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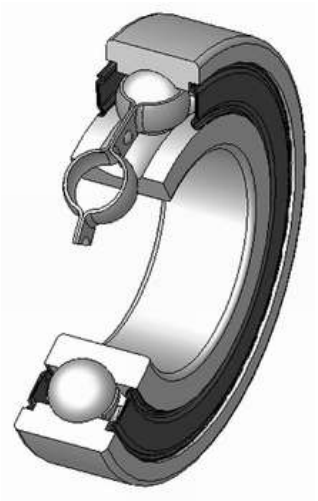

False Economy

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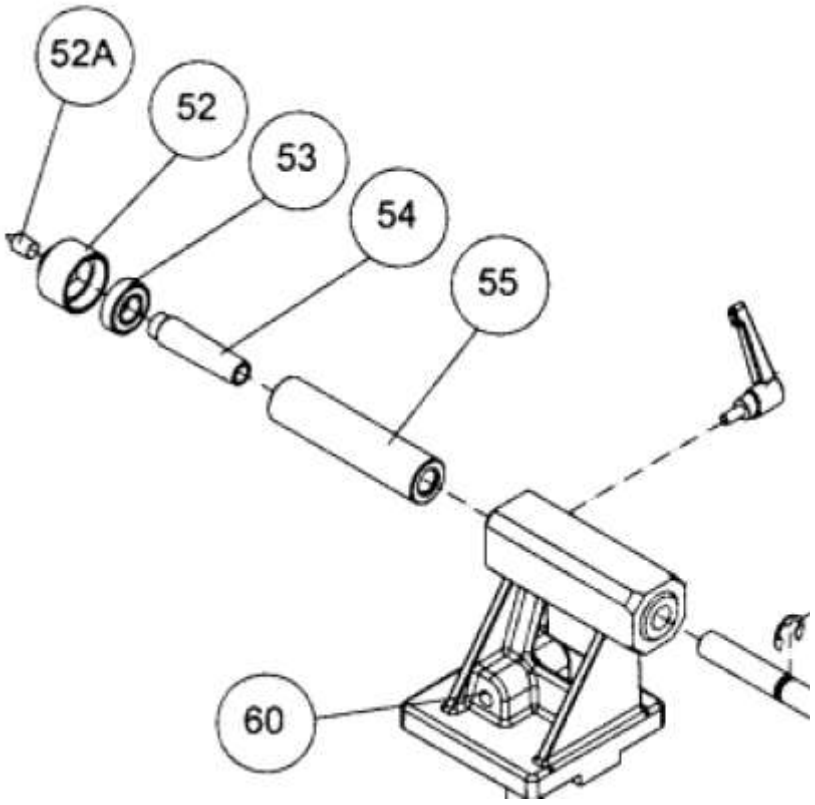
Rolling- element bearings rarely give trouble, provided you respect their limitations. If you don't exceed their designed loads, keep them clean, cool and properly lubricated, they should last almost indefinitely. In your wood lathe you will probably find several, two in the headstock, two in the motor and one or more in the live centre in the tail stock. Most of these will probably be so-called deep-groove ball bearings, like the one shown on the right. You can see there is a set of balls running in the grooves in the inner and outer races. The balls are kept uniformly spaced around the circumference by a cage and lubricated by oil or grease. To contain the lubricant and prevent contamination, end seals are fitted. These are the dark grey end plates that can be seen in the drawing on the right.
When a bearing is running in a closed environment such as a gearbox or the axle of car, the seals may be separate, so that the lubricant can circulate to cool the bearing, remove contaminants and have a reasonable life.

The example of false economy that I have in mind is the bearing fitted to the live centre supplied with my Jet 1014 Mini lathe (2004 vintage). The Jet live centre is a cheap and simple design that is also versatile. It has a hollow number 2 Morse Taper shaft that fits into the tailstock. Pressed onto the shaft [54] is a ball bearing [53], and pressed onto the ball bearing is the outer, rotating centre [52]. The outer centre supports a removable pin [52A], that locates in a taper, and can be knocked out using the supplied knock-out bar inserted down the hollow shaft.



The hollow shaft is a useful feature, because it allows drills to be inserted through the tailstock to bore a hole in the work piece. When making tool handles for tools that have a tang that locate in a socket in the handle, the hole can be bored concentrically, without removing the work piece from the lathe. Clearly some thought went into the design of the Jet live centre. However, I think some cost cutting production engineer then spoiled things by installing the wrong bearing in my one.
The bearing used in my example is a 6002Z. This is a common bearing, widely available, cheap and highly reliable. It is a deep groove bearing, so it can take significant radial and axial loads and should last a lifetime. If you look at the data sheets and the bearing life calculator provided by the manufacturer, you will see that even at the highest speeds the Jet Mini can run at, with the largest work-pieces and high tail stock pressures, the life is given in thousands of hours. But the live centre supplied with my lathe failed.
I was doing some through-hole boring at the time. The drill has to be pulled out frequently to prevent clogging and all the waste comes out through the tailstock bore. Afterwards, the centre became sticky and was inclined to jam. Clearly some of the shavings had stayed behind in the workings. When I checked the bearing part number, and looked it up on the data sheet, I could see what the problem was. The Z suffix denotes a **single** metal seal on one side only. A 2Z or ZZ suffix denotes **two** metal seals,

one on each side. There was a seal on the visible side, but not on the inside. The shavings had got into the workings and clogged up the bearing.
The exploded parts diagram from the Jet manual shows the parts of the live centre [52, 52A, 53 and 54]. An excerpt from the parts list is given below. You can see that the lathe manual gives the bearing [53] part number as 6002ZZ, so the designer did his/her job. Production messed it up!

50	JML-50	Eccentric Locking Rod	1
51	JML-51	Bushing	1
52	JML-52	Live Center Head	1
52A	JML-52A	Center Point for Live Center	1
53	BB-6002ZZ	Ball Bearing 6002ZZ	1
54	JML-54	Live Center Shaft	1
	708331	Live Center Assembly (not shown)	1
55	JML-55	Tailstock Spindle	1

Unfortunately, if you have a Jet Mini, checking the part number on the live centre bearing may not tell you whether it has a single or double seal. The replacement bearing that I fitted was also marked 6002Z and it had seals on **both** sides. Some makes may be marked with a ZZ or 2Z suffix and then you know you will be safe. However, should you clog up the bearing, read on…

How to repair the live centre?
Replacement bearings are about R41- at Bearing Man. They don't even offer the single seal Z version, only the double seal ZZ version. To dismantle, the central shaft [54] was easily be tapped out from the inner race, as it was a light press fit. The outer race was more of a challenge, short of machining a special puller, it was not going to be extracted easily from the live centre head [52]. There are various tricks that can be used, such as heating up the bearing, and hoping differential expansion will loosen the fit. Or a bolt can also be welded to the inner race. I chose to drill two holes in the outer rotating centre from the side facing the headstock, opposite the outer race, 180^0 degrees apart. Then I used a pin punch to drift out the bearing. The picture shows a view from the rear of the head with the two holes drilled from the front. The unshielded side of the original bearing is shown, clogged up with a mixture of wood shavings and grease.

The holes needed to be tilted slightly, because of the geometry, and they were simply lined up by eye. The required tilt was achieved with a 2mm spacer on the side of hole being drilled, so that the drill went in at the correct angle. I knew when the drill had reached the outer race, as it simply stopped cutting. The material of the race is so much harder than the mild steel used for the centre, that the HSS drill made no visible impression on it all. 3.2 mm holes were drilled to accommodate a 3mm pin punch.
With bearing drifted out, it was a simple matter to press in a new one. If you are inexperienced in working with bearings, you must be careful to put no force on the rolling elements when you install the bearing. Any inadvertent shock loads can damage the balls or races, leading to premature failure. When you are removing a bearing that will not be reused, this is not important, but replacement requires some care.
In this case, the inner shaft was pressed into place into the inner race using a metal working vise. The inner race was supported using a spacer to ensure that no force was being transmitted by the outer race. Then the outer race was pressed into place, using a tubular spacer, pressing only against the outer race, so no force was transmitted through the inner race. A socket spanner set is an excellent source of a range of hardened tubular spacers for this task. It is possible to drift the bearing into place, but care is needed to avoid any misalignment, or blows to the wrong part of the bearing.
The bearing is supplied pre-lubricated.

(An example from the motor industry on how bearings can be damaged: Sigma Motor Corporation which at the time imported and assembled Mazdas started to receive a number of warranty claims for wheel bearing failures, and on investigation traced the cause. The quality of the smaller Mazdas was not what it should be have been, and many of the cars were experiencing premature tyre wear due to poor wheel alignment, which was in fact a factory fault. However, the wheel alignment centres were simply bending the suspension pickup points to correct the misalignment. They made a tool that they bolted onto the

wheel hub, with a long pole, and simply used leverage to correct the geometry. These high forces were damaging the wheel bearings, causing premature failures.)