to float off.

So that's the story of launching a BIW. I went to several of the old launches, and the first of the new. The new launches are much less exciting, but they do have an inspiring side. The speech-makers are very patriotic, the bands play bold music and the fireworks are a nice touch.

Ron



### *A 3C adapter for Asian 7" lathes.*

Dave Audette

I own a couple of Asian 7" lathes. One is a "stock" Homier 7x12 and the other is a Grizzly that's been stretched to 7x24. I also have a South Bend 9" lathe and a number of 3C collets from it. All three machines have a Morse Taper #3 spindle and it wasn't long before I started thinking about a way to use the SB 3C collets in the 7" machines. After all, a lot of the work was already done for me with the SB spindle sleeve that was MT3 on the outside and 3C on the inside. Perfect.

In addition to the 3C collets I also have a very nice Buck 4" set-tru 3-jaw chuck with a 3C arbor on it that I'd really like to use with the 7" machines. A 3C collet closer for the little guys was clearly in order.

As I began to think about how to get from here to there, I saw three ways to accomplish the task. I'm sure there are many more but the three I came up with were the easiest for me to do in a home shop.

The first would be to simply make the adapter I needed. Take a piece of round stock and turn the outside diameter to a MT3 and then bore the inside to accept a 3C collet. The main disadvantages to this method were that it was the most difficult. Cutting the keyway and soldering the key in place were daunting tasks. I had decided to skip that part if I made it myself and rely on the drawtube to keep the collet from rotating.

The second method would be to use a South Bend spindle sleeve. This is a high quality piece already finished to MT3 & 3C specs with the bonus of having the key already in place. The disadvantages to going this route were the cost of a south Bend spindle sleeve and the fact (minor but irritating) that the sleeve left a 3/8" or so gap between the sleeve shoulder and the spindle face.

The third way to make a collet closer was a compromise between the first two and that was to use a Morse Taper adapter and bore it to fit the 3C collets. The advantage was having a nice Morse Taper sleeve already turned on the outside diameter and the disadvantage was having to match the 3C dimensions for the inside diameter plus adding the keyway & key. Something else to keep in mind if going this route is the hardness of the chosen sleeve. These sleeves come in two varieties, hardened and unhardened. For obvious reasons you'll want the unhardened type but if you wind up with a hardened sleeve don't worry, it can be fixed. You'll need to heat the whole sleeve up cherry red and then toss it into a bucket of sand and let it cool for an hour or so. When you go back it should be annealed and you'll be able to turn it on the lathe.

I may tackle the third method but to date my efforts have been centered on the first two options. In all honestly I had started on the first (making one from scratch) when I stumbled upon the second. I have too much work into the first adapter that I started to abandon it, but for the immediate future my plans are to use the South Bend spindle sleeve. These sleeves show up on *ebay* from time to time and I was able to get one for a very reasonable price. By using the SB sleeve, I skip a whole bunch of steps (I'll have to still go thru all of them to complete the other

adapter) and I'm able to use my collets and 4" chuck that much sooner.

After obtaining (or making) a spindle sleeve the only other step is to fabricate either a drawbar or drawtube. A drawtube is hollow down it's length and thus allows you to pass small diameter work entirely through the spindle, which is sometimes very desirable. Again, there are several ways to skin this particular cat. While I may make a drawbar at some future point, right now I'm going with the drawtube.

I started by scanning the online metal suppliers until I found one that carried Cold Rolled Steel (CRS) tubing. I found one and purchased a length of .750" tubing with a .110" wall thickness. This was a thick & sturdy tube that will make a great drawtube. I had to switch to a 4" 4-jaw on the lathe because the 3" 3-jaw didn't have the thru-hole clearance to pass the tube.

I should mention this: I've worked at this project on and off for the better part of a year. One of my early attempts at fabricating a drawtube involved putting a threaded insert into a shotgun tube but as things worked out the wall thickness just wasn't enough. I did however salvage the insert, which was actually my first threading success. After getting over the shock of pricing the .640"-26RH Tap for the 3C threads I decided to cut the threads myself.

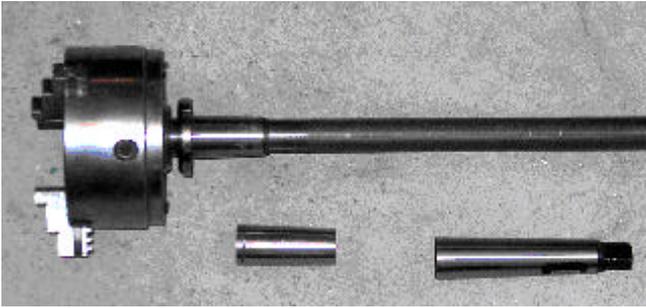
I bored the .750" tubing to accept the 3C threaded adapter, installed and loctited it in place.



Close up of the threaded insert.

Dave Audette Photo

In the next picture is the half finished drawtube assembly with the South Bend spindle sleeve and the Buck 4" 3-jaw, along with the semi-finished adapter and the unstarted Morse Taper sleeve



All the components

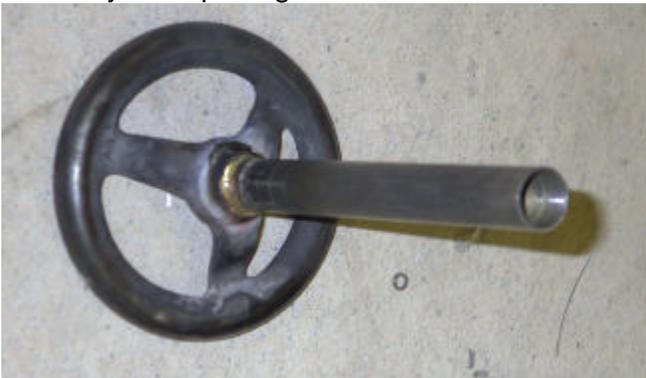
Dave Audette Photo

I scavenged a handwheel from an old lathe apron and bored it to fit the drawtube. I fit it to the tubing to measure for length, and then cut the drawtube. Both pieces were cleaned and fluxed then they were put together and silver soldered.



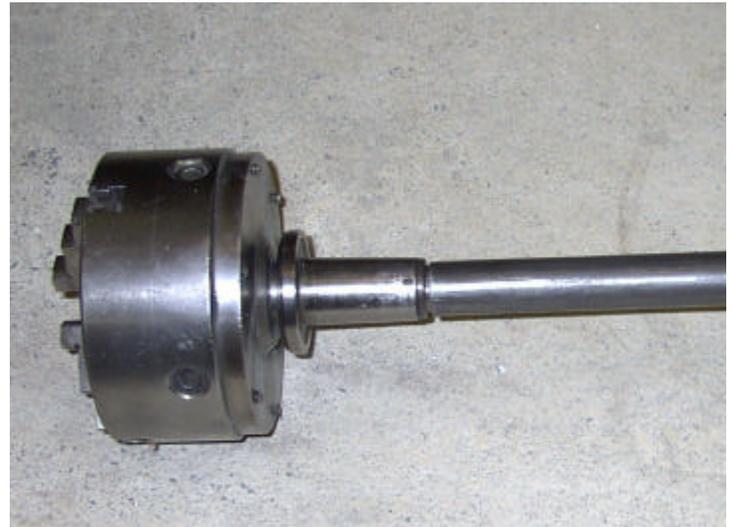
Drawtube assembly with a collet

Dave Audette Photo



The completed drawtube

Dave Audette Photo



Drawtube assembly with 4" 3 Jaw

Dave Audette Photo



Close-up of the joint

Dave Audette Photo

Yes, I know it could look better, but I had good penetration throughout and the joint is sturdy enough for its intended use.

The last thing left to do was make a brass spacer for the drawtube. This was pretty simple and straightforward.



Using a collet in the lathe

Dave Audette Photo

Now even though everything was finished, I just couldn't leave that ugly looking drawtube unfinished like that. I used my very favorite Eastwood company powder coating gun to spray the drawtube with a silver hammertone powder. It bakes on and is very durable. I cured it in a toaster oven that is dedicated to powder coating, I don't cook Pop-Tarts® in it!



Close-up of the finish

Dave Audette Photo



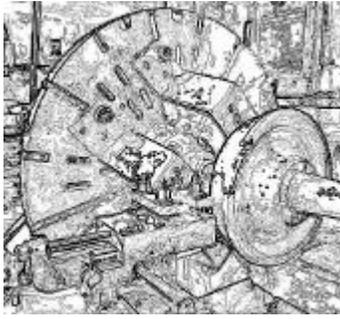
The completed collet closer assembly and all of the parts that make it work

Dave Audette Photo

In order to use the collet closer with the gear-cover in place I had to take a Dremel to the hole in the cover and enlarge it to allow the brass spacer to seat against the spindle without interference.

Well, there it is. A 3C collet closer for the Asian 7" lathe really isn't that hard to make. Probably the biggest hurdle is getting the 3C collets at a reasonable price. There are a couple vendors who carry Import collets in the \$20-\$30 range and several more who carry Domestic collets in the \$60 each range. Online auctions are another supply but both the price and quality of the collets vary greatly. Please feel free to E-mail me with any questions.

Dave



## Shop Hints

Compiled by  
Mike Boucher

### *BA to American Standard Conversion*

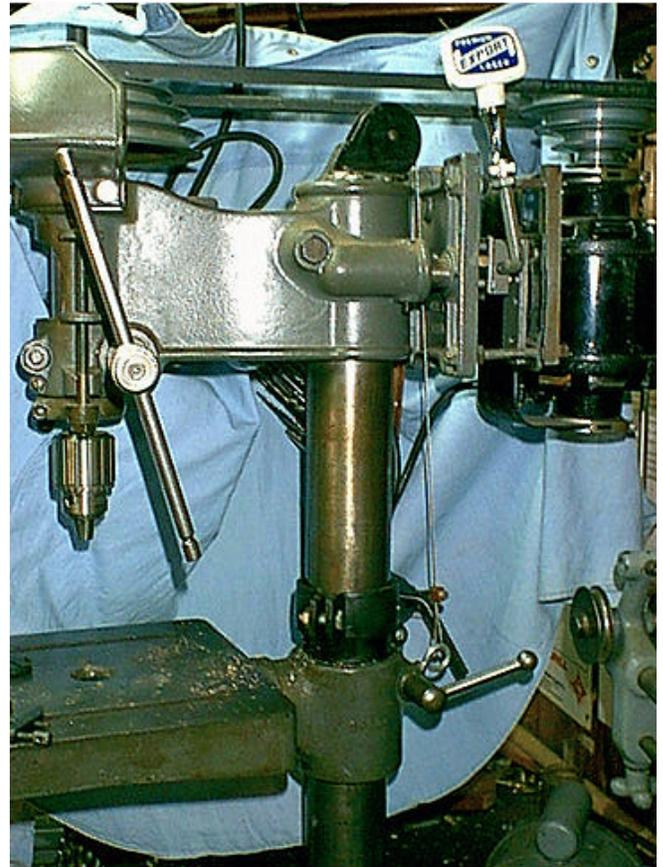
Jim Paquette sent along this great chart to convert between BA tap sizes and American Standard Threads. Those of you with Stuart Turner castings seasoning under the workbench will appreciate this!

Amreican Standard Thread	Major Diameter Inches	B.A. Bolt size	Major Diameter Inches	TPI
0 - 80	0.060	12	0.051	90.9
0 - 80	0.060	11	0.059	81.9
1 - 64	0.073	10	0.068	72.6
1 - 64	0.073	9	0.075	65.1
2 - 56	0.086	8	0.086	59.1
3 - 56	0.099	7	0.098	52.9
4 - 48	0.112	6	0.110	47.9
5 - 44	0.125	5	0.126	43.0
6 - 40	0.138	4	0.142	38.5
8 - 36	0.164	3	0.161	34.8
10 - 32	0.190	2	0.185	31.4
12 - 24	0.216	1	0.209	28.2
12 - 24	0.216	0	0.236	25.4

### *Drill Press Modifications*

By Fred Jaggi

In model engineering, we are constantly adjusting our drill presses to the work at hand. It's handy to be able to make these adjustments easily and quickly. Here are a couple of additions I have made to my fine old Delta Slo-speed 14" drill press that you can see in this photo.



Fred Jaggi's drill press

Fred Jaggi Photo

Many years ago I added a counterweight for the table based on a tip from a Popular Mechanics note. At the top of the column you can see a pulley, which in an earlier life was used as a window sash cord pulley. A small diameter cable attached at the back of the table goes over the pulley and through the center of the column to a sash cord weight below the table. This arrangement balances the weight of the table and makes it very easy to adjust. Since most of our work is light, this counterbalance is much more convenient than the rack and pinion arrangement used on many of the modern small drill presses.

In the photo, you can also see a lever which operates a cam to release belt tension. The motor is mounted on a hinged plate, which is held against a stop (the vertical bar) by the cam. Speed changes can be made very easily with this arrangement. It would be interesting to hear what other members have done, other than VFD, to make speed changing easy.

Fred



## Treasurer's Report

Rob McDougall

With the January meeting and Cabin Fever coming up, a lot of money passes around within the club's finances. Everyone pays their dues to the club coffers in January and your humble treasurer sends a big wad of money to Brush Hill Tours for the Cabin Fever Bus. (Actually, just sent \$2,195.00 to them yesterday 12/11/02). So, I wanted to take this opportunity to spell out to members how I handle the club's finances on a cash basis.

- 1) The club owns a bank account at Boston Private Bank & Trust (which is also my personal bank of choice). They only have two branches, one in downtown Boston and one in Wellesley. Since I no longer work downtown, my wife usually takes any checks received and deposits them. I keep receipts for all deposits. The club earns a small amount of interest on funds deposited.
  - 2) I "account" for all club assets and liabilities in Intuit's Quicken accounting program. Essentially, this is an electronic check book where I enter each member's dues payment, along with their name and check number. If paid in cash, I note that in the entry along with the receipt number (see below). Our current assets consist of cash, a PA system, and a File Cabinet. (Things we have paid for.)
  - 3) I keep a "receipts" book of all payments made to the club. For example, for all dues received, I make out a receipt. Most of you don't get a copy, since if you pay by check, the check returned to you serves as your receipt. I try to give a receipt on the spot for all cash payments, but this January's meeting may be different.
  - 4) I maintain the NEMES membership database in Microsoft Excel that includes a field for noting if a member has paid their dues for the current year and those who pay next year in advance.
- 5) All payments (such as for the bus company) are first registered in the club check book tab, and then in the Quicken accounting program.
  - 6) Each month I reconcile the actual bank statement received from Boston Private Bank & Trust with the Quicken accounting package.

That's about it! I want everyone to know that all these books and records are the property of the club and open to review by any member at any time. And I would be happy to show any member any or all of the above - just let me know what you would like to see and I can bring it to a meeting or you can see them at my home office.

At the January meeting, because of the large volume in one night, I am going to ask that anyone paying their 2003 dues drop their payment into a box that I will have. The following few days after the meeting, I will "account" for everything in the box according to the above procedure. I hope this is satisfactory since normally I would write out a receipt for those paying in cash. **If you do pay in cash, you will need to envelope the money and write your name and contact information on it.** I will have stick-on labels at the meeting, of all unpaid members on hand that could be used for this purpose. **Please try to pay by check if you can.** If anyone has any questions, at any time, about club finances, please do not hesitate to contact me.

Yours sincerely,  
*Rob McDougall*  
*NEMES Treasurer*



## Humor

Anonymous

Here's an email that's been making it way around the internet. I've proven some of them...

### *Mechanic's Laws (Murphy's Adjuncts?)*

After your hands become coated with grease, your nose will begin to itch. -- *Lorenzo's Law of Mechanical Repair*

Identical parts aren't. -- *Son of Beach's Law*

Any tool, when dropped, will roll into the least accessible corner. -- *Anthony's Law of the Workshop*

Nothing is as inevitable as a mistake whose time has come. -- *Tussman's Law*

If it jams, force it. If it breaks, it needed replacing anyway. -- *Lowery's Law*

The solution to a problem changes the problem. -- *Peer's Law*

There is no mechanical problem so difficult that it cannot be solved by brute strength and ignorance. -- *William's Law*

Machines should work. People should think. -- *IBM's Pollyanna Principle*

The first rule of intelligent tinkering is to save all the parts. -- *Ehrlich's Law*

It is a mistake to allow any mechanical object to realize that you are in a hurry. -- *Ralph's Observation*

*Handy Guide to Modern Science:* If it's green or it wiggles, it's Biology. If it stinks, it's Chemistry. If it doesn't work, it's Physics.



## Book Reviews

Jay Striker

If you want to get away from your workshop for a few moments, here are two books which are possible "good reads" for Model Engineers:

### Trustee From the Toolroom by Neville Shute

This is a saga of a quiet model engineer (said to be perhaps based on Edgar T. Westbury) who becomes an estate trustee and has a series of adventures in global travel. Each predicament is solved with knowledge and skill... unlike most literature where the problem is solved by violence. A gentle and satisfying read. I think Neville Shute was a practicing model engineer himself. Neville Shute also wrote On the Beach

### The Next Great Thing by Mark Shelton

This is a report on the development of prototypes of Stirling engines at SUNPOWER in Athens, Ohio in the early 1990s. Descriptions of personalities, engineering group interactions, engine parts, machinists and machining, and the hopes, losses and minor triumphs as prototypes are built. Gives an insight to small companies dealing with big corporate clients.

As far as I know, both of these are out of print but available via inter-library loan or used bookstores

Jay



For Sale

### Shaper Work CD

Put out in 1944 by the New York State education Department this 326 page manual is chock full of valuable tips and information on using the King of Machine tools....The Shaper. Covered is everything you need to know about the care and feeding of the shaper, use of the shaper, even how to sharpen tools for the shaper. Scanned and saved in Adobe Acrobat format. \$5.00 shipping included.

Errol Groff  
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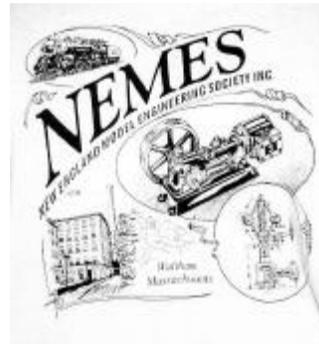


NEMES clothing

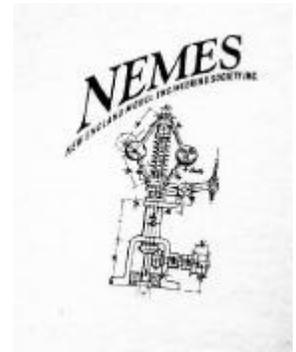
### NEMES Tee Shirts

NEMES tee shirts are available in sizes from S to XXXL. These are gray short sleeve shirt, Hanes 50-50. You won't shrink this shirt! Artwork by Richard Sabol, printed on front and back.

Artwork:



Rear



Front

Prices:  
S, M, L, XL \$12.00  
XXL \$14.00  
XXXL \$15.00

Add \$5 shipping and handling for the first shirt, \$1 for each additional shirt shipped to the same address

Profits go to the club treasury.

Mike Boucher  
295 River St  
Waltham, MA 02453-6007  
[bandm3714@hotmail.com](mailto:bandm3714@hotmail.com)



Upcoming Events

Bill Brackett

### Jan 1 – Waushakum Live Steamers “New Years Run”

Holliston MA. Call Bob Newcombe (508) 278-7431 or see <http://www.steamingpriest.com/WLS>

### Jan 2 - Thursday 7PM

NEMES Monthly club meeting Waltham, MA  
Charles River Museum of Industry (781) 893-5410

### Jan 18-19 - Cabin Fever Expo

York PA Gary Schoenly (800) 789-5068

### ***Feb 1-2 - Amherst Railway Society***

Model Railroad show at the Big E, Springfield. 3 buildings, over 5 acres of model trains.

<http://www.amherstrail.org/show/show.htm>

### ***Feb 6 - Thursday 7PM***

NEMES Monthly club meeting Waltham, MA  
Charles River Museum of Industry (781) 893-5410

### ***Feb 15 - NEMES Model Show***

Charles River Museum of Industry (781) 893-5410 or Norm Jones (978) 256-9268

To add an event, please send a brief description, time, place and a contact person to call for further information to Bill Brackett at [wbracket@rcn.com](mailto:wbracket@rcn.com) or (508) 393-6290.

*Bill*



### ***Web Sites of Interest***

### ***Truing Acela Wheelsets***

The December issue of "Cutting Tool Engineering" has an article on truing the wheels on Amtrak's Acela train. Photo and description of an interesting wheel profile form tool: 8" diameter with 145 inserts. Click on the article and you can download it in PDF format w/ photos

<http://www.ctemag.com/current/>

### ***Paper Steam Engine***

Here is a splendid little working model steam engine constructed of paper, designed by Ed Bertschy. It's based on a Riches and Watts original. The instructions are in MS Word format, and the drawings themselves are in PDF format. Both come in a .ZIP file.

<http://www.securaplane.com/steam.html>

### ***"Spare Time Lab"***

This is a Finnish site, written in English. It shows an interesting technique to make a pattern for a steam-locomotive drive wheel by cutting a "negative" in a synthetic wood material and then using resin to cast the pattern. Also, it shows a homemade iron-melting furnace, which the author admits is a highly dangerous design.

<http://members.surfeu.fi/sparetimelabs/index.html>

### ***Steam Whistle collector***

Here's a massive collection, an interesting trailer-load of whistles. They give some info on how they work and various types of whistles.

<http://www.whistleman.com/index.html>

### ***On-line calculators***

Earle Rich sent this site, a comprehensive list of on-line calculators. Also, it has some fun stuff like a calculator to convert "warp speed" to real speed.

<http://www-sci.lib.uci.edu/HSG/RefCalculators.html>

### ***The Cosmos, from start to finish***

Here's a one page timeline of the entire universe.

<http://www.time.com/time/covers/1101010625/timeline.html>