



## ISIS VS. MEGAEXO – A 2004 PERSPECTIVE

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What is driving the development of integrated-crank systems? The answer lies in the success of ISIS-Drive, which FSA has been a major proponent of, and the strengths and weaknesses of the ISIS-Drive BB. ISIS-Drive came about because the owner of the Octalink patent would not license it. Several other component manufacturers cooperated (the ISIS-Drive Committee) to develop this alternative spline BB standard that is superior in most respects and offer it as an open-standard for all manufacturers. This led to a lot of advantages for crank makers, BB makers, bike manufacturers and consumers because of the increased competition and more choices.

## ISIS-DRIVE VS. OCTALINK

ISIS-Drive BB's with 22mm diameter axles have superior strength and stiffness compared to Octalink BB's (also 22mm axles), which in turn were already an improvement over square-taper BB axles (17mm diameter axles). In our testing, ISIS-Drive BB's are typically at least 20~30% stronger and stiffer than Octalink, for comparable BB's (i.e. we weren't using M12 DH ISIS-Drive BB's). Strength and stiffness of ISIS-Drive set the bar high in those categories. Going to the 24mm diameter axle used in integrated-BB's offers a marginal improvement, only a 9% diameter increase. In comparison, the 22mm axle is already 29% larger diameter than the old benchmark 17mm axle.

Currently, FSA ISIS-Drive BB bearing life is acceptable, although in the past, many ISIS-Drive BB's suffered from short bearing life. The same oversize axle that is great for strength and stiffness presented engineering and manufacturing challenges to fit bearings with a high enough load capacity inside the BB shell. (High-end Octalink BB's had similar problems.) The difficulty of engineering ISIS bearings can be evidenced by the fact that one of the 3 members of the ISIS-Drive Committee never produced an ISIS-Drive BB, while another member was the first to follow with an external bearing BB.

FSA has used it's bearing know-how to develop long-lasting ISIS-Drive bearing BB's. Last year, CSC was on ISIS-Drive with good results (ridden to 3 stage wins in the Tour de France)! We have taken the feedback from CSC and have continued to improve our ISIS-Drive BB's by introducing high-end quadruple bearing versions with improved sealing, under the designation "MegaQuad".

## ALTERNATIVE SYSTEMS - OVERSIZE INTEGRATED BB'S

That said, over 2 years ago we started new developments looking beyond ISIS Drive. We looked at all the novel systems that came before, such as integrated cranks like Bullseye and Sweet Parts, etc. as well as external bearing BB's such made by Magic Motorcycle. But the conclusion we came to was that the weakest point in the system was the small diameter BB shell and that the best system was to enlarge the BB shell and integrate the BB into frame. The oversize integrated BB in the frame offers the greatest absolute system (frame + BB + crank) stiffness at the lowest overall weight. Cannondale previously proved this point by switching from the Magic Motorcycle external bearing system (which they owned) to a frame integrated BB. More recently, Pinarello is headed this way.

We introduced in 2002 the "MegaTech" integrated BB standard, open to all frame and BB manufacturers. The large diameter BB shell offered frame designers a larger foundation to work around with lots of space inside for BB manufacturers to engineer better axles and bearings. However, bicycle manufacturers have been reluctant to embrace the MegaTech standard (which is surprising because they sure drive the experiments with headset standards!), despite the great advantages of integrated BB's.



## ALTERNATIVE SYSTEMS - OVERSIZE THREADED BB'S

A season after we introduced MegaTech, the ISIS-Drive Committee proposed another standard for an internal oversize BB, called OverDrive. The difference is that OverDrive is not integrated, but uses oversize threaded cups. OverDrive's advantages compared to MegaTech are that frame builders do not have to hold as tight tolerances (a thread can have sloppier dimensions than the ream required for a press-fit bearing) and it is more "familiar" to dealers and consumers than a press-fit. Anyways, it is significantly heavier than other BB systems, which is probably OK for the mid-end and heavy-duty bikes it is targeted towards.

## ALTERNATIVE SYSTEMS - EXTERNAL BEARINGS AND INTEGRATED CRANKS

External bearing BB's combined with integrated cranks offer some modest weight and stiffness improvement over ISIS Drive. For a given crankarm technology, the main weight savings is the elimination of BB bolts and thinner axle, but the larger bearings, external cups, and longer axle do limit the weight reduction compared to frame-integrated BB's.

There are advantages to external bearings that are different from the advantages of integrated cranks. The advantages to the BB manufacturer of the Magic-type external bearing are that the bearings are both larger (last longer) and are common off-the-shelf cartridge bearings (cheaper), which are easier to produce and procure than custom bearings for Octalink or ISIS BB's.

The advantages to the crank manufacturer of integrated Bullseye-type cranks are that they are guaranteed that the customer will always use the intended BB with the crank (and it doesn't hurt that they will always sell a BB with a crank). The advantage to the Bike Company and dealers is that there are fewer worries about mis-matched BB's, faster assembly and compatibility with current threaded frame designs. For a bike company assembling tens of thousands of bikes a year, reduced assembly time is important.

When bike manufacturers and consumers are free to mix-and-match cranks and BB's, there is the small chance that a crank will be installed on a BB it was not intended for, which can in turn cause problems for chainline (shifting performance), crank-arm clearance and q-factor.

There are 2 major problems with square taper BB's in that there is no standard axle length for cranks and the taper dimensions can be made to either Japanese dimension (which follow JIS) or European dimension (which follow ISO), so even if you get the right axle length then you may have the wrong taper size.

ISIS-Drive cleverly addressed this problem by assigning standard lengths (i.e. 108mm for road double, 113mm for MTB, 118mm for road triple, etc.), so you (almost) always know which length of axle you need for your cranks, and by using chainline control shoulders, so your chainline would always be as intended. The great power of ISIS-Drive's open standard is also it's weakness - the tapered spline requires great care to produce and the ISIS standard leaves manufacturing open to interpretation in some respects. In some instances early on, manufacturers found that their in-spec products would not work with another's in-spec product...exactly what was not supposed to happen with ISIS-Drive. Fortunately, many ISIS-Drive competitors have cooperated together to hammer out the manufacturing kinks.

So, external bearing BB's offer some simplified manufacturing and some performance benefit compared to ISIS-Drive BB's. They are compatible with most current bikes and frames. Integrated cranks reduce the possibility of mismatched BB axles and allow faster assembly.



## MEGAEXO

FSA will introduce an external oversize bearing integrated-BB cranks in 2005. Named "MegaExo", to reflect the trickle-down over-size bearing technology from our MegaTech effort.

The main reason is a need to keep our price and performance stable for our customers. (Worldwide, the cost of raw materials is rising and we need to reduce costs somewhere...by saving cost on the bearing, we can continue to offer our famous carbon technology and performance.)

FSA will continue to support ISIS-Drive well into the future.

As long as that answer is, it really simplifies and glosses over many points and details about the advantages and disadvantages about crank interfaces...it is not intended to be a definitive treatise, but just matter-of-fact for your interest.