

# AMP TECH

# VALVES U-Like

**THE HUMBLE VALVE IS WIDELY ACCEPTED** as the most influential single component of a good guitar amp, but how do these little glass bottles work and why are they so important. Dave Hunter visits ace British distributor Watford Valves for a look at all things tubular, including the 'Brian May' testing rig...

**B**ack in the mid-'60s when transistors appeared to be the amplification technology of the future, the guitar amp industry started trying to sell the public on lines like 'durability-low maintenance-no tubes to burn out and replace'. Devoted music engineers and insiders knew, of course, that much of it was just marketing speak: wrapping up a cheaper-to-produce product as 'progress' and 'technological advancement' ('90s computer boom and planned obsolescence, anyone'). Long-time Leo Fender cohort and legendary engineer Forrest White resigned from Fender in December 1966 when CBS execs tried to force his hand on solid state production. Fender went ahead without him, and guitarists - in an era when Hendrix, Townshend, Clapton, Beck and others were reaching new heights of lusciously distorted valve amp tone - fled from tranny amps in their droves. These new amps were different in a lot of ways, but the single most significant omission? *Valves*.

In order to lift the lid on these mysterious glass bottles, TGM visited Derek Rocco of Watford Valves in St. Albans. As one of the UK's premier valve retailers and the most thorough valve tester in Europe, he was keen to help us discover what's behind Watford's raison d'être, and to unveil the complexity and variety of the valve market

as we approach the Millennium.

## HARMONIC DISTORTION

'I think in a nutshell what's important is how the valve distorts,' says Rocco. 'When you push a transistor into distortion, when it clips, it just shuts down - it doesn't see anything at the peaks and troughs of the sine wave (figure 1). With a valve you get that harmonic distortion happening as the valve slowly goes into distortion. The more it distorts the more it clips, giving that compression and distortion that everybody loves.'

Even with valve amp settings we'd consider 'clean', a certain amount of smooth, rounded distortion adds texture and harmonic richness to the sound, along with some valve-induced compression which makes the tone feel more tactile and playable, and warmer to the ear. 'That's why valves have survived,' adds Derek, 'and, I think, solely because of the guitar world. We've got a huge valve hi-fi market now, but it was guitarists who recognised how great valves could sound when everything else had gone over to solid state.'

## TUBES? VALVES?

Inside your amp the guitar signal is handled as a flow of electronic current; inside the



valves themselves this takes the form of electrons flowing from the 'cathode' to the 'plate' (see figure 2 for the constituent parts) - all of which means little to us out of context.

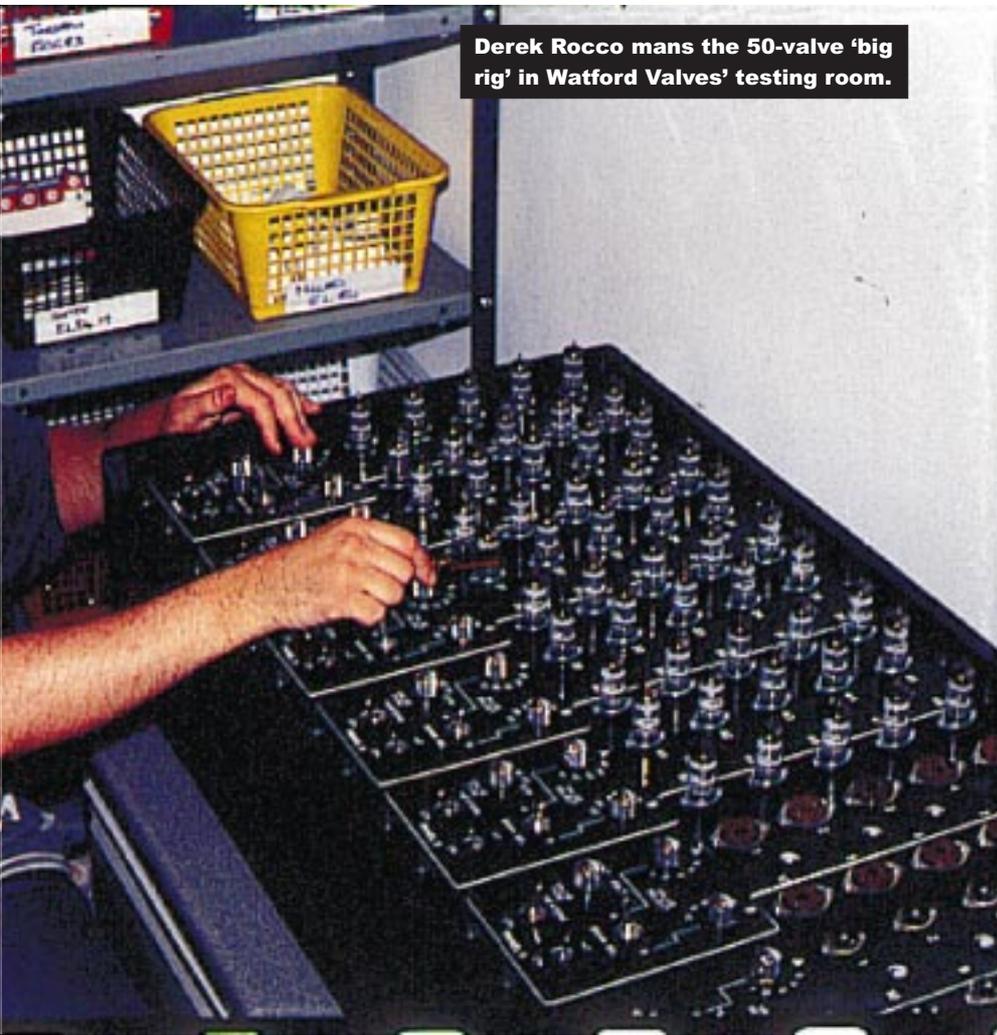
'Basically, a valve amplifies the signal,' explains Rocco. 'One way to look at it is to examine why we call it a -valve-. The Americans call it a -vacuum tube- because there's a vacuum in that bottle, but what it basically does is - and it's probably a more logical way of describing it - is it's an electronic valve. Just as your central heating's water valve can limit the amount of water flowing through the system, electronic valves can limit or increase the current flowing through them.'

As the major handlers of current flow within the amplifier, the valves play a big part in shaping the resultant tone. Valves with different characteristics shape the sound differently; the ultimate conclusion of this thinking is the fact that, while you can put any functioning valve of the right type in your amp and it will 'work', in order to get it performing at its peak and sounding just the way you want it, it pays to put a little extra thought into your valve buying.

## TESTING, TESTING

Even though the best valve manufacturers (mainly European and American) shut down in the '70s, '80s and early '90s as western industry - and, significantly, the military - turned more and more to solid state components, a great number of generally excellent NOS (New Old Stock) valves

Derek Rocco mans the 50-valve 'big rig' in Watford Valves' testing room.



remain available from makers like GE, RCA, Mullard, Brimar, Philips and others. All newly made valves currently come from factories in Eastern Europe or China. Not only do different makes have somewhat different characteristics, but wide tolerances within the industry often mean that even valves of one type from the same factory can sound and perform very differently. In either case, as with any product turned out en masse, there are also a certain number of duff valves in any batch to come off the assembly line; sadly, plenty of these seem to slip past the factory and/or wholesalers' (sometimes, admittedly, limited) quality control and into the marketplace.

The only way to weed out the clunkers is to test them individually; and while

undertaking such quality tests, some retailers - Watford Valves and Groove Tubes among the very few in the world - also test their valves along further parameters which help to quantify their tonal characteristics.

'What's driving me is the goal of producing the best-tested valves in the world,' says Rocco. 'We've had the opportunity of working with people like Brian May, Manic Street Preachers, Kula Shaker, Thunder, Lighthouse Family and others - touring musicians, who need to rely on the quality of the valves in their amps.'

While tube testers have existed for as long as tubes have been manufactured, Rocco's drive to further quantify their quality and characteristics led him to obtain - and in some cases, to have custom-built - valve

# Connections

**Watford Valves**

WWW.WATFORDVALVES.COM

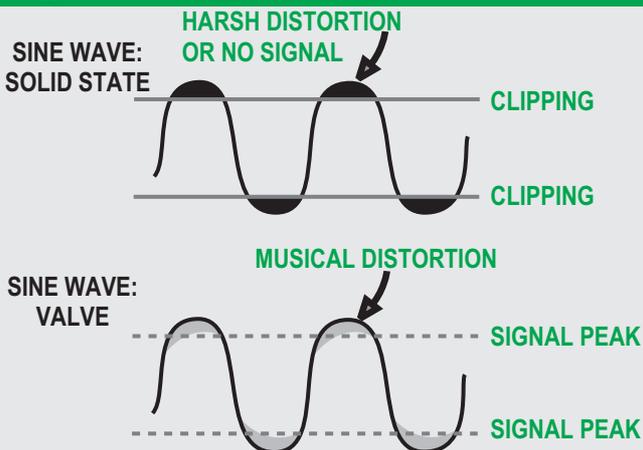
Digitally matched and graded valves for the music industry

testers that go well beyond good valve/bad valve.

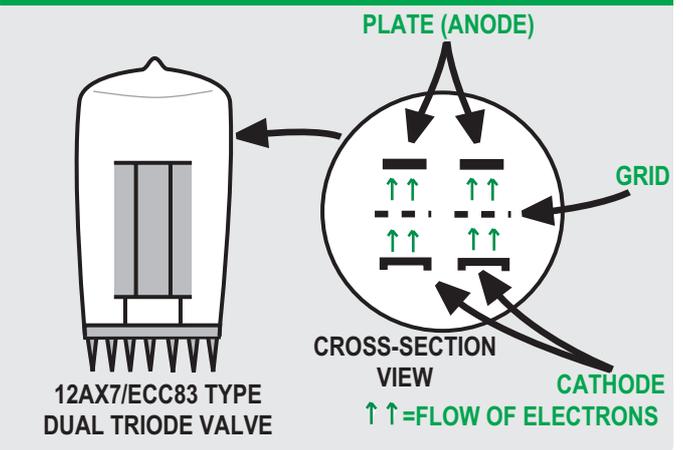
'We had our preamp valve tester designed and built especially for us,' explains Rocco. The resultant rig holds 50 preamp valves of types such as ECC83 (called 12AX7 in the USA), 12BH7, 12DW7 and others, and runs them through more checks than any other testing facility in the world, even that used by famous California retailer Groove Tubes. 'This is an actual, working amplifier with the same loadings you'd find inside your guitar or bass amp, and we drive an actual signal into each valve. We put them through a range of tests that are relevant to musicians.' These include:

- drive - the power/gain factor
- distortion - the point at which they cross over into distortion
- hum
- balance - valves like ECC83s are called 'dual triodes' because they contain two small valves within one bottle; for optimum

**Fig. 1 Valve vs. Solid State Distortion**



**Fig. 2 Inside a Preamp Valve**





performance in the amplifier circuit the two halves should be balanced

- microphony - susceptibility to vibration disturbance and feedback
- noise

'The main thing we're looking at, beyond the basic function and whether the valve is noisy or not, is drive. The drive scale runs from 0 to 300. For good, basic valves we're looking for 170-180. For an excellent first driver valve for a Marshall, say, you might want each half of the triode to be 250 - but you'll find out of a whole batch of good valves, not many will read that high. We selected a batch of preamp valves for Kula Shaker recently, and they were all 270 and 280!'

Output (power amp) valves of the 6L6 type (which includes 6550s, 5881s and others) are run on another specialised rig which tests for gain, distortion, hum and microphony. These are driven at a whopping 500+ volts, close to or above the levels running within actual amps, to determine current-draw levels for accurate matching (for the importance of output valve matching, see Biasing sidebar).

## MAY DAY

When it comes to pinpointing premium examples of the sweet-sounding, small-bottled EL84 output valves, however, Watford Valves are driven by a higher calling. 'We were supplying valves for Brian May's Vox AC30s, and we found they were failing at an alarming rate,' says Rocco. 'Brian runs his AC30s flat-out, with a treble booster going into the front end, and anything but the sturdiest EL84s just can't take it.'

To isolate valves that are up to the job, Watford built yet another custom rig, this time with the help of TGM contributor and premier Vox technician David Petersen.

'David is brilliant,' enthuses Rocco. 'He worked out all the parameters for this tester according to what's actually going on inside Brian May's amps. We power up 12 at a time, and while we're burning them in under load a timer puts signal surges through them every few seconds for an extended period of time. Any weak ones will blow, and we'll weed them out.'

'Batches of EL84s tested in this way have been sent to May for months now, to the great satisfaction of the man himself - and the even greater relief of his amps.'

To capitalise on their valve-testing experience, Watford have recently launched their own high-end range, branded as Harma 'Diamond Range' valves. 'Our goal,' Rocco admits, 'is to one day be rated alongside Groove Tubes, but to still be able to sell valves cheaper than they do' - although many Harma valves are already tested to more stringent parameters. 'What

we want to achieve is an affordable way to test all our valves for quality, then the Harma range will be a select valve that will combine confidence in how it's been tested with the knowledge that it's different from anything else on the market.

'The downside is, the more rigorous testing we do the more valves we come across that fail our standards; so we've approached it from the perspective of - what's the best sounding- rather than just - what's the cheapest or most readily available wholesale valve-.'

'What a full range of testing allows us to do, however, is to offer quality guarantees on all valves but, for a little more money, also offer valves that have been tested and graded more rigorously - for more headroom or more distortion, use in Fenders or Marshalls, and so forth. That allows us to tailor valves to a variety of specialist applications and sounds.'

**For more information on Watford Valves and the Harma 'Diamond Range', contact: Watford Valves ☎ 01923-893270, or visit their Web site: [www.watfordvalves.com](http://www.watfordvalves.com)**

# Amp Helpline: **Biasing**

**W**hat is this thing called 'biasing' that we're meant to have done whenever we change power valves, and what's it all about?

**T**hink of your amp as the engine on an older model car,' explains Derek Rocco. 'Changing the valves is like putting in new spark plugs, points and condenser, but in order for things to run smoothly you still have to set the timing and idle control. Biasing simply sets the operational level of your amplifier's output valves.' Preamp valves, note, are self-biasing - and therefore excuse themselves from the discussion from here on in.

All valves of the same type may be made to the same general specs, but they come off the assembly line with slight variations meaning that, plugged straight in, they won't necessarily draw the same current as the valves you're replacing. The 'negative grid bias' setting affects the current flowing from the plates of the power valves: increasing the negative grid bias means less current flows through the valve, while decreasing it means more current will flow. Why is this important?

'If you have too much current flowing through your valves you will run them and your amp hot. This will result in burning the valves out prematurely and can even risk amplifier and/or transformer damage,' says Rocco. 'If your amp is running with not enough current flow then the valves will not

have enough time to correctly amplify the signal, resulting in weak tone and a horrible un-musical distortion which is hard on the ear.'

The importance of correctly biasing your amp also brings us to the subject of 'matched' power valves. Most amps provide a single facility for bias adjustment, even though they may carry a pair or a quartet of power valves. Because the amp must be set a single negative grid bias level that both valves are happy with, it's important to install matched sets with similar current draw levels. Slightly mismatched power valves may 'work', but the push-pull circuitry in the amp will operate inefficiently, possibly resulting in impaired tone.

Some amps are built with fixed-bias circuits - notably many by Vox and Matchless (the classic old and new Class A designs), some older Fenders, and even earlier Mesa/Boogies - so they can't be adjusted anyway, though matching output valves remains vital to keep the push-pull circuit at its peak.

**NOTE:** Biasing - which involves working with potentially lethal voltages - is a professional job only. Don't attempt it yourself without proper training, the correct tools and equipment, and full safety precautions. An amp tech should charge between £10-£30 pounds to correctly bias new power valves (and may include it as part of a general service and re-valving job)