



Capacitor Test

Various capacitors undergo the famous Humble Homemade Hi-fi listening test

The results of this test are meant to give you a basic idea of the sonic differences between capacitors when used in loudspeaker filters. I test all the capacitors in the signal path of tweeter and midrange circuits in loudspeakers crossover, I mostly use values of 4,7uF and 10uF to be able to make direct comparisons between different brands and types and try them out in both series- and parallel crossovers. The capacitors are tested in various speakers, varying from the ones I happen to be building at the time to a few standard speakers like my HATT's. I also use solid-state and tube amplification, analogue and digital source equipment and several different interlinks and speaker-cables during the process of evaluation that takes several months of extensive listening. Testing is done by listening to various good quality recordings on CD and vinyl and everyday FM radio. Over time I have re-evaluated my previous conclusions as new capacitors entered the contest, widening the listening platform. The only measurement done is to check the value of capacitance to make sure they were in within the margin stated. I have given each participant a rating. This scale is based purely on sound quality; price has been left out of consideration.



So far I have tested the following capacitors (in alphabetical order):

- AmpOhm FP-CA-AU Film and Foil
- Arcotronics MKP-C-4G
- ASC X386S MKP in oil *
- Audio Cap PPMF MKP
- Audio Cap Theta PPT MKP-Sn
- Clarity Cap PW MKP
- Clarity Cap PX MKP
- Clarity Cap SA FP *
- Clarity Cap DTAC MKP
- Ducati 4.16.10 MKP
- Duelund VSF copper-foil/paper *
- Evox-Rifa PHE 450 MKP
- Hovland Musicap MKP
- Inco Sintex 45T D2BS MKP
- Intertechnik Audyn Cap MKP-QS
- Intertechnik Audyn Cap Plus MKP
- Jantzen Audio Standard Z-Cap MKP
- Jantzen Audio Superior Z-Cap MKP *

- Jantzen Audio Silver Z-Cap MKP *
- Le Clanché PPM MKP *
- LCR Capacitors FSC tubular foil polystyrene
- Mundorf M-Cap MKP
- Mundorf M-Cap RXF
- Mundorf M-Cap Supreme Cap MKP *
- Mundorf M-Cap Supreme Silver/Oil MKP *
- Mundorf M-Cap Supreme Silver/Gold MKP
- Mundorf M-Cap Supreme Silver/Gold/Oil MKP
- North Creek Crescendo Film and Foil MKP
- Obligato aluminium-foil MKP (dry version) *
- Sonic Craft Sonicap MKP
- SCR Châteauroux MKP-PB
- Solen Châteauroux Fast Cap PB-MKP-FC
- Super PP Capacitor
- TRT Wonder DynamiCap MKP
- Vishay Roederstein MKP1837 *

*Personal favourites!

AmpOhm FP-CA-AU 630VDC – 5% tolerance

Technical Specifications: "Designed for high performance audio systems. Low ESR and low self-inductance. High stability with respect to both temperature and frequency. Ideal for use in loudspeaker crossover networks and valve amplifiers where pure sound is at a premium." Dissipation factor <0.001 @ 1kHz and 20°C; Terminations 70mm long, 1/1.0 copper with PVC insulation; case: Flame retardant polypropylene, epoxy resin filled."

Sound: The Amp Ohm FP-CA-AU is a very neutral sounding capacitor that takes a nice smooth and calm approach to the reproduction of music. I found the balance of the midrange very pleasing letting acoustic instruments keep their natural warm tone. Absolute detail and air isn't quite up to the level of an Audyn Cap Plus or Mundorf Supreme but it comes very close although they do need some time to open up so don't judge them fresh out of the box. Spatiality is broad with reasonable depth but if you want "bowling alley" depth go for (the much more expensive) Mundorf Silver/Oil.

Verdict: 8,5

Arcotronics MKP-C4G 600VDC – 5% tolerance

Technical Specifications: Self-healing metallised polypropylene snubber capacitor intended for use in power semiconductor circuits to suppress or attenuate undesired voltage peaks e.g. electronic ballasts and motor applications.

Sound: The Arcotronics cap is a modest sounding capacitor, a little on the quiet side concerning dynamics. I quite like the midrange quality especially with percussion music. Drums, etc had a nice natural timbre. There seems to be a focus on the midrange, the treble is slightly rolled off. Spatiality is a little compromised resulting in a slightly distant and compact image. Overall detail is slightly better than a standard Audyn Cap for example but doesn't compete with an AmpOhm or Mundorf Supreme. A good MKP for basic filter applications.

Verdict: 7

ASC X386S MKP in oil 600VDC – 10% tolerance

Technical Specifications: Industrial application capacitor. Although the tolerance stated is meant to be a poor +/- 10%, I measured all of them and they were all spot-on the stated capacitance. Now that is what I call built to industrial standards! I guess they state such a large tolerance because being designed for industrial applications they will be used in varying temperature conditions. The vegetable oil inside will therefore vary in fluency. But at normal room temperature they seem to be at their best. The values are different to the standard range but they come in values from 1,0 to 60mF although small quantities are hard to get unless you want to order more than a hundred of them. ASC also supplies these metalized polypropylene types to other notable High-End Audio companies, including Conrad-Johnson. ASC polypropylene and oil capacitors feature a sealed metal 'oil can' construction and hefty

four-way solder/copper connections. The capacitor itself is made of metalized polypropylene, similar in construction to standard MKP's, but suspended in a bath of vegetable oil: some claim that this oil provides a damping effect in audio circuits. When you shake it you can hear the oil splash around!

Sound: They sound a bit dull at first because they take a while to burn-in. But after a few days of normal use they deliver a wide and open sound stage. Nice and neutral, maybe a slightly warm sound. One of those things that don't impress at first but sort of grow on you after a while, you learn to appreciate their qualities – great! If you want a lively and bright sounding filter then this is not your cap (try a Hovland Musicap instead), if you are looking for a smooth, warm and relaxed sound then give these a try.

Verdict: 7,8

Audio Cap PPMF MKP 200VDC – 10% tolerance

Technical Specifications (according to manufacturer): "The PPMF Audio Caps are metalized polypropylene, useful as upgrade from Mylar or inferior film caps, and available in values large enough to be ideal for speaker crossover networks. They are built of the best materials and exhibit excellent electrical and environmental characteristics. Their superior build quality and high capacitance values provide a high-quality stable, long-term performance not usually found in this price range. The gold-plated OFHC leads provide long-term high reliability and excellent solder ability, superior to silver wire because of gold's non-oxidising properties."

Sound: Slightly more detail, depth and separation than a standard Mundorf M-Cap but slightly less than a Hovland Musicap. The M-Cap has a more "round" character, the Audio Cap PPMF a more "glazy" character – for the rest I find them reasonably neutral.

Verdict: 7

Audio Cap Theta PPT MKP-Sn 200VDC – 10% tolerance

Technical Specifications (according to manufacturer): "The PPT Theta Audio Cap is an excellent film & foil capacitor for all audio circuits and power supplies. It provides low distortion performance and long-term reliability. It exhibits excellent electrical and environmental characteristics at a reasonable price. Its sonic signature is rich and full and its superior build quality ensures a high-quality stable, long-term performance not usually available in this price range. The gold-plated OFHC lead wires provide long-term high reliability and excellent solder ability, superior to silver wire owing to gold's non-oxidising properties."

Sound: These caps have a lean, clinical brightness to them but at the same time lack transparency. A form of artificial clarity is created by means of a treble "glare" in the top end – at least they don't have a loudness effect. They work well in opening-up a dull, lifeless speaker but that's about it. Use them as a small value bypass cap only; they will clean up a cheap Intertechnik Audyn Cap nicely. But costing far more than an ERO MKP1837 I don't really see the point of buying them.

Verdict: 6,5

Clarity Cap PW MKP 160VDC – 5% tolerance

Technical Specifications (according to manufacturer): "The PW range has long been established as an economical component producing improved sonic performance over many overseas brands. Over the years numerous companies have used this range as their entry-level products with great success. Available at ratings of 160Vdc, 250Vdc, 400Vdc and 630Vdc, it offers audio engineers the maximum flexibility when considering components for their circuits. Wound from 4µm, 6µm, 8µm and 10µm metallised film respectively, components can be selected using their slightly differing sonic performances and aspect ratios to give the optimum solution desired. Copper clad steel terminals are standard; however, others are available upon request Tape and resin colours are flexible with options shown in Custom products. Unless specified, capacitors would be supplied with white tape and red resin."

Sound: The Clarity Cap range has an overall similarity in tonal balance, going up the range you gain clarity and spatiality. I found the PW to be neutral with a slightly warmish presentation. Compared to the PX there is a loss of detail but they never sound dark. Compared to a standard Mundorf M-Cap the stereo-image is a little larger. The price/quality ratio is very good. I can recommend this capacitor if you have a tight budget and like a speaker to be as smooth as possible.

Verdict: 7

Clarity Cap PX MKP 250VDC – 5% tolerance

Technical Specifications (according to manufacturer): "The PX range was developed to address the performance gap between the PW and SA ranges. It is closer to the SA in terms of sonic performance but at a price very similar to the PW range. Since it was introduced, it has made significant inroads into the loudspeaker industry. Constructed from a 250Vdc(6µm) rated film, this component is spindle wound. It is then given a special heat treatment before it has insulated copper terminals hand soldered to give the best possible connection. The inherently low dissipation and dielectric absorption factors of polypropylene allied with excellent mechanical stability results in an extremely detailed sonic performance. The construction also results in a low self-inductance and ESR (Equivalent Series Resistance) and the devices are highly stable with regard to temperature and frequency. Tape and resin colours are flexible with options shown in Custom products. Unless specified, capacitors would be supplied with blue tape and blue resin."

Sound: The Clarity Cap range has an overall similarity in tonal balance, going up the range you gain clarity and spatiality. I found the PX to be neutral with a slightly warmish presentation. Compared to a standard Mundorf M-Cap the stereo-image is a larger but less spacious than a Mundorf Supreme or Audyn Cap Plus. Clarity is a good step up from the PW and also the M-Cap. The price/quality ratio is very good. I can highly recommend this capacitor if you are looking for a nice, but not too expensive MKP.

Verdict: 8,5

Clarity Cap SA MKP 630VDC – 5% tolerance

Technical Specifications (according to manufacturer): "The SA range, developed in conjunction with a renowned loudspeaker manufacturer, remains one of the most highly regarded axial components currently used in the audio market. Time and time again the component is specified as a benchmark for other manufacturers components to try to aspire to. Sales continue to grow year on

year as new customers, in new markets appreciate its worth. Especially developed to meet the needs of the professional audio engineer in both hi-fi and studio monitoring, these components are the result of extensive consultation between the audio industry and Clarity Cap. The capacitors are hand wound using a 10µm (630Vdc) rated polypropylene film. Following a special heat treatment cycle insulated copper terminals are hand-soldered to give the best possible connection. The inherently low dissipation and dielectric absorption factors of polypropylene allied with excellent mechanical stability results in an extremely detailed sonic performance. The construction also results in a low self-inductance and ESR and the devices are highly stable with regard to temperature and frequency."

Sound: The Clarity Cap range has an overall similarity in tonal balance, going up the range you gain clarity and spatiality. I found the SA to be neutral with a slightly warmish presentation. Compared to the Audyn Cap Plus definition and separation are better, the stereo-image is also little larger. The Audyn Cap Plus seems to focus in tonal balance a little more on the midrange, the Clarity Cap SA has a more neutral balance. I did find the top end to be slightly rolled-off, not that they lacked detailed but on some recordings I wanted a fraction more transparency – but all in all still very nice. Making a capacitor using about 90% Clarity Cap SA and about 10% Mundorf Supreme works very well, this opens up the top end just nicely without altering anything else. I find the Clarity Cap SA a nice alternative in the upper range capacitors especially when cost is an issue.

Verdict: 9,5

Clarity Cap DTAC MKP 630VDC – 5% tolerance

Technical Specifications (according to manufacturer): "A narrow 10µm (630Vdc) polypropylene film with a special spray and heat treatment contribute to the exceptional performance of this capacitor. These measures combined with hand soldered M8 male or female terminations ensure that the ESR is greatly improved when compared to the traditional axial leaded components. It has been designed to produce the lowest possible resistance within the component, which Clarity Cap believe has a direct relationship to sonic performance. The low ESR is particularly relevant in high quality crossover networks, ensuring that loudspeakers perform to their optimum. Tape and resin colours are flexible and unless specified, capacitors would be supplied with gold tape and black resin."

Sound: The Clarity Cap range has an overall similarity in tonal balance except for the DTAC. It doesn't have the rounded character of the other Clarity Caps and sounds in comparison nicely spatial and clear. I may be exaggerating a little here, but the DTAC makes a Clarity Cap SA sound a little cheap. Compared to a Mundorf Silver/Gold they still seem a fraction rounder and they are as transparent and clear as a Jantzen Audio Silver Z-Cap without being over bright. If you were looking for lots of depth, ambient information and concert-hall reverberation then I would advise to look at the Mundorf Silver/Gold, but if you prefer a slightly smoother top-end then the Clarity Cap DTAC is a very nice alternative.

Verdict: 10,5

Ducati 4.16.10 - 400VAC – 5% tolerance

Technical Specifications (according to manufacturer): "The dielectric is polypropylene film, the electrodes consist of an extremely thin metal coating obtained by vacuum evaporation. Case and cover are made with self-extinguishing plastic material; the capacitive element is sealed with polyurethane resin. The main characteristics of these capacitors are: Low losses non-inductive winding; Self-healing property avoiding short circuits; Small size and limited weight; No leakage risk; Class of safety protection: P0; Capacitance tolerance: ± 5%; Working frequency range: 50 ÷ 60 Hz; Individual test voltage: Between terminals: 2.15 Vn for 2 sec.; between terminals and case: 3KV for 2 sec; Dissipation factor tan δ: <20 10-4@ 20°C V=Vn, 50Hz; Protection Case and cover in self – extinguishing plastic material, grade V2 according to UL 94; Terminals: twin cable, unipolar leads; Protection degree: with terminals: IP00; with twin cable IP55; Cover : Ball pressure test (IEC 309-1): 125°C; Glow wire test (IEC 695-2-1): 850°C; Tracking resistance (IEC 309-1): ≥ 250V; Threaded fixing bolt M8"

Sound: This industrial type capacitor (like the ASC and Inco) is quite nice! They sound a bit dull at first because they take a while to burn-in. But after a few days of normal use they deliver a reasonably wide and open sound stage. Nice and neutral, maybe a slightly warm sound. One of those things that don't impress at first but sort of grow on you after a while, you learn to appreciate their qualities – great! Not the ultimate in sound staging or micro-detail and if you want a lively and bright sounding filter then this is not your cap. But if you are looking for a smooth, warm and relaxed sound then give these a try.

Verdict: 7,5

Duelund VSF Copper Capacitor - VAC? – 2% tolerance

Technical Specifications (according to manufacturer): "The Virtual stack foil capacitor, a capacitor made specially for loudspeaker crossovers. This new capacitor is the realisation of a lifelong ambition. It consists of copper foil and high-density paper, soaked in pure mineral wax, coated with pure cocoon silk and finally, treated with special lacquers made from natural materials. It is without question a "green" product. The actual construction has been overseen by Mr. Steen Duelund Chief Engineer of Duelund Coherent Audio. Mr. Duelund has dictated the capacitor's special characteristics, i.e. its flatness, giving the opportunity to create its stack-foil working manner ensuring very low inductance, forming a solid block resulting in a form free of internal resonance. Furthermore, the flatness makes it easier to achieve greater values by connecting the capacitors in parallel".

Sound: WOW! Now I know how natural a capacitor can sound! They are super natural, smooth, clear, open, and at the same time they stay calm and controlled but delivering dynamics when the music calls for it. The tonal balance is near perfection, especially audible on acoustic instruments and the human voice. This makes my classical music collection so much more realistic. Also I was very pleased with the separation of every individual instrument in an orchestra, the string section is much more a group of individuals rather than just a group. In comparison I found the Mundorf Silver/Gold to be a little over-etched sometimes, they seem to have a slight top-end emphasis. The Duelund VSF Copper Capacitor seems to be the only capacitor I have tested so far that doesn't need bypassing with an MKP1837 to be at its best. Still my ooh so natural reference!

Verdict: 12,5

Evox-Rifa PHE 450 MKP 250VDC – 5% tolerance

Technical Specifications: Double metalized Polypropylene Film Pulse Capacitor intended for high frequency, high current stress applications. Typical Application: Protection circuit in SMPS and Electronic Ballasts. Encapsulated in self-extinguishing material meeting the requirements of UL94V-0. Only available in values up to 4,7mF.

Sound: The Evox-Rifa PHE 450 is a very transparent and clear sounding capacitor, some times a little too "fresh" sounding but this character can be compensated by adding a capacitor with a more round character – I had very good results with about 10% of the total value made up from Angela (Jensen) paper in oil. On its own I find the midrange a little under exposed and the treble has a slight "glaze" over it, which again can be removed by bypassing it with a Vishay MKP1837. Imaging is quite good with a nice sized soundstage but only average separation. Dynamics are nice and snappy and the treble is well detailed. It might seem that I am not too keen on the PHE 450 but this is just a way of trying to describe its character in words – I still find it a very nice little capacitor considering the price. I can imagine the smaller values would also work well as a bypass capacitor. This capacitor has a high price/quality ratio and matching it with other capacitors to create a custom capacitor gives very good results.

Verdict: 7

Hovland Musicap MKP 100VDC – 2,5% tolerance

Technical Specifications (according to manufacturer): "Separate layers of polypropylene film & conductive foil; Large flexible 16 gauge, stranded, silver-plated copper leads; Lead-free silver-bearing solder used in tinning and attachment of leads; Manufactured in U.S.A. Hand soldered lead termination; Extremely low DA, DF and ESR; 100% pre-testing for quality assurance; Consistent, even, winding tension." They are slightly squiggly, when you squeeze them their capacitance changes!

Sound: "MusiCaps deliver fine dynamics, speed, focus, correct timbre and depth of field, and good inter-transient silence" – I can't agree more on this! But I must say I have a love/hate relationship with them: they don't mate with all types of tweeters. If in series with a very nice soft-dome tweeter they seem to bring out more detail than usual from such a tweeter compared to when used with other caps. I had good results with Scan speak soft domes and for the Dynaudio D260 Esotec I couldn't imagine a better cap in this price range. But if the tweeter tends to be a tad on the bright or clinic side they sound awful. Of course you do get more detail and a better sound-stage compared to if you used an Audyn Cap or Le Clanché but for example I tried them with the Focal tweeter in the Auriga and this didn't work at all! It hurt my ears! Here's a good tip: When tweaking a combo with a Scan speak D2905-9700 I found the best to be a 50/50% combination of the Hovland Musicap with a Mundorf Supreme Cap.

Verdict: 8

Inco Sintex 45T D2BS MKP 425VAC – 5% tolerance

Technical Specifications (according to manufacturer): "Metalized Polypropylene Film Capacitors to be used with Alternate Current. The most specific use of these capacitors concerns the starting and running of single-phase and three-phase motors when the latter are to be connected to any single-phase power supply mains." "Self-healing metallised polypropylene capacitors for motor run applications. Stud mount M8, flexible wire ended, plastic case."

Sound: This industrial type capacitor (like the ASC) is quite nice! They sound a bit dull at first because they take a while to burn-in. But after a few days of normal use they deliver a reasonably wide and open sound stage. Nice and neutral, maybe a slightly warm sound. One of those things that don't impress at first but sort of grow on you after a while, you learn to appreciate their qualities – great! Not the ultimate in sound staging or micro-detail and if you want a lively and bright sounding filter then this is not your cap. But if you are looking for a smooth, warm and relaxed sound then give these a try.

Verdict: 7,5

Intertechnik Audyn Cap MKP-QS 400VDC – 5% tolerance

Technical Specifications: The Intertechnik MKP QS series of capacitors are recommended for use in medium quality loudspeaker crossovers. Two voltage ratings are available, 400VDC/250VAC and 630 VDC/400 VAC.

Sound: The Audyn Cap is a good step-up from cheap electrolytic capacitors often found in standard quality factory built speakers. Nothing wrong with them but also nothing exciting. Compared with electrolytics they have much more detail, smoothness and a wider stereo image. Compared to an Audyn Cap Plus they sound dull, mushy and closed-in. Your basic good old MKP for all basic filter applications, especially when not in the signal path. A good substitute for electrolytics.

Verdict: 6

Intertechnik Audyn Cap Plus MKP 800VDC – 2% tolerance

Technical Specifications: These low loss capacitors have been developed for extreme impulse/power handling. An important design/constructional feature is the power handling of the connection between the foils (electrodes) and the end. The Audyn Cap Plus has a vastly improved system of connecting the electrodes to the end leads. Audyn Cap Plus also utilises an internal series connection system whereby layers of metal foil are combined with a one-side metalized "blind" layer. As a result of the double metallization performance is greatly enhanced. Dielectric: Polypropylene Winding: Induction free: 2 windings series connected Layers: Vacuum metalized Body: Aluminium, Synthetic material (plastic).

Sound: The Audyn Cap Plus is a nice high-end capacitor! They sound a bit hard at first and have a sort of midrange haze because they take a while to burn-in. But after a few days of normal use they deliver a very spatial sound with lots of depth that only gets better as time passes. Good reproduction of musical nuances. Furthermore, the effect is not only achieved with very expensive high-end components. It delivers a significant enhancement in more price-conscious configurations, making it a very worthwhile upgrade even though it is a little expensive. Clarity, depth, detail and openness are there. When I first switched over to these I thought, "this is it!" even though they were fresh from the shelf (but that was a few years ago). They sound a little more mid-range forward compared to the equally good Mundorf Supreme Cap.

Verdict: 9

Jantzen Audio Standard Z-Cap MKP 400VDC – 5% tolerance

Technical Specifications: metalized polypropylene film, "special winding techniques". Loss ang. $\tan \delta = 0.0002$ for 1kHz / 1uF

Sound: Like the Intertechnik Audyn Cap QS they lack clarity and sophistication. Even after extensive burn-in they still stay rather closed-in. But at least they don't have that "mushy" sound the Audyn Cap QS has and their tonal balance is reasonably neutral. They do emphasise "S" and "T" sounds a little, so don't use them in the signal path! Due to their low cost they are ideal for parallel capacitors in the low-pass of a woofer for example where in low budget systems electrolytics are often found. They are nicely compact in size, so they can turn out handy when space is critical.

Verdict: 6,5

Jantzen Audio Superior Z-Cap MKP 800VDC – 2% tolerance

Technical Specifications: metalized polypropylene film, high-grade copper lead wire. The finish is a flame-retardant tape wrap, and the end of the caps is resin sealed to protect against humidity. Loss angle tan = 0.00002 to 1K; Loss angle tan = 0.00001 to 10K.

Sound: Very neutral and coherent balance, they don't seem to highlight anything and I mean that in a positive way! They are a little flatter in presentation than their more expensive brother, the Silver Z-Cap but still better than the Clarity Cap SA in depth and spatial information. In direct comparison with a Clarity Cap SA they are less up-front in the lower treble and have a very good texturing of acoustic instruments like a violin for example. In the upper treble they are slightly brighter than a Mundorf Silver/Gold which probably explains the good spatial information and separation. Compared to the Jantzen Audio Silver Z-Cap I find them the more musical of the two and I will definitely add them to my favourites list.

Verdict: 10

Jantzen Audio Silver Z-Cap MKP 800VDC – 2% tolerance

Technical Specifications: metalized polypropylene film, high-grade silver lead wire. The finish is a flame-retardant tape wrap, and the end of the caps is resin sealed to protect against humidity. Loss angle tan = 0.00002 to 1K; Loss angle tan = 0.00001 to 10K.

Sound: More transparent than the less expensive Superior Z-Cap, very detailed. Sometimes too detailed for my liking which makes them less coherent than the Superior Z-Cap. They give some emphasis on the upper treble but are still more civilised than a Clarity Cap SA for example; they have a so-called "high-end" flair. Objectively speaking they are better than the Superior Z-Cap but I prefer the Superior Z-Cap for its more neutral presentation. I guess you could call the Jantzen Audio Silver Z-Cap the "audiophile" capacitor and the Jantzen Audio Superior Z-Cap the "musical" capacitor.

Verdict: 10,5

LCR Capacitors FSC tubular foil polystyrene, axial lead, 0,01uF 160Vdc – 2,5% tolerance

Technical Specifications (according to manufacturer): "Polystyrene is a superior dielectric material with exceptionally high insulation resistance and low loss. Aluminium foil electrodes are used and terminal wires are welded to them to ensure satisfactory performance at low voltage and high frequency. Low temperature coefficient. Close capacitance tolerance. Extreme capacitance stability. Low power factor. High Q. High insulation resistance. Small physical size. These are recommended for use in I.F. transformers, tuned circuits, pulse networks, laboratory standards, timing circuits, analogue and digital computing circuits and many other applications where superior qualities are used to advantage. Marking: Wherever possible capacitance tolerance and working voltage are clearly indicated by black digital lettering, but on small components a letter code is used for tolerance."

Sound: Like the MKP1837 they really clear things up. They take away the "grainy" edge from any capacitor. A gain in clarity and transparency making instruments better separable from each other, the violins in an orchestra are a group of individual violins instead of one mass. They don't do the disappearing-act quite as well as the MKP1837 but they come close.

Verdict: An alternative to the MKP1837 – use them as bypass cap with any capacitor.

Le Clanché PPM MKP 250VDC – 5% tolerance

Technical Specifications: Industrial application capacitor. Although the tolerance stated is meant to be +/- 5%, I measured all of them and they were all spot-on the stated capacitance.

Sound: Similar in character to the Mundorf M-CAP but with more detail right down into the midrange. Pleasant open sounding and smooth. Less depth than the ASC MKP in oil. I quite like these!

Verdict: 7,5

Mundorf M-Cap MKP 400VDC – 3% tolerance

Technical Specifications: The Mundorf M-CAP is a high quality metalized polypropylene capacitor. Great care taken during the production is meant to guarantee constant high quality and minimum electrical and mechanical tolerances. Thus, in the final inspection, maximum deviations in capacitance of 1.5 % are measured, so the guaranteed value of 3 % is far exceeded. I found them to be within 1% accurate. The practically induction-free type of construction and the low loss factor of the M-CAP result in a very "quick" capacitor. Used by Audiodata, Sonus Faber and many others.

Sound: I find the Mundorf M-CAP a little better than the Intertechnik MKP QS. The difference in sound quality is reflected in the price: also a little higher. Nothing extreme but noticeable, especially if all capacitors in your filter are M-Cap's. A little livelier than the Audyn Cap MKP-QS with slightly more midrange openness.

Verdict: 7

Mundorf RXF MKP 600VDC – 3% tolerance

Technical Specifications (according to manufacturer): "Optimised Winding Geometry. Extremely short low-loss signal transmission. Maximised internal contact surfaces. Extremely reduced residual-resistance (ESR). Considerable low residual-inductivity (ESL). Sealed foil coil against microphony effects. Polypropylene capacitor-foil, alu metalized. Massive connector plate".

Sound: Compared to the M-Cap they are cleaner and more transparent. The M-Cap's are slightly more midrange focussed. The RXF are nicely detailed without being "edgy" but could be a little smoother sometimes, they tend to draw your attention to the top-end more than the rest. This top-end focus does gather points regarding the retrieval of ambient information and reverberation. But I find the lower treble lacks some refinement, a bit "in your face". They do get better over time but a slight "glare" stays. The Supreme is similar in spatial information but more refined and therefore better. I also find the Clarity Cap PX to be smoother, rounder and therefore scores better in long term listening. This is most evident on well-recorded classical music. Overall I am still very positive about the RXF (especially considering the price) and see them as a welcome arrival for the budget sensitive user. They could also be a handy upgrade for existing crossovers where space is limited because they are built more compact than regular tube-shaped capacitors, especially when you need large values.

Verdict: 8

Mundorf Supreme Cap MKP 800VDC – 2% tolerance

Technical Specifications: 1. Special induction-free winding technology: Two capacitor windings are interleaved so that their inductances effectively cancel each other out. These two windings are connected in series. This means that it takes two 2µF windings to make a single 1µF M-CAP SUPREME capacitor - the same amount that it would take to produce a full 4µF of capacity using conventional technology! 2. Best available materials: The polypropylene film used for the M-CAP SUPREME has exceptionally low loss characteristics. 3. Sturdy plastic and aluminium cases: This prevents microphone effect feedback, thus protecting important signal details.

Sound: The M-CAP SUPREME delivers a very spatial sound with lots of depth. Good reproduction of the musical nuances. Detail and depth from the high treble right down into the low mid-range. Furthermore, this effect is not only achieved with very expensive high-end components. It delivers a significant enhancement in more price-conscious configurations, making it a very worthwhile upgrade. Clear and transparent sounding cap with a good sound stage. They provide a good improvement in clarity, focus and dynamics compared to standard quality MKP's. The degree of improvement is comparable to upgrading to high-end cables and interconnects. I must say I was impressed when I first auditioned them. The Mundorf M-Cap Supreme mix very nicely with Clarity Cap SA type capacitors, so blend the two to make your own personal taste.

Verdict: 9

Mundorf M-Cap Supreme Silver/Oil MKP 1200VDC – 2% tolerance (typ. 1%)

Technical Specifications: "An oil impregnated metallised paper dielectric capacitor, with the same series wiring as the Mundorf M-Cap-Supreme capacitors. The winding technology enables the production of induction-free capacitors. As the name indicates, high-purity silver is used for the capacitor coating, and the winding is impregnated with special oil developed in an exhaustive series of experiments and listening tests. The metallised paper foils make it possible to maintain extremely exacting production tolerances that cannot be achieved with traditional oil/paper capacitor designs. This is also the first time that the benefits of oil-impregnated capacitor design have been successfully combined with the well-known long-term stability of metallised paper and internal series wiring for induction-free performance. These low manufacturing tolerances is one of the key reasons for the wonderfully spacious music reproduction achieved with these capacitors: Perfect stereo is only possible when the performance of the left and right channels is virtually identical. The long-term capacitance stability of these products is equally important, of course. Without it there is no way to achieve really constant performance – not even with capacitors selected as matched pairs."

Sound: The M-CAP Supreme Silver/Oil is one of my favourite capacitors! I can only underline what Mundorf states: "...wonderfully spacious and detailed sound reproduction ... full and smooth tonal richness and diversity. This capacitor's ability to bring out the finest nuances and the subtlest distinctions make the music sound more alive and "juicy", ...Wonderfully spacious music reproduction... ". Music detail and depth throughout from top to bottom. Very smooth and liquid. To exaggerate things: it makes a standard Supreme Cap sound slightly rough!

Verdict: 10

Mundorf M-Cap Supreme Silver/Gold 1200VDC – 2% tolerance

Technical Specifications: The top coil technology of the Supreme capacitors is combined with silver foil, containing 1% gold. According to Mundorf the crystalline structure of the silver is also improved. Available in values from 0.1µF to 1.0 µF. Made from 99% pure silver and 1% Gold metallised foils. Dielectric: Polypropylene, Metallization: 99.99% pure silver with 1% gold, Dielectric strength: 1200V DC 800V AC, Tolerance: ± 2%, typ. 1% Loss angle tan d = 0.00002 to 1kHz Loss angle tan d = 0.00001 to 10kHz.

Sound: Nicely clear and transparent, rich textured treble, very spacious – front to back and left to right, very good separation of individual instruments, deep black background, clean and dynamic, heaps of micro-detail information, the details get high-lighted a little. I know one could easily think that this capacitor must be good because everyone says so and it is very expensive but I have tried to keep my objective view and even so I am very impressed. Were I would describe the Silver/Oil as extremely neutral, I would describe the Silver/Gold as extremely natural if you know what I mean. Acoustic instruments like a viola da gamba sound really life-like. In comparison to the Duelund Copper Foil capacitor they can sound a little bright in the top-end, but this can be a plus point if you want to brighten up a dull sounding system or you just dig those so-called "high-end" recordings with bells, chimes and things. They are by no means harsh, just on the clear side of neutral sometimes.

Verdict: 11+

Mundorf M-Cap Supreme Silver/Gold/Oil 1200VDC – 2% tolerance

Technical Specifications (according to Mundorf): "The MCap® Supreme Silver/gold/oil is the top-of-the line model of the Mundorf oil impregnated capacitors. In comparison with the Silver/Oil version, it technically features a further extended lifetime. More importantly, sonically the Silver/Gold/Oil version stands out due to its wonderful natural singing and exceptional micro dynamic, at the same time." Capacitance: 0.010µF-10µF; Dielectric: Polypropylene; Metallisation: 99.99% silver, 1% gold; Purity of silver: min. 99.97% typ. 99.99%; Purity of gold: min. 99.97% typ. 99.99%; Dielectric strength: 1200V DC; Loss factor tan δ: 0.0002@1 kHz, 0.0001@10 kHz

Sound: At this level we are talking about a serious capacitor, so my findings are relative to other exotic types. They are richer and

better layered than the Mundorf Silver/Gold, they seem more open and more spatial. Compared to the Duelund VSF copper they are not as well harmonically structured. The Duelund VSF copper capacitor creates smoother harmonics and a better midrange balance. The Silver/Gold/Oil excels in image depth, call it "bowling alley depth"! In direct comparison the Duelund VSF copper sounds flatter. Like the Mundorf Silver/Gold, the Silver/Gold/Oil has a slight top-end emphasis, this probably contributes to the perceived spatialness and micro-detailing. It will depend on the implementation and personal taste, some may prefer the Mundorf Silver/Gold/Oil, some may prefer the Duelund VSF copper foil capacitor.

Verdict: 11,5

North Creek Crescendo Film and Foil MKP 200VDC – 10% tolerance

Technical Specifications (according to manufacturer): "Released in 1996, these capacitors were designed with a lush, rich midrange and romantic but detailed top end; a tonality opposite that of other large film-and-foil capacitors. Proper application of the thick 200 Volt film results in a tonal continuity from the midrange through the treble extremes, and balances the midrange correctly with the upper octaves. The extreme top end of the Crescendo capacitors is soft and very quiet. Although Crescendo Harmonically Balanced™ film-and-foil capacitors were designed to operate un-bypassed in most tweeter circuits, they also benefit from bypassing and cascading with the higher voltage Crescendo bypass capacitors. They also make an excellent bypass cap when paired with most other base caps for high performance midrange circuits, and can be configured in large pure film-and-foil stacks for the ultimate in midrange performance". Although the tolerance stated is meant to be a poor +/- 10%, I measured all of them and they were (like the ASC polypropylene in oil) all within about 1% the stated capacitance – the worst one measured 10,12mF.

Sound: Well all the above is just sales talk! Okay, they are very good capacitors with good separation of the individual instruments and a nice deep sound stage but the major drawback is they have a sort of "loudness" built-in, like with the Hovland Musicap (of which they remind me of the most) I have a love/hate relationship with them: they don't mate with all types of tweeters, they don't make an excellent match for most aluminium and titanium domes. I tried them in the new HATT-MkIII and felt like wanting to increase the L-pad function of the tweeter. If in series with a very nice soft-dome tweeter they seem to bring out more detail than usual from such a tweeter compared to when used with other caps. I had good results with the Seas Excel tweeter used in the Mezzo Proteus but other soft-domes should also benefit the same way. If the tweeter tends to be a little on the bright or clinic side they sound awful. But you do get more detail and a better sound stage compared to if you used an Audyn Cap or Le Clanché. Here's a good tip: Use them as a bypass cap only; they will clean up a cheap Intertechnik Audyn Cap nicely.

Verdict: 8

Obligato MKP 630VDC (dry version) – 5% tolerance

Technical Specifications: Chinese built, extra tight winding, no voids and thick-coated aluminium film imported from Germany. Very low inductance. Lead-outs are soldered copper, solid core.

Sound: Analogue is the word that keeps popping-up in my head when trying to describe these capacitors. They have a rich texture and produce an open and smooth image with realistic dynamics and good retrieval of ambient information. They have slightly less depth than a Clarity Cap DTAC but are also very detailed and never get harsh. They seem to have a sort of "detailed warmth" about them. Very nice especially when you look at their price!

Verdict: 10,5

SCR Châteauroux MKP-PB 400VDC – 2% tolerance

Technical Specifications: Tinned solid-core lead-out version of the Solen Châteauroux Fast Cap PB-MKP-FC.

Sound: The Solen MKP-PB are a fraction better than the Intertechnik Audyn Cap QS (but what isn't) but are still rather flat and lack depth and transparency. Rather coarse compared to the cheaper range Clarity Caps like the PW and APW series but they do have a similar, reasonably neutral tonal balance. What they have going for them is their very low cost, to get more spatial information and better definition you would have to look at a slightly more expensive Mundorf RXF for example if you really want to improve things.

Verdict: 6,5

Solen Châteauroux Fast Cap PB-MKP-FC 400VDC – 5% tolerance

Technical Specifications (according to manufacturer): "Low dielectric absorption factor; High insulation resistance; High frequency and temperature stability; Good self healing characteristics of polypropylene dielectric; High Current Capacity; Excellent Over voltage and Pulse handling capability; Low self inductance; Low equivalent series resistance; Excellent stability; Flexible leads: Tinned pure copper multi-strand insulated sleeves; Superior high frequency characteristics; High Ionisation level; Dissipation factor @ 20o C: Less than .01 %; Dielectric absorption factor at 20o C: Less than .01%; Insulation resistance @ 20C: More than 100 K megohms/mfd; Temperature range: -25o C to+85o C; Dielectric: Polypropylene Film; Working Voltage: 400 VDC." Low priced cap, same quality as SCR and Angela branded capacitors, same sizes. Why? Because they are exactly the same!

Sound: The Solen Châteauroux Fast cap is a good step-up from MKT capacitors often found in standard quality factory built speakers. Like the standard Intertechnik Audyn Cap nothing wrong with them but also nothing exciting, but if I had to choose between the two I would still go for the Solen, they seem to have a fraction more "musicality" to them. Compared with electrolytics they have much more detail, smoothness and a wider stereo image. Compared to a Mundorf Supreme Cap they sound closed-in. Midrange is slightly forward compared to more neutral caps, they can be a little "nasal" sounding in some configurations. Due to this "character" they would make a good match with Focal tweeters for example. If you have a tight budget then this is a good choice!

Verdict: 6,5

Sonic Craft Sonicap MKP 220VDC – 5% tolerance

Technical Specifications (according to manufacturer): "The Sonicap is a revolutionary product! How is it revolutionary? It redefines the price-to-performance ratio for "audio capacitors". The Sonicap is the "entry level" of its design. However, the design is world class! The Sonicap will yield or exceed the performance found with the most prestigious of boutique caps, yet a price conducive to

that of "entry level". The Sonicap is well balanced and true to the source. The word "neutral" is so loosely (and incorrectly) used that I prefer the term "balanced". While capacitors suffer from more noise (high distortion) than most audio components, the Sonicap exhibits very low noise and parasitics. The presentation is rich in harmonics, warm, without the slightest loss of detail retrieval! As a matter of fact, the micro-dynamics of the Sonicap is unmatched by anything close to its price range. All Sonicaps are tested at twice their rated voltage. The Sonicap meets or exceeds several Mil-specs. Dissipation Factor is typically better than 0.02% @ 1kHz. The Sonicap leads are tinned solid copper (high purity). Tolerances are typically better than 5%. Custom values and tighter tolerances are available. For the mods, which require a smooth presentation "unlike" that, produced by capacitors where dielectric breakdown ("self healing") is an acceptable (admirable) attribute. For the tweak who's system is well balanced and does not require "coloration band aids". For the hobbyist on a budget. Whether it is a power supply bypass, coupling, or speaker application, the Sonicap will be there!"

Sound: I can agree on the good price-to-performance ratio! You get a nice capacitor for a reasonable price – nearly 4 times the price of an Intertechnik Audyn Cap but still only half the price of an Audyn Cap Plus or Mundorf Supreme. Compared to a standard Mundorf M-Cap they are more transparent and clearer with lots more depth. Bypassing them with an MKP1837 (a good tweak for any capacitor) can create even more detail and separation! They reveal micro-information in a way that reminds me of a Hovland Musicap but without the Hovland loudness effect. I didn't find them to mix well with other caps – a 50/50 mix with a standard Mundorf M-Cap gave me the funny sensation of listening to two different cap's at the same time. I can advise them if you are looking for a "high-end" cap but are on a "tight" budget.

Verdict: 8,5

Super PP capacitor (SPP) MKP 400VDC – 5% tolerance

Technical Specifications (according to manufacturer): 5 layers Composite dielectric, Super low DF.

Sound: First of all they need a much longer burn-in time than most capacitors, in the beginning they are rather aggressive. After burn-in I still find the top-end over-etched which gives it a slightly artificial treble. They are well detailed but I find the midrange a little under exposed, maybe they would work well in a dull sounding speaker. Spatiality is good, probably due to the highlighted top-end but only average separation. I find them similar in character to the Evox Rifa PHE-450. They also benefit a lot from a paper-in-oil bypass capacitor. For their low price they perform well.

Verdict: 7,5

TRT Wonder DynamiCap MKP 210VDC – 5% tolerance

Technical Specifications: "DynamiCap includes special rugged wrap and a construction with metal end caps, and individually hand soldered 19 gauge silver clad copper wonder wire leads. DynamiCap boasts a virtual infinity of parallel paths through the plates, from input to output. More importantly these parallel paths are virtually the same length as one another, so all parts of the input signal arrive simultaneously at the output terminal." Physically they are very lightweight compared to other brands of similar size.

Sound: Their name does describe them a bit: they have a wide dynamic range and sound "fast" and "quiet" - dynamics are nice and snappy, but at the same time they are not very subtle or delicate, they seem to grab attention and run away with it. Now I do find dynamics to be one of the most important factors in the aim to reproduce recorded music in a lifelike manner, but the DynamiCaps seem to lack coherency and make the music nervous and therefore fatiguing – not relaxing at all. At first they are impressive but soon they become distracting and get you listening to things like transparency, transients and detail instead of listening to the music! Use them if you want to spice things up a bit, some might call them revealing, I find them grainy. Also imaging is a little compromised, compared to a Clarity Cap PX they sound a little on the flat side, a Clarity Cap PX has more space and depth. They do form a nice upgrade from standard quality MKP's and work better as a midrange capacitor than a capacitor in the signal-path of the tweeter, but considering their price, there are many alternatives out there with a more neutral approach to music.

Verdict: 7,5

Vishay Roederstein MKP1837 (a.k.a. ERO MKP1830) 0,01uF MKP 100VDC – 1% tolerance

Technical Specifications: Metallised polypropylene, radial capacitor, designed for LC/RC filter circuits, coupling and de-coupling at high frequencies.

Sound: I was tipped by Klaus Witte of Germany to try this capacitor as a bypass cap for the Mundorf M-CAP SUPREME. I tried them as a bypass for the tweeter series caps in my Progress speaker and I must say I am very impressed! To get straight to the point they don't change a Supreme into a Supreme Silver-Oil but they really do clear things up. I must admit I was sceptical at first as the value is only 10nF (0,01uF) - and the caps in the Progress are 12,6uF. The difference is most noticeable with classical music but also good quality recordings of jazz and fusion benefit: No change in soundstage width or depth but there is more "concert hall acoustics" that let you get into the recording more. Not as liquid as silver/oil but they take away the "grainy" edge from the Supreme's. A gain in clarity and transparency making instruments better separable from each other, the violins in an orchestra are a group of individual violins instead of one mass. Jazz drum brushes sound more like a brush than a "shush".

Verdict: Can't live without them! – Use them as bypass cap with any capacitor, they cost practically nothing!



In practice

For some reason the differences between capacitors seem to be more apparent in series-crossovers than with parallel types, but my findings do apply to all loudspeaker crossover types only in some they are more evident than others are. For optimum results all capacitors in a series filters should be of the same high quality, even the ones in correction and Zobel networks! Also the higher the quality of the hi-fi-system the more obvious the difference between the various capacitors will be. A higher rating doesn't always mean "better"; it depends on the implementation which capacitor is "the best" for your situation. Just replacing everything with the capacitor with the highest rating isn't always the optimal solution, try using different caps in different places throughout the crossover; it's just like cooking! A bit of pepper here, a pinch a salt there, etc and try to get your favourite "blend" of sound that way, and don't forget the Vishay Roederstein MKP1837. To be continued!

Tony Gee - The Netherlands

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Humble Homemade Hifi has the right to change information without notice.