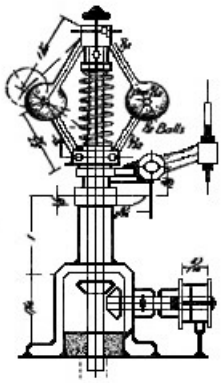

The NEMES Gazette

NEW ENGLAND MODEL ENGINEERING SOCIETY INC.

No 254 September 2017

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September Program

The NEMES program will be held at 7 PM on Thursday, September 7, 2017, in the Jackson Room of the Charles River Museum of Industry and Innovation.

The meeting agenda will be:

Members exhibiting interesting projects, recent acquisition, questions for the membership, etc.

A talk by Mr. Peter Peter Babigian of the Queen Screw and Manufacturing Company here in Waltham. Queen Screw is a high volume CNC shop that makes precision parts for local biomedical, high tech, and bio-med firms. They machine plastics and soft metals to tolerances as close as 0.0001". A lot of these plastics are soft and heat sensitive and move a lot when they get hot. How they hold these tolerances will be quite interesting to hear about,=.

Mr. Babigian has said he will bring some samples as well.

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Club Business

Rich Baker

Online Store. The NEMES Online Store is now live, and you can order NEMES apparel and pay your dues from the comfort of your living room. The link is available on the www.neme-s.org.

NEMES Apparel. We have NEMES denim button down shirts, t-shirts, and sweatshirts for sale. The denim shirts $35, sweatshirts $25, and the t-shirts $15. Order online or contact Rich Baker at 978-257-4101 if you would like to order one.

NEMES Membership List. Our mailing and email lists are only as good as the information we are given. Please let us know if you move or change email addresses. If you know anyone who has moved, let us know the new contact information.

President's Corner

Dan Erying

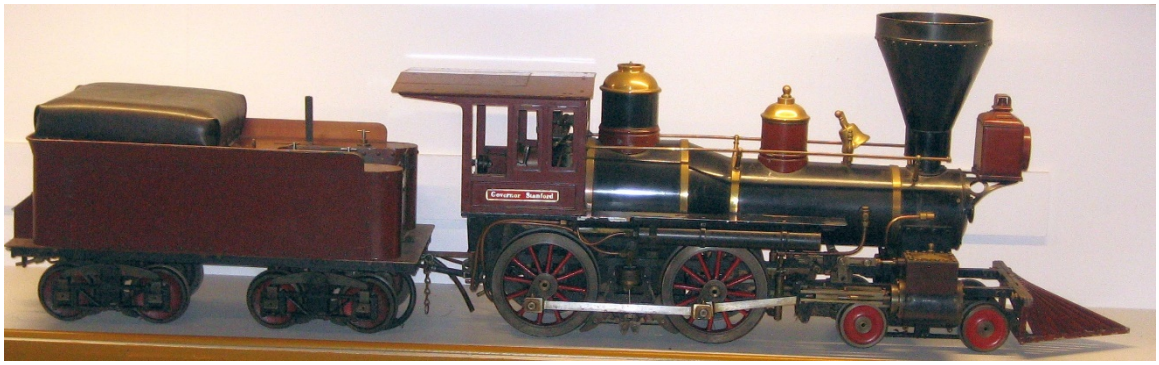
[Dan's column will depart from our usual 2 column format for this issue, in order to fully display the pictures along with it—Ed.]

This month I am happy to show you a new CRMII exhibit, known as "The Steam Gallery", that puts the amazing model locomotives of Walter Bush on display – as they so richly deserve. Volunteer Roger Wiegand deserves many kudos for his excellent carpentry in constructing the new display cabinets.

Walter, a longtime volunteer at the Museum, became interested in steam engines as a young boy when his Father took him down into the engine rooms of steam boats. After World War 2, having served with a French speaking unit of US Army Military Intelligence, Walter purchased some machine tools and decided to build steam Engines. He started building stationary engines and then progressed to steam locomotives, which were built both from plans, as well as his own drawings.

The five model steam engines donated to the Museum were painstakingly built over a period of 35 years. Walter's long service to the Museum and his love and knowledge of steam engines will not be forgotten. They are now on permanent display at the CRMII.

Below are the two new display cases in which Walter Bush's locomotives are now on display and descriptions of their contents. Also on display are two artifacts of unknown origin – A "Nickel Plate" (New York, Chicago & St. Louis Railroad, commonly known as the Nickel Plate Road (NKP) locomotive and tender and a red caboose. Any information on these will be greatly appreciated.



Governor Stanford and Tender

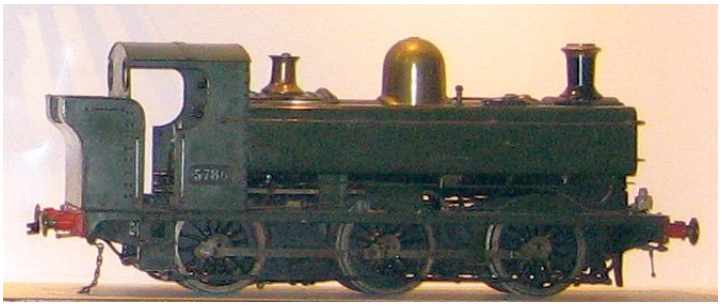
Description: 1 ½ inch scale, 7 ¼ inch gauge, 4-4-0 wheel arrangement, coal burning model, operates at 80 – 100 PSI. Built in 1962 – 1967 by Walter M. Bush. Weight is about 200 pounds. Original was built by the Norris Locomotive Works in Philadelphia, in 1863, and shipped around the Horn of Africa to become the first locomotive of the Central Pacific Railroad. Also includes tender, cow catcher and front deck. Original is at the Sacramento Railroad Museum in Sacramento, California.

Locomotive #6

Description: Model Saddle Tank Locomotive, 2 inch scale, 7 ¼ inch gauge, 0-4- wheel arrangement, operates at steam pressure of 80 – 100 PSI, burns coal, weight is about 200 pounds. Built in 1983 – 1985 by Walter M. Bush. Original was built in 1913 by the Vulcan Iron Works in Wilkes-Barre, Pennsylvania for a granite quarry in Stonington, Maine. Original is now owned by the Maine Narrow Gauge Railroad Museum in Portland, Maine.

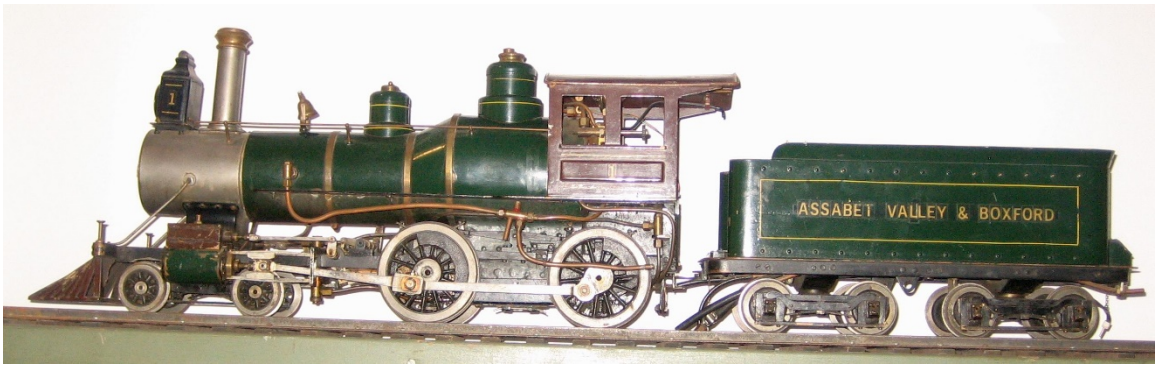
Locomotive #4472 and Tender

Description: Coal burning model, 1 inch scale, 4 ¾ inch gauge, operates at 80 – 100 PSI. Built by Walter M. Bush in 1977 – 1981. Wheel arrangement is 4-6-2. Original is famous British “Flying Scotsman” built at Doncaster railway works is in the town of Doncaster, South Yorkshire, England for the London and North Eastern Railway in 1923. Set a speed record in excess of 100 miles per hour. Includes tender.



Locomotive Number 5786

Description: Coal burning model, 1inch scale, 4 ¾ inch gauge, 0-6-0 wheel arrangement, operates at 80 – 100 PSI. British “Pannier Tank” used for light passenger and freight hauling, a member of the British Great Western Railway 5700 Class locomotive. Built by Walter M. Bush in 1971 – 1975.



Locomotive Number 1 (Virginia) and Tender

Description: Coal burning, wheel arrangement 4-4-0, 3 ½ inch gauge, ¾ inch scale. Built in 1950’s by Walter M, Bush. Operates at 80 – 100 PSI. Typical of 1880 engines “that built America”. Includes Tender.

From the Editor's Desk Bob Timmerman

I would like to call member's attention to a video by Keith Fenner, who runs a small machine shop on Cape Cod. He has one series of videos on repair of a 1840s E. Howard Tower clock which might be of interest both to our general machine audience and to our horologists. To find it, go to the Keith Fenner YouTube site, and search for West Dennis Tower Clock Repair. There are three video in the series, Part 1 and Part 2 deal with the actual machine shop work of repairing the clock, and the final one, titled West Dennis Clock Tower Field Trip, shows a trip to the clock tower to install the repaired part, and details of the clock and the clock tower. The clock had been operated by falling weights, as the one in the Museum is now, but has been converted to a synchronous motor, with another motor to strike the bell to chime the hour.

Unfortunately, the introduction to the first part has been clipped, so the video starts in the middle of the repair process in the shop. Missing is the original description of the problem (a broken shaft). The remaining portion of the video is still worth watching for the description of the care necessary when working on antique machinery.

I would like to remind people that the Yankee Steam Up of the New England Museum of Steam and Wireless will be held Saturday, **September 30**, instead of their usual date of the first weekend in October.

The Gazette is still looking for articles, and shop tips to include. If you do not want to type it out in Word, it would work if you could send me something handwritten with a number of .JPG pictures. You could send articles to editor@neme-s.org, or my personal e-mail, RWTimmerman@gmail.com.

Notes on the August program

This program was a video put together to describe the process of using sophisticated CNC to produce parts for the Challenger model V-8 engine. Rolly spotted this engine as a 1948 Cadillac. The program went into the steps necessary to machine most of the parts, and to assemble the engine. It also covered a quick tour of the shop. Participation from the audience was encouraged and received.,

.End of August meeting

A Mechanical Engineer Looks at Belt Drives

Robert W. Timmerman PE

Part 1: V belts

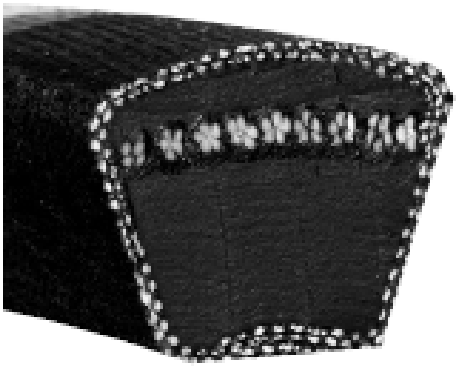
V belts are the most commonly used ways to connect an electric motor to a piece of equipment. Even if the final drive is through gears, frequently the first drive is a v belt.

V belt drives are inexpensive, highly efficient, and provide speed reductions up to about 5:1. They work well at normal motor speeds of 1750 and 3450 rpm. Cone pulleys provide a means of obtaining a series of spindle speeds, and are used on lathes and drill presses.

V belts are not particularly practical at small pulley speeds much below about 500 rpm—usually other types of drive, such as a chain or timing belt, is a better choice if the small pulley operates below about 500 rpm.

V belts can operate at belt speeds up to about 6500 feet per minute, which equivalent to about a 7" pulley on a 3450 rpm motor. Above this, other factors come into play, particularly centrifugal forces tending to drive the belt out of the groove. To illustrate what 6500 feet per minute is capable of, if this were a step-up drive with a 2.5" pulley on the spindle, the spindle speed would be about 9500 rpm. For belt speeds above about 6500 feet per minute, a lighter belt is needed. Sometimes, lightweight flat belts are used.

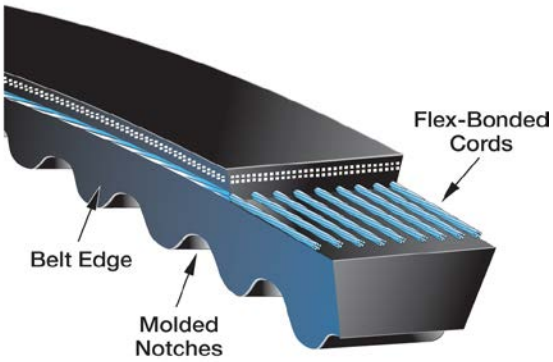
The conventional v belt is a rubber core, covered by fabric, and reinforced with cords, usually made of synthetic fibers today. Typical belt construction is shown below::



From the Browning HVAC Catalog

When passing around a pulley, the sides of the belt bulge out a bit, and grip the sides of the pulley. Thiis is what makes the belt work so well on small diameter sheaves. The v grooves in the pulleys keep the belt in the pulleys, reducing the problem of the belt slipping off the pulleys.

There is a variation of the basic V belt designed to better flex around small diameter sheaves, which has notches in the bottom of the belt, as shown below:



From the Gates Rubber Catalog

The notched molded into the bottom of the belt help it flex around small sheaves. This type of belt is commonly available as an alternate to conventinal belts.

Types of Small Belts

There are a number of different types and constructions of small belts. Some are illustrated below, in an illustration taken from the Browning Catalog, with sizes added in larger type:

3L	3V	"A Belt	4L	5L
3/8"	3/8" x 5/16"	1 / 2" x 5/16	1 / 2"	21/32"

From the Browning Catalog
Not all illustrations are to the same scale.

From the left, the belts are 3L (3/8" wide at top), 3V—a narrow design (also 3/8" wide at top), the traditional "A" belt, ½" wide at top x 5/16" deep. The 4L belt, also ½" wide at the top, and the 5L belt, 21/32" wide at the top. There is also a size 2L belt, ¼" wide at the top, which is used mainly by OEMs and is not standardized.

The 3V belt is an industrial belt, invented by the Gates Rubber Company, designed for high horsepower drives in industry. It requires special sheaves with a steeper angle than traditional V belt sheaves. The L series belts (2L, 3L,4L, and 5L) are light duty belts, designed for small pulleys and low horsepower ratings. The 4L is the same size as the traditional A belt, and the 5L is the same size at the traditional B belt (not shown).

The notched belt shown above Is interchangeable with normal "A" belts, and is designed to run on slightly smaller pulleys.

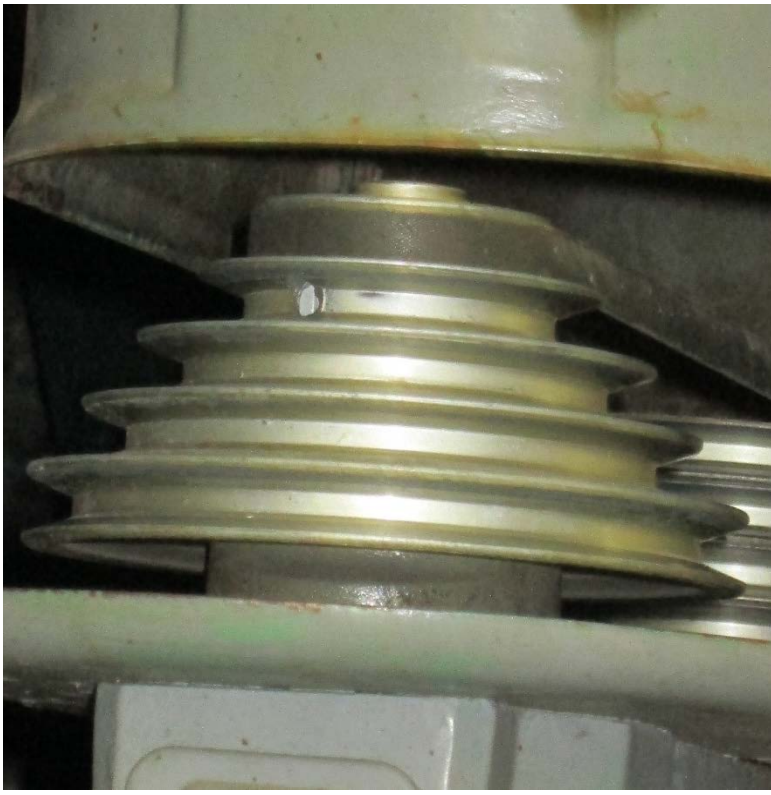
V belts are made endless, and can be spliced only with a special splice which requires special tools to install. Belt manufacturers do make belting designed to be spliced, and special splices and the tooling can be obtained from Flexco (www.Fleco.com). Flexco is the same company

that makes the Alligator and Clipper splices and lacing for flat belts.

If you have a machine where the pulley is between the bearings, and it is difficult to remove the pully to install a new belt, there is an alternate to a belt splice—the Link Belt. The Link Belt is made up of individual links of rubber reinforced with fabric. The belt can be taken apart at each link, making is possible to take the belt apart to install over a pulley between bearings. Various manufacturers have their own designs of Link Belt. One brand is shown below:

Other types may differ in how they are put together, or in the materials used. The belt illusrated is made by Browning, and is available from suppliers such as Rockler and Grizzley. Browning advises that this belt is about 300% more expensive than conventinal belts, and suggests limiting it's use to special applications, such a pulleys between bearings, where breaking and reassembling the belt is easier than removing the shaft from the bearings.

The two pictures bellow show a drill press using a traditional A belt, and another one using a 2L belt. The drill press with the A belt has 5 speeds ranging from about 450 rpm to 3600 rpm



Drill press with 5 speeds and A Belt

, while the one with the one with the 2L belt has 8 speeds, ranging from about 360 rpm to about 8500 rpm.

Drill press with 8 speeds and 2L belt

The A belt o n the 5 speed drill press appears fully capable of carrying the full power of the ¾ hp motor, while the 2L belt in the 8 speed drill press could probably not carry the full power of the ½ hp motor in the lower speeds. The 2L belt might not

last as long as the A belt, although in light home shop use it has lasted about 15 years

The advantage of the 2L belt is that is makes possible a compact drive with a wide range of speeds.

There are also special V belts in the shape of a hexagon, that can run in pulleys on both sides of the belt, for special applications.

V belts can be used on quarter turn drives, but special pulleys with deep grooves are required to guide the belt around the turn.

Other Types of Power Transmission Belts

Conventinal V belt are available in sizes of A, B, C, and D. The narrow V belts are available in sizes 3V, 5V, and 8V. V belts are frequently used in muttiple to handle more power than a single belt can handle.

There is also a multi-groove belt that looks like a flat belt with a lot of small V belts on it, parallel to the long dimesion of the belt. These are sometimes seen on consumer grade air compressors.

There are a large number of different types and sizes of belts which look like flat belts with notches or grooves molded perpindicular to the long dimension. These are generically known as timing belts, but are used for all kinds of applications from motion control and timing in office equipment, to power transmission in hundreds of horsepower. Because the belts flex less than V belts, they are generally more efficent than multi-V belts for high power applications, and have been used to replace V belts in energy conservaton projects.

This discussion is about the common A belt with some discusson of the L series.

Technical Considerations

Torque: the twisting force on a shaft. It is force times length of lever arm, and is measured in pounds-feet. One pound-foot is a force of one pound on a lever arm of one foot.

Work: Force times distance, usually measured in foot-pounds. (note the difference in the order of the words).

Belt Speed: This is the same as surface speed, pi x diameter (or 3.1416 x diameter). This exactly the same a surface speed used for calculating performance of turning.

Power transmisson between pulleys: Torque on the driving pulley produces a difference in tension between the tight side of the pulley and the loose side of the pulley. A certain minimum tension is required to keep the belt from slipping. The greater the torque, the greater the difference in tension. If the difference in tension is the same, the larger pulley will produce the greater torque.

Since the belt speed is the same for both pulleys, the speed ratio is the same as the ratio of the diameters.

Units of belt speed, torque, and pulley diameter muust be consistent. If belt speed is in feet per minute, then pulley diameter must be in feet, and torque will be in pounds-feet.

The manufactuers ratings give a minimum pulley diameter for each belt size based on standard motors. This minimum size is determined by the ratings of the motor bearings. A small pulley will take more belt pull to develop the motor torque and horsepower than a large pulley. Too small a pulley will exert more pull on the motor shaft than the motor bearings are designed for. Motor bearing ratings are based on hours of use before failure, so it may be possible to run a smaller than standard pulley for short time usage.

Rated power transmitted by a belt drive

There is a formula in *Machinery's Handbook* for the horsepower transmitted by a V belt dirve, but the formula is fairly complex, and in most cases, it is simpler to use the belt manufacturer's data. Sources of this information are available on the Internet, where to find them is presented in the References

Belt ratings appear to be based on belt life, so one can use an undersized drive for intermittent use.

The belt ratings given by the manufacturers have to be modified by several factors:

- Service factor of load
- Belt length factor
- Loss of arc of contact factor

The service factor of the load reflects any factors that wear out the belt, such as jerky starting. The actual motor load is *multiplied* by the service factor to get the design load. The design load is the load for which the belt is selected. The service factor is always greater than 1, so belts are selected with a rating greater than the actual load imposed on them. For most machine tools and other power tools, the service factor is 1.0, so it can be neglected. (You might need to multiply by a service factor for a large fan with across the line starting, especially if the fan starts frequently.)

The belt length factor allows for the reduction in belt flexing around the pulleys if the belt is long. It is given in the table below. It is a factor less than 1, and mulltiplies the theoretical belt power rating to get the actual horsepower the belt will carry.

The loss of arc of contact factor allows for the reduction in the arc of contact around the small pulley when one pulley is smaller than the other. The formula the manufacturers use for loss of arc of contact is: (large pulley dia-small pulley dia) x 57/ Distance between centers. This gives an answer in degrees. [*Machinery's Handbook* has a slightly different formula, the results of which are entered into a table to get the arc of contact, not the loss of arc of contact.] The loss of arc of contact factors are presented in the table below. The loss of arc of contact factor is less than 1 and multiplies the actual horsepower the belt will carry.

The required belt horsepower= load power x service factor, equal to or greater than load power

Belt capacity = belt capacity from rating tables x belt length factor x loss of arc of contact factor. This will be less than the belt rating in almost all cases.

Summary of Belt Drive Information

Belt Length Factor

From	To	Factor
26"	42"	0.81
42"	58"	0.9
	>58"	1

Loss of Arc of Contact:

Formula:
(lg pulley dia-sm pulley dia) x 57/center dist.

From	To	Factor
75 degrees	90 degrees	0.69
50 degrees	70 degrees	0.79
30 degrees	45 degrees	0.92
less than	45 degrees	1

Basic power ratings for belts

2" motor pulley
1750 rpm motor
Speed reducing drive, motor pulley fastest

Belt	Basic hp
A	0.9
A notched	1.24
3L	0.29
4L	0.29
5L	0.39

These factors provide a start to designing a belt drive. More detailed information can be found in the References.

Conclusions

For most applicatons, the ordinary "A" belt offers the best combination of power rating and cost. Where more power is needed, or the belt has to

operate over small pulleys, the notched type A belt would be advisable. The L series belts would be worth considering only if the belt had to operate over small diameter pulleys. The link belt would justify it's cost if the shaft could not easily be removed from the bearings.

If applications exceed the power rating of a single A belt, and a small diameter high speed pulley must be used, consider multiple A belts instead of a larger belt.

Installation and Maintenance

The drive should have some means of adjusting the pulley center distance to adjust the belt tension. An adjustable motor base is ideal, either the type that slides, or pivoting the motor, with some way to hold the motor in position.

Do not force the belt over the sheaves, it may break the cords.

The deflection of the belt should be about 1/64 of the distance between centers, and should take about 4 to 6 pounds of force to do so.

Th ideal belt tension is the smallest that keeps the belt from slipping.

Too much tension wears out the belt, and the motor bearings.

References

Browning and Gates are two of the major belt drive manufacturers. Their catalogs can be found on the Internet.

One of the more useful references is Browning publication 8586E_Sec_B.PDF. To find this on the Internet, go to *Browning—Regal Power Transmission Solutions.* Publication 8586E is second from the bottom of the list.

Upcoming Events

September 2017

8-12 September-46th Annual Dublin Engine Show
Dublin NH, East of junction 101-137 on Rt 101—Feature Vertical Engines.

Contact: Bart Cusing, P.O. Box 668, Walpole, NH 03608 (603) 313-9970

Email: bart@cushingandsons.com
www.dublinnhgasenginemeet.com

13-17 September Tobacco Valley Flywheelers 37th Annual Show
Haddam CT
Haddam Meadows State Park, Rt. 154. Contact: Russ Bengtson, 646 Bear Hill Rd., Middletown, CT 06457 860-347-5774
www.oldengine.org/members/tvf

22-24 September 33rd Annual Connecticut Antique Machinery Assn. Fall Festival
Kent CT
1 mile north of Kent on Rt. 7.
Contact: John Pawloski, PO Box 425, Kent, CT 06757 860-927-0050
loski@att.net
www.ctamachinery.com

30 September Annual Yankee Steam Up, New England Museum of Steam and Wireless

1300 Frenchtown Road, East Greenwich, RI 02818

(401) 885-0545

www.newsm.org

9AM—4PM

Admission $15, students $7

Plenty of free parkkng

Food available for purchas

Steam and air tables will be available

Note September 30 date instead of usual first weekend in October

October 2017

15 October ATCA 36th Annual Antique Truck Show

Lancaster, MA At Bolton Fair Grounds, 5 miles from Rt. 495 from the East 3 miles from Rt. 190 from the West. 8AM-3PM. Trucks can be delivered on Saturday. Parking for self contained motor homes. Vendors, food available, dash plaques, no ATV's, no dogs. Truck Registration $10

Contact Name: Bill Semple 978-460-0465 oldtrucksrfun@verizon.net

14-15 October Rail Fair 2017 - Model Train Show

Boxboro, MA At Boxboro Regency Hotel, 10-5 on Saturday, 10-4 on Sunday. Sponsored by Nashua Valley Railroad Association.

http://nvrra.com/