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This is an article based on a letter that was written by the Chief Engineer of the Reefsteamers Association, Andrew King. He wrote it on behalf of Vesco Plastics South Africa, for their promotional material.



Reefsteamers have adopted the use of Vesconite as a standard bushing material on current and future steam locomotive repairs and rebuilds. This letter explains our findings and decision to use a space-age synthetic bearing material in our vintage steam locomotives.

- Click here to visit the [South African Website of Vesco Plastics](#).
- Click here to visit the [Australian Website of Vesco Plastics](#).
- Click here to [view a Depot News Page](#) that includes usage of Vesconite.

Andrew says :

The Reefsteamers Association was formed in 1992, with the aim of restoring and operating one or more steam locomotives, with an operational base established at the old Germiston Steam Locomotive Depot. We achieved the first part of this wish when we successfully negotiated the lease-land of a Class 15F Steam locomotive (#3046) from the Transnet Heritage Museum. We then spent weekends working on this locomotive to bring it back to full working condition.

This included stripping the whole engine right down to the frames and working from there upwards. While inspecting the parts for repairs, it was found that a lot of the bushings were very worn in various places on the locomotive, including most of the bushes on the valve gear. The valve gear is the many-jointed system of rods and levers that move the valves backwards and forwards to control the flow of steam to the pistons to give the locomotive its forward and backwards motion.

The original bushings were fabricated from bronze. We measured up all the parts required and got prices for what was needed. After I picked myself up from the floor and got my breath back, I thought that there had to be an alternative to traditional bronze, with the use of modern Industrial Plastics. I, (Andrew King) have used this material successfully many times in the past in industrial practice.

But the railways did not like the idea at all !



A typical bronze bushing in a locomotive application.

These traditional bushings have good heat absorption, but are prone to wear and failure in event of poor lubrication and also with water or dirt ingress.

In locomotive applications, they require frequent and time consuming manual lubrication by the locomotive crew.



Reefsteamers Machinist James Thompson machines a new bushing for an Expansion Link Trunnion. The length of the shaving tail demonstrates how easy this material is to cut and machine on a standard lathe. No broken cutting tools here!

We have found that if the recommended clearances are observed (slightly larger than bronze) then no problems are observed.



An original bronze bushing (RHS) and a newly machined Vesconite equivalent. (LHS)

This bushing is for the trunnion bearing of a Walshearts gear valve link and it is subject to a rocking motion rather than rotary. A rocking or oscillation application makes higher demands on lubrication as the oil wedge cannot be maintained at the change of direction - maintaining vulnerable film lubrication only.

So, I went ahead and did it anyway, to prove my point. Thus, we brought the Vesconite from Vesco, as I had used Vesconite successfully before. We then replaced all the worn bushings with this material. I have to admit that, at the time of writing, this particular engine still has not operated. It is still being finished.

However, over the years, we have acquired (on lease) two more Class 15F's, a Class 12AR, a Class 25NC and a Class 15CA. These are all different types of steam locomotives. The first locomotive to get the Vesconite treatment and run thereafter was one of the Class 15F's. (#3016 'Gerda') We replaced a lot of bushings on the valve gear, in a similar fashion to as performed on our first Class 15F (#3046) However, this particular locomotive, with the Vesconite valve gear bushings, has been operated for at least eight (8) years now with no problems to date. The Vesconite bushings have been found to still be in good condition.

We have since replaced the valve gear bushings on both the Class 15CA #2056 'Dorothy' and the Class 25NC #3472 'Elize' as it became necessary due to wear on the original parts. We are, at this moment, repairing the same parts with Vesconite bushings on our Class 12AR Locomotive, #1535 'Susan', as this as now become due.



A current Vesconite Project - a Vesconite tube being machined down on our lathe to make two die block bushings for our Class 12AR.

Looking rather like an isometric technical drawing exercise, here's a cleaned Class 12AR die block with newly machined and installed Vesconite bushing (in sparkling white) and the radius rod pin.

A test fitting of a die block in one of the Class 12AR's expansion links. The pins fit into the radius rod which imparts the movement along the slot. (Vertical, in the locomotive)

We have also replaced bushings on other parts of the locomotives, apart from the application of Vesconite in re-bushing the valve gear. These applications include parts of the brake gear, pivots for parts of the reversing gear and also the pivots on bogie parts on the tender for our Class 12AR. I, as Chief Engineer, will use Vesconite on all locomotive parts that are not subject to high heat (areas subject to live steam) and on parts subject to very high loading, as I cannot guarantee long service life in these applications.

When fabricating the Vesconite bushings for these parts, one has to make an effort to forget what one learnt while working on bronze or your new bushes will seize. We have found that more clearance must be allowed for the plastic material to adjust to the running heat and the different lubricants in use. One major factor in the use of Vesconite is that you don't need to lubricate it at all, as it is self lubricated.

We manufacture the bushings to the specifications supplied by Vesco Plastics in their manual. This methodology had given us no problems at all on our engines. Some of the pins on which the bushes run are either untreated carbon steel, or case hardened, depending on the application. But we have found that it makes no difference, wear wise, which type is used.

Areas like the brake gear normally have hardened steel bushings, but this can be replaced with Vesconite. Again, we have found no problems in this application, providing the specifications are adhered to otherwise these bushings can come loose.

Please visit our website: www.reefsteamers.co.za for regular updates on what we do with Vesconite and for more information about us and/or our steam trip details.



Vesconite Hi-Lube Tube Stock.



A Vesconite equipped locomotive, Class 15F #3016 'Gerda' immediately after a service stop in Kroonstad - on route to Bethlehem and later Ficksburg, far eastern Free State - with no bearing or bushing problems whatsoever on this hard scheduled international steam tour.

Introduction to Vesconite :

Vesconite is a special material compounded from an advanced engineering thermoplastic with a combination of properties specially formulated for low friction, long life bearing applications.

It combines a load bearing capacity greater than that of white metal with self lubricating properties better than those of nylon, while giving up to 10 times longer service than phosphor bronze. Developed and proven in many industrial applications over three decades, Vesconite has become the preferred material when high loads must be carried with small clearances, under dirty and unlubricated conditions.

It is also most effective in moist, immersed and corrosive applications. This is because Vesconite has high dimensional stability and does not swell in water, in contrast to nylon 6 and 66 which absorbs up to 9% water by weight with consequent expansion and softening.

Not only do Vesconite bushes generally last much longer, but the life of the mating pins and shafts is often greatly extended. Vesconite has therefore gained international recognition as a versatile, high performance replacement for traditional materials in anti-friction and wear applications. Vesconite's initial cost is moderate.

Vesconite is readily available in a wide range of shapes and sizes, and is easily machined to fine tolerances into finished parts on standard metal working equipment. The factory also offers a special service for the production of custom components.

Summarized General Properties of Vesconite :

High load bearing strength :

Vesconite has very low creep rates under design loadings of 30MPa and has a much higher load capacity than nylon, being unaffected by water absorption.

Dimensional Stability :

The thermal expansion factor of Vesconite is only 2,5 times that of bronze, while nylon and HDPE are 5 to 10 times greater respectively. Vesconite does not swell when exposed to water or humid conditions, while nylon can expand by up to 3% linearly when immersed. Vesconite therefore requires only slightly more clearance than the corresponding metal parts and no allowance needs to be made for moisture changes.

Low Friction :

Vesconite shows outstanding dynamic frictional properties, with friction losses of about half those of bronze or nylon. This allows for higher combinations of loads and speeds. The greasing of Vesconite bushes on assembly further decreases friction, allowing higher speeds to be used and generally improving performance.

Water is also an excellent lubricant for Vesconite bushes, making the material highly suitable for immersed conditions. Vesconite HILUBE® offers even further

reduced friction (down by 50%), making it an ideal material for unlubricated applications.

Temperature Limits :

Vesconite's melting point of 260 ° C is one of the highest among thermoplastic materials and on a par with white metal. Vesconite is suitable for continuous use at 80° C.

The low thermal conductivity of Vesconite, common to all synthetic materials, means that frictional heat is removed only slowly through the bush. One should avoid extreme heat build-up by first checking the PV (load x speed) when designing a replacement for a bronze bush operating at a high PV factor.

The PV limit of Vesconite is about twice as high as that of nylon and higher than most synthetic bearing materials.

Wear Resistance :

Vesconite provides outstanding wear resistance, resulting in many times longer service life when compared with bronze. It is also less affected by poor lubrication and dirty conditions.

Chemical Resistance :

Vesconite is very resistant to dilute acids, organic solvents, oils and petrol. However, it has limited resistance to strong acids and alkalis, and lengthy immersion in boiling water should be avoided.

Longer life of Metal Counterparts :

The wear of metal pins and shafts is reduced by up to 90% when Vesconite bushes are used. This valuable benefit alone justifies the change over to Vesconite in many instances.

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