

# EQUIPMENT REVIEWS

## Empire X Series Cartridges

Prices: see Table. Manufactured by Empire Scientific Corp., New York, Distributed in UK by Rank Audio Products, PO Box 70, Great West Road, Brentford, Middx.



MY first introduction to Empire cartridges was quite a number of years ago when reading new pickup Patents. A Patent assigned to the Empire Scientific Corporation disclosed a complex magnetic system and a sophisticated approach to reducing the dynamic mass of the armature and cantilever system. Unfortunately samples were not available in this country until some time later (see my review of the 999VE in November 1968). The Empire Scientific Corporation of New York have now appointed Rank Audio Visual to act as their UK distributors.

By now, Rank must be accounted one of the major manufacturers and distributors of high fidelity equipment. Rank Wharfedale produce Leak amplifiers, Wharfedale loudspeakers etc., and are now importing a Japanese cassette recorder operating on the Dolby format, whilst the Audio Visual section import Akai tape recorders, Rotel amplifiers and Empire cartridges. To this end, they have established a service organisation at the head office at Brentford. This latter facet is of extreme importance to the general public; all too often foreign merchandise is imported without adequate arrangements being made for servicing and spares. When these are required, the unfortunate customer may be left high and dry.

The cartridges operate on the variable reluctance principle (unlike the Shure and Elac

types, which are moving magnet). To be successful, the magnitude and direction of the magnetic field must be carefully adjusted in relation to the cross-sectional area of the armature in order to achieve maximum sensitivity without saturating the armature, which would result in harmonic distortion. To obtain this optimum field strength with high linearity, three small magnets are fitted inside the Mumetal shield disposed around the conical armature (see Fig. 1). The armature itself is a tiny truncated cone of high permeability material, only a couple of thou thick and a few milligrammes in static mass. This is connected to the tubular cantilever, terminating in the diamond stylus tip and supported on a hinge of elastometric material. Fore and aft movement of the stylus assembly is prevented by means of a thin wire tie-bar. Because of the excellent magnetic and mechanical symmetry, balance between the two channels is exceptional, being within 1dB in all the models tested at frequencies below 5 or 6 kHz. In the worst case the unbalance was still less than 2dB at all frequencies up to 20 kHz (the upper frequency limit of the CBS STR100 test record).

The overall decor of all the cartridges is similar. With the exception of the 909X, the bodies appear to be identical, the main differences being in the stylus assemblies which are identified by means of a colour code. Six cartridges were submitted for test, five being closely related and the odd man out, the 909X, intended for the equipment manufacturers' market. It is fitted with a 0.7 thou spherical diamond tip, the static compliance is  $15 \times 10^{-6}$  cm/dyne and the recommended playing weight is 1 to 4 grammes. All tests were carried out at a playing weight of 3 grammes and the cartridge adequately tracked all our heavily modulated music test records. The frequency response is shown in Fig. 2 and the channel separation is excellent for this class of cartridge. There is the familiar 'suck out' in the 5 to 7 kHz region and the system resonance is of the order of 16 kHz. The output was 1.7 millivolts/cm/sec. and was free from distortion except in the 6 to 8 kHz region where third harmonic distortion became evident but no greater than with other cartridges in the same price range. In spite of the high compliance, the cartridge was sufficiently robust to withstand the rigours of operating with one of the cheaper record changers and at the end of an accelerated

life test it was none the worse for wear. This cartridge should find a ready sale in the medium priced high fidelity equipment.

The five remaining cartridges are the 999X, 999SE/X, 999TE/X, 999VE/X and 1000ZE/X. With the exception of the 999X, which is fitted with a 0.7 thou spherical tip, all the cartridges are fitted with a bi-radial tip, nominal dimensions being 0.7 thou major radius, 0.2 thou minor radius. The polish and form of all the styli are excellent. The manufacturer claims that they are hand polished and, from the complete absence of 'orange peel effect' often noted on points that have been 'tumble' polished, this claim appears to be well founded. All the tips were within  $\pm 2$  microns of the nominal dimension on major radii and within  $\pm 1$  micron on minor radii. The spherical tip radius of the 999X was 0.62 thou, but still well within tolerances.

## How they performed

The Table lists the principal parameters of the cartridges. The overall frequency response of two of the cartridges is shown in Figs. 3 and 4. As is to be expected, the performances improved progressively towards the most expensive cartridge, which is the 1000ZE/X selling at £62.53. The overall characteristics of all the cartridges followed the same pattern, the major operational differences being the lower playing weights of the more expensive cartridges, the improved channel separation and the progressively reduced distortion in the mid-upper region. It must be emphasised that this distortion is a common feature of practically every magnetic cartridge produced, and the performance of the Empire cartridges in this respect are equal to the best of their competitors in the equivalent price ranges.

With the 999VE/X and 1000ZE/X the distortion at low levels (below 3 cm/sec.) could not be measured and at velocities in excess of 5 cm/sec. it was a maximum of a few percent. It is a

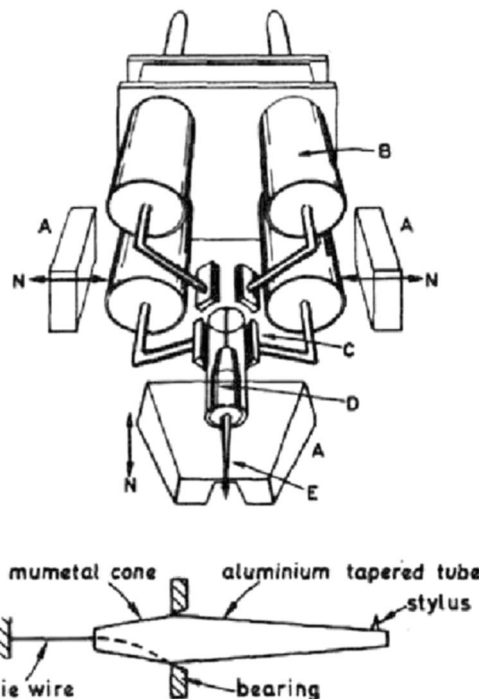


Fig. 1. General assembly showing A—magnets, N—field direction, B—coils, C—poles, D—armature, E—cantilever and stylus. The lower diagram shows the cantilever in detail

moot point whether these distortions are due to the record, tracing distortion or the pickup. We have come to the stage in the art of pickup design when the overall performance is comparable with that of the recording head and

certainly better than a lot of pressings. A case in point—out of a batch of six new test records, four showed identical frequency response, one showed a broad bump in the 14 to 16 kHz region and the last one had the 20 kHz level some 6 dB down in the right channel compared with the left. Thus, unless one exercises extreme care (and has fairly deep pockets, because these records are not inexpensive) it is quite easy to damn a good cartridge unwittingly because of record deficiencies.

The overall separation of the 999VE/X is exceptionally good, being marginally better than the 1000ZE/X. I normally use the Goldring-Lenco 88 as test turntable because of the facility of infinitely variable speed control. However, because of the inherent vertical rumble due to the direct drive from the motor to the underside of the turntable, low level crosstalk figures could easily be masked by the rumble voltage. Therefore the test figures on the 999TE/X, 999VE/X and 1000ZE/X were taken using an electronically controlled transcription turntable in which rumble was negligible. All tests were made using the SME 3009 arm and lightweight shells.

The 1000ZE/X cartridge is described as a stereo calibration standard. It has a claimed specification of  $\pm 1$  dB from 20 to 20,000 Hz and, if one draws a pair of 'tram lines' spaced 2dB apart, the sample submitted almost fits within these limits. The major portion of the curve is ruler flat to 2 kHz, drops to approximately -3.5 dB at 10 kHz, and rises to almost zero level at 20 kHz. The reason for the cartridge not quite meeting its claimed specification is my test set-up. In order to simulate normal domestic stereo equipment, the input of my valve voltmeter is terminated with a pre-set resistance nominally 50 Kilohms (but if the manufacturer specifies a different value of load resistance this can be varied) in parallel with a 300 pF capacitor to simulate the capacity of the normal connecting pickup leads, input capacity of the amplifier, etc. Quite obviously this capacity will resonate with the inductance of the pickup coils and, at frequencies above resonance, the combination will act as a low-pass filter.

The inductance of these cartridges was 0.6 H and the system electrical resonance 13.5 kHz. Reducing the load capacity to 100 pF and increasing the load resistance to 100 Kilohms resulted in the 1000ZE/X exactly meeting its specification of  $\pm 1$  dB up to 20 kHz. Because the vast majority of stereo systems produced today present a load of 47 Kilohms in parallel with 200

Fig. 2. Empire 909X frequency response and crosstalk

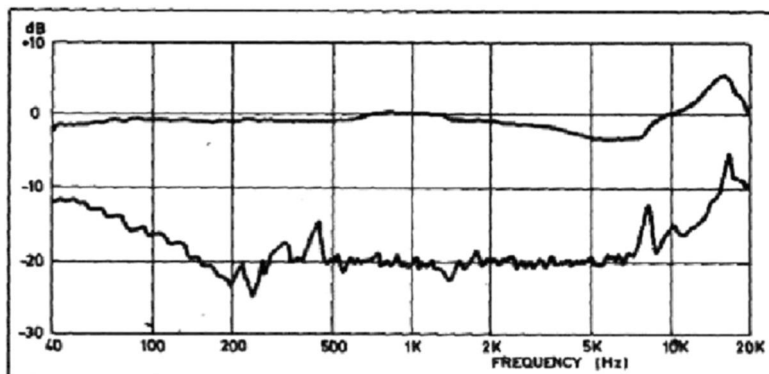


Fig. 3. Empire 999VE/X

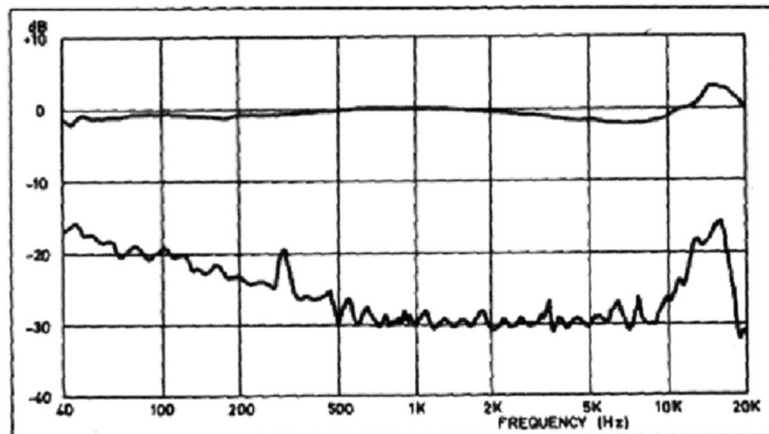
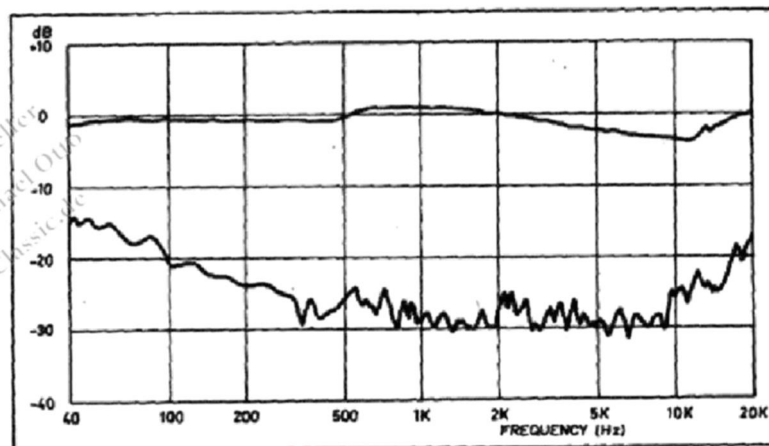


Fig. 4. Empire 1000ZE/X



to 300 pF I usually test under these conditions. The crosstalk of the 1000ZE/X was never less than 30 dB at frequencies below 8 kHz and

never less than 20 dB up to 20 kHz. I checked the high frequency response to a limit of 50 kHz and found that the sensitivity fell fairly sharply above

**SPECIFICATION AND TEST RESULTS  
EMPIRE CARTRIDGES**

	909X		999X		999SE/X		999TE/X		999VE/X		1000ZE/X	
	Maker's Specification	Test Result	Maker's Specification	Test Result	Maker's Specification	Test Result	Maker's Specification	Test Result	Maker's Specification	Test Result	Maker's Specification	Test Result
1.	Variable reluctance	—	Variable reluctance	—	Variable reluctance	—	Variable reluctance	—	Variable reluctance	—	Variable reluctance	—
2. Frequency response (Hz)	15-20,000	See Fig. 2	10-30,000	—	8-32,000	—	6-32,000	—	6-36,000	See Fig. 3	4-40,000	See Fig. 4
3. Sensitivity (mV/cm/sec.)	1.6	1.7	1.6	2.0	1.6	1.5	1.2	1.2	1.2	1.0	1.0	1.0
4. Crosstalk (dB)	20	20	35	20	35	25	35	32	35	32	35	30
5. Compliance (10 <sup>-6</sup> cm/dyne)	15	15	20	20	30	28	30	30	35	32	35	37
6. Rec. playing weight (gm)	1-4	3 used	1-2	2 used	1-1½	1.8 used	1-1½	1½ used	1-1½	1½ used	1-1½	0.8 used
7. Stylus tip radius (x 10 <sup>-3</sup> in.)	0.7	0.62	0.7	0.74	0.7 x 0.2	See text	0.7 x 0.2	See text	0.7 x 0.2	See text	0.7 x 0.2	See text
8. Distortion (5 cm/sec at 4,000 Hz)	—	5%	—	5%	—	3%	—	1%	—	<0.5%	—	<0.5%
9. Price (complete)	£9.60	—	£13.00	—	£21.05	—	£26.00	—	£44.58	—	£82.53	—
10. Price (replacement stylus)	£5.94	—	£8.44	—	£14.98	—	£23.75	—	£24.52	—	£34.49	—

25 kHz due almost entirely to the low-pass filter action of the electrical circuit mentioned above. With a load of 100 Kilohms and 100 pF the response was only 8 dB down at 40 kHz, which is a truly remarkable performance. The low frequency response was equally impressive. The low frequency resonance occurred almost exactly at 10 Hz and resulted in a lift of about 3 dB at this frequency.

To summarise:—this range of Empire cartridges caters for all pockets. The workmanship, finish and conception are excellent. Channel separation is more than adequate, as is frequency response; the musical performance of the 1000ZE/X is outstandingly good and it was impossible to fault it on any of the test records used. However, it costs £62.53. For those whose pockets are not quite so deep, both the 999TE/X and 999VE/X offer excellent performance. Indeed, musically, it was difficult to hear any difference between the three, but the outstanding capability of the 1000ZE/X to track all records at less than 1 gramme playing weight puts it in a class of its own and we are now coming to the point in time where, providing the record is kept clean, record wear should be negligible.

STANLEY KELLY.

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