

ZFC MAIN TEST (5000km) in brief. Full version is found via link towards bottom of this web page.

*Note – there is NO CLEANING of chain during main test. The wear rate performance achieved across the test is all up to the lubricant. Many lubricants claim to "Repel dust, dirt and grime" and to "Clean as they Lubricate" etc. Cleaning maintenance during test would severely impact the ability of the test to assess key performance abilities and marketing claims. It is a difficult test, lubricants that maintain a low wear rate through the full test are thus impressive in their performance for their actual use case – on a bicycle chain. Not a short clean lab test. Not a tribology test. Not ISO standards tests using ball bearings or pin on disk test, or spinning wheel on bearing cylinder brugger / falex test. Or Milspec testing – using Milspec because it sounds more hardcore if it has military in it. It will have performed in its ACTUAL use case, so the cross over of ZFC test results to the real world is MUCH greater than any other test known in this space, at this time. If a lubricant performs poorly in the ZFC test, regardless of the results of other non relateable tests, then you should hold a lot of concern with regards to how it will perform in the real world on your bicycle chain, and the rapid wear and damage to chain, cassette and chainrings that may follow. Rapid / notable wear of metal parts inside chain on on your drivetrain – that is not low friction running. And it is much more costly.

Join the land of low friction and consider trying a product that has proven it excells in its actual use case – on a bicycle drivetrain, over thousands of kilometers, and including both dry and wet contamination.

Link to Main Test Brief document below – PLEASE take 5 mins to read just the test protocol below before sending an enquiry such as "Is the chain cleaned during the test? Is the chain re lubed during the test? How often is it lubed etc etc. All is stepped out nice and clearly in the test brief, and the main test will all make sense why it is the most robust test in this space at this time, and why it is heavily used by Manufacturers to prove how their lubricant stacks up on the league table.

You will soon see for yourself why the ZFC main test is so valuable – to cyclists of all demographics and to the lubricant manufacturers who have developed genuinely great products for this very specific use case.

To the test, enjoy!

Block 1 – 1000km. No contamination. Assess any initial penetration issues present + clean road conditions performance.

0km – Lubricate strip cleaned chain as per mfg instructions, included any needed set time before test commence. Chain is precisely check measure for net start measure.

Interval 1 – 400km – Big ring, Cog 4 – 12hrs 15 mins.

Re lube as per mfg instructions inc. any needed set time.

Interval 2 – 200km – Small ring, Cog 1 – 11hrs 06mins

Re lube as per mfg instructions inc. any needed set time.

Interval 3 – 400km – Big ring, Cog 5 – 11hrs 12 mins.

Check Measure for Block 1 wear amount vs start measure.

Block 2 – 1000km – Dry Contamination test. Ability to resist becoming abrasive when exposed to dry contamination. Ability to "clean as it lubricates" and "repel dust, dirt and grime, and "forms a high strength film preventing contamination from metal surface contact and wear" – and other marketing claims of this nature. A high wear rate in this block demonstrates the lubricant readily absorbs contamination and become abrasive. A low wear rate demonstrates an excellent ability for the lubricant to resist absorbing abrasive contamination and would be a top choice for gravel / mtb / cx etc.

re lube interval is doubled in contamination blocks as it is expected people will re lube more often when riding in harsher conditions vs dry road conditions.

Re lube as per mfg instructions inc. any needed set time.

Interval 4 – 50km – small ring, Cog 2 – 2hrs 30 mins.

ADD 5 Grams fine grade sandy loam.

Interval 5 – 50km – small ring, cog 2 – 2hrs 30 mins

Re lube as per mfg instructions inc. any needed set time.

Interval 6 – 100km – Big ring, cog 6 – 2hrs 30mins

ADD 5 Grams fine grade sandy loam.

Interval 7 – 100km – Big ring, cog 6 – 2hrs 30mins

Re lube as per mfg instructions inc. any needed set time.

Interval 8 – 50km – Small ring, cog 3 – 2hrs 18mins

ADD 5 Grams fine grade sandy loam.

Interval 9 – 50km – Small ring, cog 3 – 2hrs 18mins

Re lube as per mfg instructions inc. any needed set time.

Interval 10 – 100km – Big ring, cog 4 – 3hrs 04 mins

ADD 5 Grams fine grade sandy loam.

Interval 11 – 100km – Big ring, cog 4 – 3hrs 04 mins

Re lube as per mfg instructions inc. any needed set time.

Interval 12 – 50km – Small ring, cog 1 – 2hrs 48mins

ADD 5 Grams fine grade sandy loam.

Interval 13 – 50km – Small ring, cog 1 – 2hrs 48mins

Re lube as per mfg instructions inc. any needed set time.

Interval 14 – 100km – Big ring, Cog 5 – 2hrs 48 mins

ADD 5 Grams fine grade sandy loam.

Interval 15 – 100km – Big ring, Cog 5 – 2hrs 48 mins

Re lube as per mfg instructions inc. any needed set time

Interval 16 – 50km – Small ring, cog 2 – 2hrs 30mins

ADD 5 Grams fine grade sandy loam.

Interval 17 – 50km – Small ring, cog 2 – 2hrs 30mins

Check Measure for Block 2 wear amount vs end of Block 1 measure for its wear rate through Block 2

Block 3 – 1000km – No contamination

This can give a clearer indication re lubricants ability to self clean / flush clean. During block 2 as it is constantly hit with more contamination, this ability may not show up. If there is a notable wear rate drop shown for Block 3 vs Block 2 – we know that although if a lubricant did show a propensity to absorb contamination and become abrasive, it does do an admirable job of self cleaning when that exposure stops. That is very handy to know vs marketing claims, and handy to know if you only occasionally ride in a higher contamination environment (ie sometimes do some gravel but not all the time).

Re lube as per mfg instructions inc. any needed set time

Interval 18 - 400km - Big ring, cog 6 - 2hrs 30mins

Re lube as per mfg instructions inc. any needed set time

Interval 19 – 200km – Small ring, cog 3 – 9hrs 12 mins

Re lube as per mfg instructions inc. any needed set time

Interval 20 – 400km – Big ring, cog 4 – 12hrs 15mins

Check Measure for Block 3 wear amount vs end of Block 2 measure for its wear rate through Block 3

Block 4 – 1000km – Wet contamination

Here is where things get tough. This block puts many lubricants to their knee's if block 2 didn't do that already. Many lubricants tested don't actually even make it to this test block before exceeding the maximum amount of chain wear allowed for the main test. Over the years I have received feedback that lubricant X would have been excellent in wet conditions as it is designed for wet etc. However the reason it did not make it to block 4 was due to a very high wear rate in Dry contamination block 2. What I can say is that in every case, the wear rate in Block 4 is greater than it is in Block 2 for all drip lubricants. So if the result was poor in block 2, it will not do better in what is a harsher test block. If you are looking at a wet conditions lubricant, and it has been tested by ZFC and did poorly in block 2, and did not make it far enough into test to be tested in block 4 – it will have a wear % result that is highlighted RED. This denotes it is an extrapolated result. The extrapolation is based on the wear % increase in block 4 vs block 2 for all lubricants tested to date that made it through to the end of block 4. This extrapolation is likely kind to the lubricant because it is based off of lubricants that overall performed better, and so made it deeper into the test. In short, a lubricant has highlighted RED wear % in block 4, it is not recommended, regardless of its claims re wet conditions performance.

For all others that have done well enough to make it this far in test, or have A LOT of wear rate allowance left as have absolutely smashed it with impressively low wear across blocks 1, 2 and 3 – things are often either tough or really tough here. Water WILL bring contamination deep into the chain where in block 2 it was maybe able to largely prevent that. Will the lubricant be washed out? Abraded off? Combination of both? How does it recover on each re lube? A big jump in wear is expected – but will it just be high, or really high, or just killed it dead – always exciting to find out.

Re lube as per mfg instructions inc. any needed set time

Interval 21 – 50km – Small ring, cog 2 – 2hrs, 30 mins

500ml Water spray over 1 minute plus 5 Grams fine grade sandy loam.

Interval 22 – 50km – Small ring, cog 2 – 2hrs, 30 mins

Re lube as per mfg instructions inc. any needed set time

Interval 23 – 100km – Big ring, cog 5 – 2hrs 48 mins

500ml Water spray over 1 minute plus 5 Grams fine grade sandy loam.

Interval 24 – 100km – Big ring, cog 5 – 2hrs 48 mins

Re lube as per mfg instructions inc. any needed set time

Interval 25 – 50km – Small ring, cog 3 – 2hrs, 18 mins

500ml Water spray over 1 minute plus 5 Grams fine grade sandy loam.

Interval 26 – 50km – Small ring, cog 3 – 2hrs, 18 mins

Re lube as per mfg instructions inc. any needed set time

- Interval 26 100km Big ring, cog 6 2hrs 30 mins
- 500ml Water spray over 1 minute plus 5 Grams fine grade sandy loam.
- Interval 27 100km Big ring, cog 6 2hrs 30 mins

Re lube as per mfg instructions inc. any needed set time

Interval 28 – 50km – Small ring, cog 1 – 2hrs 48mins

500ml Water spray over 1 minute plus 5 Grams fine grade sandy loam.

Interval 29 – 50km – Small ring, cog 1 – 2hrs 48mins

Re lube as per mfg instructions inc. any needed set time

- Interval 30 100km Big ring, cog 4 3hrs 04 mins
- 500ml Water spray over 1 minute plus 5 Grams fine grade sandy loam.
- Interval 31 100km Big ring, cog 4 3hrs 04 mins

Re lube as per mfg instructions inc. any needed set time

Interval 32 – 50km – Small ring, cog 2 – 2hrs 30mins

500ml Water spray over 1 minute plus 5 Grams fine grade sandy loam.

Interval 33 – 50km – Small ring, cog 2 – 2hrs 30mins

Check Measure for Block 4 wear amount vs end of Block 3 measure for its wear rate through Block 4

Block 5 – 1000km – No contamination

Similar to block 3, block 5 gives the lubricant a chance to clear / clean / heal / recover post a pretty rough 1000km test block. It is very interesting if this does or does not happen. Ie lubricants that resisted dry contamination well did not have to recover much in block 3. But there is little escaping block 4 contamination penetration. Some lubricants their Block 5 wear rate is very similar to block 4 even though contamination stopped, whereas others will show a sharp drop. So far only the highest performing products have wear allowance left to even make it to block 5.

Re lube as per mfg instructions inc. any needed set time

Interval 34 – 400km – Big ring, cog 5 – 11hrs 12 mins

Re lube as per mfg instructions inc. any needed set time

Interval 36 – 200km – Small ring, cog 3 – 9hrs 12mins

Re lube as per mfg instructions inc. any needed set time

Interval 37 – 400km – Big ring, cog 6 – 10hrs.

Check Measure for Block 5 wear amount vs end of Block 4 measure for its wear rate through Block 5

And this marks the end of the MAIN test. For chains that still have sufficient wear allowance left to attempt it, there is an EXTREME contamination block 6, also 1000km.

I wont type that one out as its too long, but in short – take block 4 – wet contamination block as the base. The number of contamination intervals is doubled – so there are two instances between re -lube, not one. And the contamination amount for all instances is doubled – so it is 1 litre of water over 2 minutes, and 10 grams of sandy loam (vs 500ml and 5 grams in block 4).

At the time of writing this document after many years of testing, only two drip lubricants have made it too the end of block 6. The handful of others are all the top immersive waxes.

However- it is the first 5 Blocks that make up the main test, from which the COST TO RUN MODELLING is based. The total wear of the chain, and what this means re cassette wear, chain ring wear – is then costed out across different groupset price ranges. The cost of the lubricant and the amount of lubricant use is also recorded and included.

Summary

Most other lubricant testing for bicycle chain lubricants (as far as I know, pretty much all other) – are doing outright efficiency testing. This tends to be short duration (X hours). And contamination free. The outright efficiency of a lubricant in a clean lab test is of limited value for most cyclists as they will not be doing full chain reset post every ride. And it can mean very little indeed if the efficiency will be impacted quickly – such as in offroad cycling, wet conditions etc.

The Zero Friction Cycling test CANNOT assess outright efficiency. It is wear correlation based. The correlation being if a lubricant becomes abrasive and thus high wear – rapidly eating through the hardened steel parts of the chain simply cannot be low friction vs lubricants that remain, well, lubricating vs abrading.

What the ZFC test can and does measure;

> Any initial penetration issues

- > Dry contamination environment performance
- > Wet conditions performance
- > Ability to clear contamination
- > Cost to run modelling based on wear performance and lubricant cost and usage amount.
- Results by block enable cyclist to choose product that suits their cycling ie dry road, Offroad, frequent wet riding.
- > Lubricant performance benchmarked on the largest open League Table able to sorted via overall or by each block.

Aside from the issue already explained with regards to the limitations of outright efficiency test, such testing / test facilities have over time proven to had quite a number of issues worth being aware of;

- > Results from one facility to another reporting wildly different efficiency loss data for the same lubricants tested.
- Manufacturers booking in testing with such facilities need to book multiple tests, as each manufacturers data is private it is their paid for data. There is no open league table or leaderboard like ZFC. So if a manufacturer books in 10 tests their lubricant and 9 competitors, and they are beaten by 4 competitors, they will go to market as the number one product beating 5 other lubricants. It is to a degree pay to win, because every manufacturer who tests with that facility will of course always be able to go to market winning. They are not going to go to market showing they were 5th place.
- With ZFC any paid private tests if they do not go well and the mfg does not wish to have results published, they do of course remain private. However, if it tests very well and they green light the data to be open then the result is the result the product will slot into the League Table in the position it attained, and so it is a league table that grows constantly and becomes ever more competitive and difficult to get into the top 10 or the top 15. Over the years as only the best private tests become public, this makes the league table TOUGHER so there is no negative impact to the cyclists of the world reviewing this open data to find the best products, the only negative is to the manufacturers as the benchmark keeps getting harder.

As much as I can I also balance with open tests run on ZFC own volition. I try to rotate these open tests as follows;

- Test a product I think has a strong chance of being a genuine top product, or one that has been most requested by followers, or one that is bringing potentially new tech / new claims to the table worth a closer look.
- > Test a product for which I have the most concerns re marketing claims vs reality (ie Wend wax, Prestacycle One, Muc-off)
- > Test a product that is mid to low price common lubricant as a general benchmark.

VIDEO

To see how dry and wet contamination is added and to know a bit more about the test, go to the Zero Friction Cycling You Tube channel vid here;

https://www.youtube.com/watch?v=2soU9J0Z7hk

FAQ's

Q: Why are data updates infrequent?

A: As you can see each test takes significant time resources to run (a test can easily take 2months + if it goes deep and needs as set time after each re lube). Then there is the detail review to be done and cost to run modelling. And many tests each year are private for manufacturers – often as part of lubricant development – so this work goes unseen, and only private tests of production products that test outstanding greenlit to tear up NDA, as well as what open tests I can get done as well. Post each test machines need a reset, new parts, calibration etc – testing is EXTREMELY time resource intensive.

Q: Doesn't the test favor immersive waxes?

A: Yes – but that's just the nature of immersive waxing. For those whom immersive waxing suits (which is actually most!) – they simply enjoy some huge benefits for popping chain off and popping it into a bath of wax each re lube.

Low friction, and thus low wear lubrication of bicycle chain is effectively an open battle against contamination. X lubricant will absorb X amount of contamination over X time before next re lube and thus be X level more abrasive than what it was before. On a re lube with

a drip lubricant – as an average you will be adding about 3 to 5ml of lubricant onto chain. Your chain will likely be over 100 links long, so that is about 0.03 to 0.05ml per link fresh lubricant mixing it with whatever is in there already. There is only so much that can do to flush clean chain / improve the ratio of lubricant to contamination. It helps of course, but if I asked you to clean my chain and I gave you 0.03ml per link of something to do that, that then also was needed to lubricate chain – you would probably give me some sort of meaningful look. A look that says perhaps I should consult a medical professional. In the Psych department.

For immersive waxing, the re lube is rather more effective. The chain is going into typically 400 to 500ml of lubricant for a nice bath and swish around. Over time, as the chain brings a small amount of contamination into the wax – the wax will become more abrasive than a batch of fresh wax. But coupled with being a solid lubricant and thus highest contamination resistance possible – you can imagine how long it takes for the contamination level in hundreds of ml of wax to remotely look like what is happening on your few ml of lubricant at any one time on your chain.

If one doesn't want to wax but wants to get a similar thing happening, at the end of the day there is nothing stopping your putting your chain in a bath of oil. The oil will get much contaminated much more quickly vs wax as its oil, it will not have the contamination gathering resistance of wax, but – it sure will get a great reset vs just dripping some on. But... then you have a lot of excess to deal with, and it would be quite a mess.

But I hope all up that paints the picture of the challenge drip lubricants have to match day in, day out – the ultra low friction, wear and cleanliness of the immersive waxing option.

In reality of course most drip lubricant users will (I hope) be performing some level of periodic maintenance, but again this simply cannot be part of the ZFC test to assess the lubricants performance across the range of conditions, nor would I be able to assess its performance against marketing claims made.

And its worth noting that not all immersive waxes are created equal. One in particular tested rather terribly, and that will for sure not be the only case on the market – the market is now flooded with immersive wax products as many look to jump on the coat tails of awesomeness pioneered by the top products.

Q: Is there a conflict of interest as ZFC sells lubricants?

A: Simply no. The testing by ZFC is fiercely independent. Testing is extremely difficult to make any viable revenue or profit from. Even at a high test cost for the Mfg, the test time and labor is very high, and only a fairly small number of tests per year can be physically completed.

Simply for the open data and independent testing of ZFC to exist, there has to be a retail side.

And that works by simply we stock only the best products found from the testing! So it is literally just win win for everyone.

- Cyclists get the most robust and exhaustive independent data on a product so they can choose a proven product to suit their cycling
- > This data is open, and free.
- Manufacturers have the most robust test to put their own products through -pre or post production release.
- > This independent testing gets to exist.

So that's it – it is simple and open business model. We have a testing side which conducts testing for manufacturers as well as what other tests I can get to each year, and we have a retail side that stocks the best products we find from testing, and the retail side enables the test side to exist. And quite clearly, if there was a concern, then manufacturers would not book to test and be benchmarked!

And of course there will be many in the big wide world outside of Australia for whom purchasing from Aus and high international shipping costs just don't make sense. If it does and you wish to help support the testing work – then great. But if it doesn't, don't feel

obligated. You have the data and information to purchase a great product from a manufacturer that has worked hard to bring a genuinely great product to market, as opposed to literally hundreds or thousands of others that have only brought great marketing to market. So you can hunt the suitable great product down from somewhere in your area.

There are many other great ways to support the work at ZFC other than just making a retail purchase, that includes simply subscribing to Zero Friction Cycling You tube channel and watching any vids of interest, and sharing those with friends. Positively engaging with any other cycling media you come across that features or references ZFC work, letting your friends know about ZFC work etc – all of that really helps everyone.

Q: What other testing does ZFC do?

A: ZFC has ploughed into a fair bit over the years! 28 different chain models have been tested for wear durability (so as opposed to control chain and testing lubricants, a control lubricant on different chains). We have done a good bit of tensile strength testing, currently working on testing chain prep products, hope to get to chain maintenance method test soon, as well as we have numerous other chain models not to try to get to testing for wear life and tensile strength. Component wear durability is also on the hopeful list to try to get to.

In short – ZFC is always working hard to add a lot of great information into this space that otherwise would not exist.

Oh – and where possible the lubricants tested through the main test are tested for single application longevity. This is running rather behind, and also I tend not to bother testing most of the poor performing lubricants as it is really a waste valuable test time resources – I don't really care how long a lubricant treatment lasts if it is a poor product that will never be recommended.

We also have a good amount of outright chain efficiency test data from Ceramic Speed Denmark research lab. Yes it is a problem that this is not independent, but it is the best data we can get at this time. I am always looking for an investigating other test facilities that may be able to provide accurate efficiency loss data to complement the zfc wear test data, as having that independent loss result as well would be a great addition.

Q: Manufacturers - How do I go about getting my lubricant tested?

A: Send an email enquiry to info@zerofrictioncycling.com.au and I will send out the base template information regarding booking in a test. But before that, really take in the ZFC test protocol and think how will your lubricant perform once the contamination starts. I encourage extensive field testing to be very confident of your products performance before booking in a test with ZFC, or it can be some good \$\$\$ in test cost to receive a disappointing result, which is no fun for everyone. But if your product is looking to be a winner after your own extensive testing- then benchmarking it against the biggest open league table could be a great outcome.

Q: DIY'ers – can you test by beeswax / paraffin / lanolin / carnauba / paraffin oil / xylene / moly / ptfe / ws2 / graphene home blend, I think its amazing

A: Alas no – I have tested a good candle wax base, and I hope to also test a food grade paraffin base – but that will be it for DIY waxing. It is an area that could never be satisfied by ZFC testing as I will never be able to test all the DIY blends requested. Ie oh groovy you tested that Gulf canning wax + ws2 blend, but what about my X paraffin + 5% beeswax + graphite? Add 50 more combinations of this as you get an idea of my DIY wax testing enquiry week.

And whilst I think many DIY'ers can make a great DIY wax a) Overall DIY making ones own wax or lubricant is a very small demographic in cycling, b) of that very small demographic there are endless blends of "the best" DIY wax, c) You don't need ZFC validation. If you believe your DIY blend is all that and a bag of chips and you are really happy with it, be happy with it and be at peace. Over time if you

wish you can pit your DIY wax blend vs a commercial immersive wax across multiple chains each, accurately tracking wear rate data, being as fair and as even as you can regarding re wax intervals, riding conditions, types of riding workout etc to reduce the typically pretty big real world ride testing variance (as really you are not controlling any key variables).

It is a fun area for many, and some have a great product, some make a gunky mess following some wacky crap on TikTok or Instagram. But sadly ZFC will not be devoting years of test machine time and resources to testing endless DIY wax blends, and I hope it makes sense why. It is hard enough to have capacity to be there for manufacturers who need testing as there a very few options for them to independently have their products tested (in a test that actually means anything) – and it is important for manufacturers genuine about their products performance to be able to have independent testing. And outside of that, there is just so much work to be done re commercially available products that is going to be of much higher information value to oh so many more people – so we have to focus on what is the greatest good for the greatest number of people vs focus on a very very niche segment. Hope that all makes sense. In short – do your own testing and enjoy they whole journey of it

