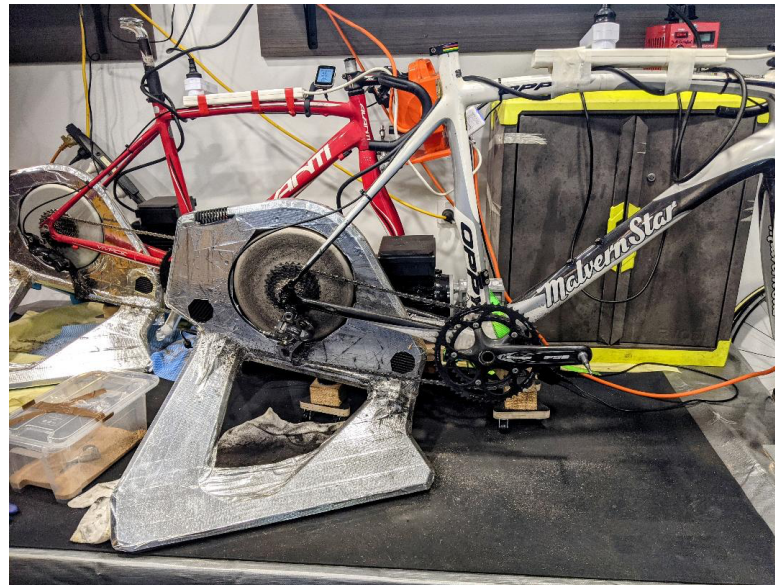


# Zero Friction Cycling

*Worlds most exhaustive independent bicycle chain lubricant and chain testing – over 300,000km of controlled testing to date.*



**Video demonstration ZFC test contamination**

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

## Lubricant On Test : Muc-Off Ludicrous AF

Cost: \$89.90 Aud from online stores.

Size – 50ml



Photo :

Manufacturers Description on package;

## THE WORLD'S FASTEST RACE LUBE HAS LANDED AND IT'S LUDICROUS AF!

Tested and refined over the last three years by the industry's leading tribologists, Ludicrous AF has been pro-peloton-approved for taking speed and performance to an entirely new level. Thanks to their state-of-the-art R&D facility, our Muc-Off boffins have created a true masterpiece – an ultra-low-friction, highly durable lube which allows you to go harder and faster for longer than ever before. Basically, it's fast as f\*\*k

### PRO-PELTON-APPROVED

Developed with INEOS Grenadiers, EF Education-NIPPO and deployed on the Olympic stage, winning 6 gold medals in 2021. Ludicrous AF has been built to take on all conditions at the highest level of racing. Tested during the 2020 season and perfected for 2021, this badass lube has already taken multiple podiums and an overall win at the 2021 Giro d'Italia.



### A BEAST OF A BLEND

For Ludicrous AF, simplicity is king. It's all about a few essential ingredients, that are dialled-in to work together in perfect harmony. This is a race lube after all, so it's a pure, stripped back performance focussed bottle of speed. That means no colouring, no fragrance and no additional corrosion inhibitor. Just a unique blend of environmentally friendly raw ingredients designed to minimise chain friction and wear – so you can put some serious power down, mile after mile!

# EXCEPTIONAL SCIENCE

## EXCEPTIONAL SCIENCE

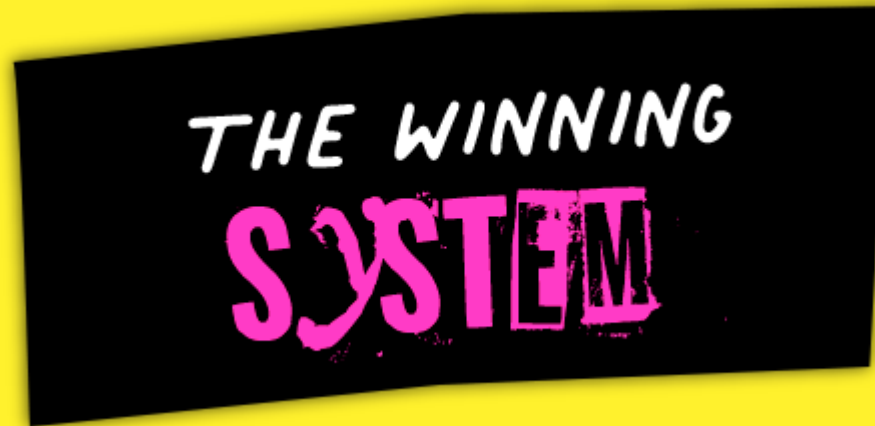
Ludicrous AF changes the game. When applied to a chain, it penetrates chain link scars to create a sheer plane – which means more speed! The molecules in the formula charge up, which helps to accelerate both chain and rider by reducing friction and power loss.

The proprietary additives contain synthetic polymers, which are designed for long-distance performance. This means class-leading low levels of wear on chain components, making it super-fast and super-durable. This provides unbeatable performance in both wet and damp or dry and dusty conditions at a range of temperatures. All in all, it hits any other competitor chain lube or wax out of the park

# FAST AS F\*\*K

### **FAST AS F\*\*K**

When developing a chain lube for the world's fastest riders, nothing but the best will do. We formulated Ludicrous AF to be liquid lightning to help our teams and riders win at the highest level. As we know, less friction means more speed and better shifting efficiency, which is what Ludicrous AF is all about. The drivetrain is often overlooked in the search for speed, with gains from wheels, tyres and clothing taking the headlines – Ludicrous AF is the lube to make the world sit up and listen!



### **THE WINNING SYSTEM**

We work with the top teams in professional cycling and triathlon, providing them with optimised chains that are often the difference between winning and losing. Our motto: Treated chains = performance gains. We receive hundreds of chains from teams around the world. They're cleaned multiple times using our state-of-the-art Ultrasonic Tanks and specially formulated cleaner, before being dried, and then optimised on our 'dyno'. We then give them a thorough coating of Ludicrous AF before packaging them up in James Bond-style briefcases and shipping them back to the world's best, complete with testing data. We'll soon be making this process available to everyone – more on that in the coming months!



## SMOOTH OPERATORS

### **SMOOTH OPERATORS**

With Ludicrous AF, shifting is smoother than anything else you will have experienced before. With its easy application, you'll be able to hit every contact point of the chain for a super-smooth ride. The viscous formula reduces chain noise and rattle for stealthy shredding – who doesn't love a quiet bike? We've even gone to a molecular level with our in-house contour white light interferometer, to study how the lube beds-in to the chain, giving you turbo-charged performance.



## SUSTAINABILITY BUILT IN

### **SUSTAINABILITY BUILT IN**

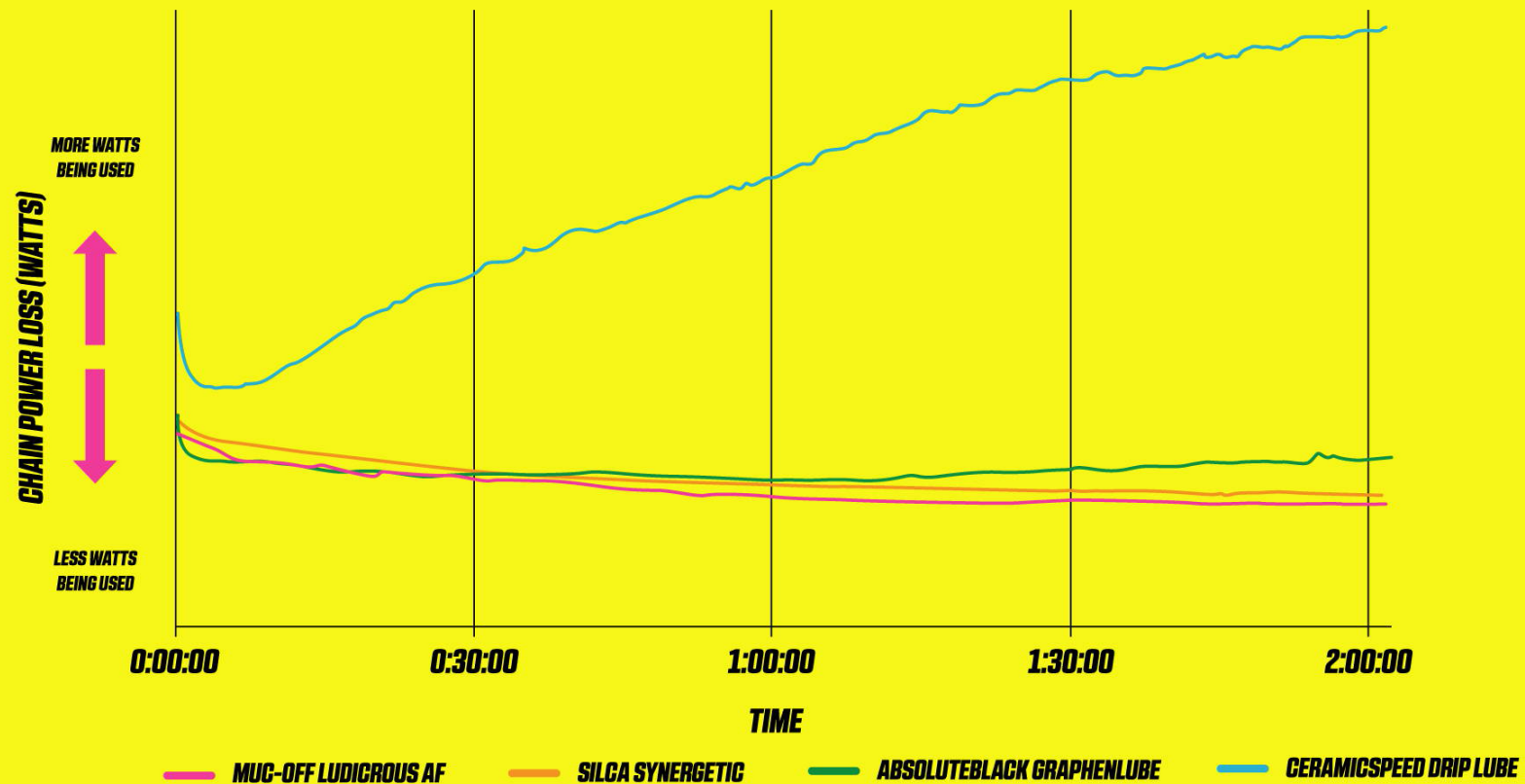
The Ludicrous AF formula is non-toxic and readily biodegradable, so you can prep your chain ready for racing, guilt-free! In wet conditions or when a bike is being cleaned, naturally, some lube will get washed away. Unlike other competitor lubes and waxes that often contain harmful ingredients like PTFE, Ludicrous AF won't leave a toxic oily mess that damages the environment. That's not all, Ludicrous AF will also prolong the life of your chain and even bring it back to life. The lubricant continues to improve with chain run-in due to continued surface improvement at a molecular level, so you can minimise your environmental wastage by using an existing chain, whilst maintaining the same incredible levels of performance.

## 2 HOUR TEST ON NEW CHAINS

**5% MORE POWER REQUIRED IF USING SYNERGETIC OVER LUDICROUS AF**

**18% MORE POWER REQUIRED IF USING ABSOLUTEBLACK OVER LUDICROUS AF**

**195% MORE POWER REQUIRED IF USING CERAMIC SPEED OVER LUDICROUS AF**



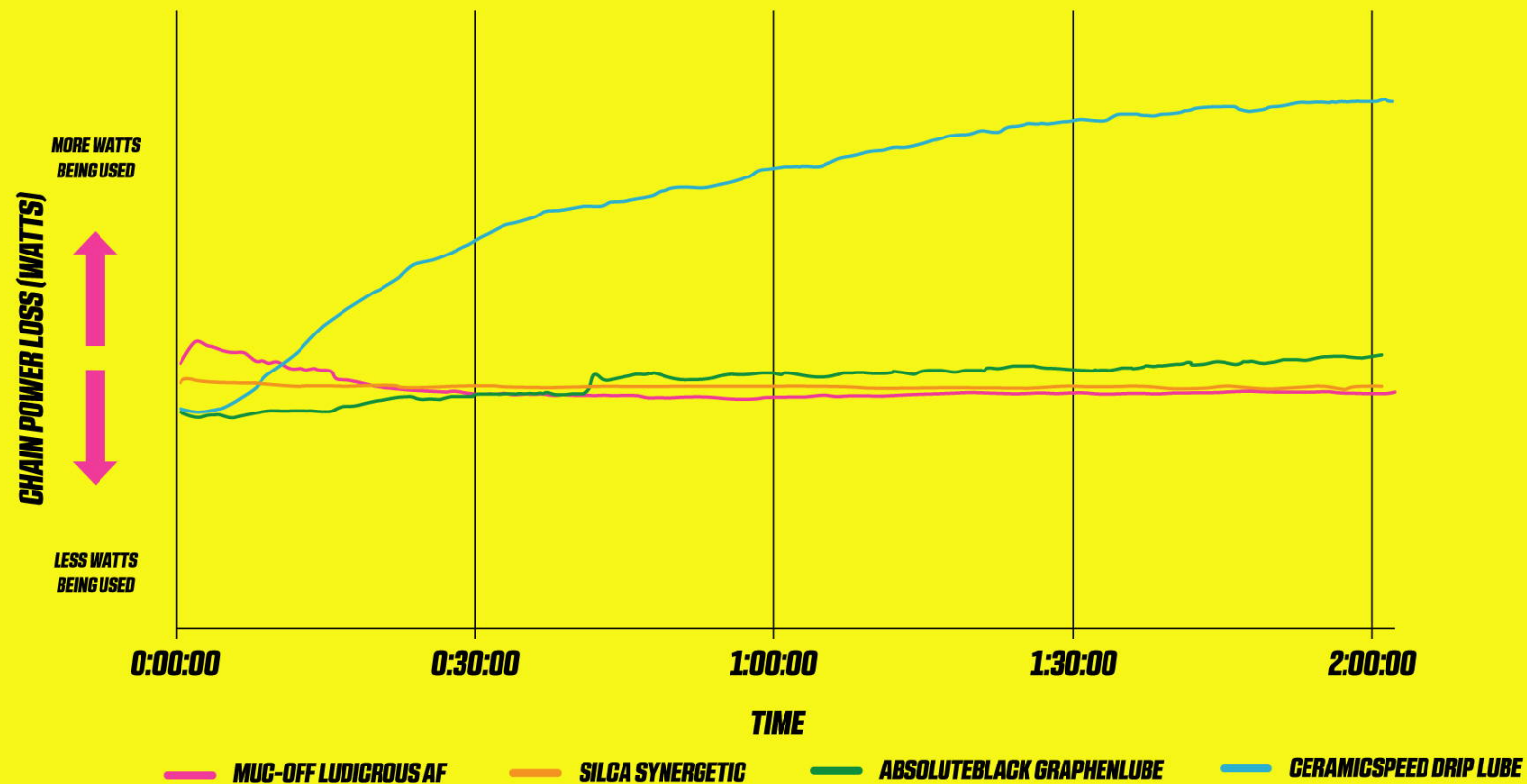


## 2 HOUR TEST AFTER 6 HOURS AT 300 WATTS

**3% MORE POWER REQUIRED IF USING SYNERGETIC OVER LUDICROUS AF**

**15% MORE POWER REQUIRED IF USING ABSOLUTEBLACK OVER LUDICROUS AF**

**124 % MORE POWER REQUIRED IF USING CERAMIC SPEED OVER LUDICROUS AF**



# ZFC REVIEW

Before start the review – I need to cover a bit re lubricant testing and claims.

As a prelude however, I will advise that Ludicrous AF tested **EXTREMELY POORLY** in the ZFC, demonstrating **extremely rapid wear rate** of the test chain.

Some aspects around this need to be discussed first, as Muc-Off are contesting that wear rates can be linked to a lubricants efficiency.

So before presenting you with data and my opinion / conclusions from my test data, I am going to need to quickly cover Muc-Offs contention re wear rates and efficiency losses. I think it is important for you to take into account what Muc-Off has put to myself re wear rates and efficiency losses, and my initial response and questions back to them which need further input. This outline will give Muc-Off's input a fair hearing until such time as I can attain further answers, and yourself to have a fair shot at making your own call with regards to are Muc-offs claims valid and you should disregard ZFC testing results, or if you think that the ZFC tests results are highly indicative of the lubricants performance in real world riding.

Now if you hadn't already seen, outright efficiency testing for lubricants is currently a huge mess – something i cover in detail in the you-tube video below. So if you want to bone up on what is the current state of play here, and why I use wear correlation testing to begin with – watch that video below vs me typing out a whole bunch.

<https://www.youtube.com/watch?v=aROF7EFSgXc&t=1623s>

Welcome back from the video, hope that explained ok the current basket case that is.

Now I need to quickly cover off Muc-Off contesting the wear rate correlation that I use for ZFC lubricant testing results. I am obviously biased here, but I promise to be absolutely faithful re what was put to me by Muc-Off in a recent call to discuss testing and results – I did not get to drill down further with them on this topic when raised as a I wished, the call was moved on to tribology testing, and so I have sent them a whole bunch of points I need them clarify for me to help substantiate their case.

Let's step things out. Firstly, in case you didn't watch the video, a quick recap on what I claim the ZFC test protocol, using wear rate correlation, is able to assess for lubricants put through the main ZFC test protocol;

- Any initial penetration issues present? (ie high wear in clean block 1, or very low wear – clean block 1 is basically like ergo riding / very clean road conditions riding – the lubricant should record very low wear rate here unless there were issues penetrating to the pin. ie a 20% wear rate result is bad. Sub 5% is great).
- Dry contamination resistance / performance . Block 2 the chain is hit with numerous rounds of dry contamination. How does the wear rate change vs block 1. Does it increase notably (showing high absorption of abrasive contamination, make the lubricant not the best choice for dry off road riding), or is there only a minor change in wear rate vs block 2 demonstrating very high dry dust contamination resistance.
- Block 3 moves to a clean block again, no further contamination is added. As there is no cleaning of the chain through the main test, the wear rate in this block shows the lubricants ability to clear contamination absorbed during block 2. Some lubricants show a large jump in wear rate in block 2, and hold that higher wear rate in block 3 showing no ability to clear contamination. (many lubricants claim to “clean as they lube” .....). Some lubricants show

a notable increase in block 2, but then a tangible wear rate reduction in block 3, showing some level of clearing some contamination.

- Block 4 moves to wet contamination to assess lubricants ability to perform in harsh wet conditions, and typically very large increase in wear rate vs previous blocks is seen in the block 4. Block 4 spells doom for many a lubricant.
- Should the lubricant survive block 4, block 5 is again a clean block to give it a chance to re-set, and the final block 6 is an extreme contamination block to really try to kill it dead.

So with the alternating clean and contamination blocks, and the differing contamination blocks, by tracking the wear rate changes we are able to ascertain a very full picture of the lubricants performance across a lot of cycling conditions / demographics.

I will circle back to this point shortly, but whilst I'm here, if a lubricant for instance shows a wear rate of 8.9% in clean block 1, and then in dry contamination block 2 the wear rate increases to 78% - it is pretty clear (in ZFC opinion), that the wear rate change is due to the lubricant absorbing a lot of the abrasive contamination. If the wear rate – which is wearing through hardened steel parts of the chain – has greatly increased, due to being more abrasive, due to absorbing contamination, ZFC position is that this SIMPLY MUST correlate with an increase in friction losses over its block 1 result.

This correlation is agreed upon by numerous other industry heavy weights, and heads of other major manufacturers, whom after reviewing the ZFC test protocol and how the test data correlates to likely real world performance of the lubricant, have then booked in testing, often a lot of repeat testing – with ZFC. Quite a number of the most experienced and smartest people in the cycling industry absolutely agree that these changes in wear rate will correlate to how the

lubricant is performing. As does as best as I can tell all cycling media who are familiar with ZFC testing. And to date, after 5 years +, despite being emailed by countless cyclists who are engineers, scientists, chemists etc etc who have reviewed ZFC testing and data, not a single one has emailed in a concern re the test protocol and wear rate correlations. I had actually expected to be hit with some armchair trolls across this period, I have been pleasantly surprised, I have had no left field counter arguments yet.

Ok, that is ZFC position and foundation part 1. I have more after I put Muc-Off position forwards.

### Muc-Off's contention of wear rate correlation



During the call with head of Muc-Off's test lab, he demonstrated some data that they have, as well as some very high tech imaging from tribology testing of the metal surfaces of key load components (pin) of chain.

- Their test data shows that chains treated with Ludicrous AF (henceforth to be called L.A.F) are initially very fast, but that the chains continue to get faster with subsequent re optimised treatments
- The images presented appeared to show very clearly that the surface condition of metal was markedly improved. (Chain parts under high magnification will look surprisingly rough, and with conditioning the peaks and troughs and be smoothed out for a lower friction surface, this is why Fully optimised race chains typically have a specific break in, Silca use a diamond slurry polish etc).
- Hence Muc-Off state that with L.A.F, it is clear that the chains continue to get faster and faster as they wear, and hence the ZFC wear rate correlation showing increase friction losses is not always going to be correct, and is not correct in the case of L.A.F.

## **ZFC counter to the above contention;**

Alrighty, the points I am about to cover below are a shortened version of what I have sent to Muc-off to address specifically. To uphold their contention, in my opinion they need to address these points individually, in detail, no surface level fluffing.

## Part 1;

- Conditioning metal takes friction. If one sets about conditioning metal – so physically removing peaks to improve surface smoothness – with a frictionless cloth, nothing will happen. To abrade through some steel, takes some level of friction.
- For instance Silca use a diamond slurry to do the chain metal conditioning for their wax race chains. Once the conditioning has been completed and chain ultrasonically cleaned, they moved to a very low friction lubricant.
- They are not going to use the diamond slurry as both the conditioning agent, and as the low friction lubricant.
- At this time, I cannot think of another example in either cycling or industry, where what is used to surface condition metal is the same product as is used as the lowest friction lubricant choice post conditioning.
- The only exception to this really is products that ADD nano particles to fill troughs / fissures – ie lubricants with tungsten disulphide which are to bond to chain metal and improve surface via a very low friction additive process. This is a completely different approach vs conditioning via abrading through metal to a degree that will show up as chain wear. Again, abrading away hardened steel simply MUST take some friction, there really is no way around that.

- During conditioning, metal is being removed to improve surface smoothness. Where is this metal going? Obviously it is becoming part of the lubricant. I cannot see how one would deliberately add steel particles – regardless of how small – to their lubricant as a method improving its lubricity.
- Muc-off Data – I can see how chain is cleaned and treated with L.A.F and is X fast. It is then raced, brought back, ultrasonically cleaned and re treated with L.A.F and it is now faster, despite chain now showing some wear. But what was it pre being re treated? This question becomes more pertinent when I bring up part 2.

## Part 2;

- In the ZFC test, L.A.F showed a hugely increased wear rate in dry contamination block 2, moving from an ok 8.9% wear rate in clean block 1, to a 78% wear rate in block 2. The dramatic increase in wear rate in block 2 is clearly attributed to L.A.F readily absorbing the dry contamination. I do not see that this point can be contested. If I do not add contamination, block 2 results are very close to block 1 results with the exception of lubricants that have significant penetration issues, in which case the wear rate improves. Such a large jump in wear really can only be attributed to the presence of abrasive contamination absorbed by the lubricant.
- Readily absorbing dust / contamination and increasing the lubricants abrasiveness, and its ability to abrade through hardened steel faster – ZFC believes this is rather convincing of a notable increase in friction losses. I would like Muc-Off to explain how this is not the case. This is not X amount of wear showing up due to the metal being conditioned, this is a large amount of wear showing up because abrasive dust is now part of the lubricant.



- Muc-Off lubricants tested to date, including L.A.F, have shown the poorest results of all lubricants tested with regards to readily absorbing contamination. Not only does this show up very clearly in the wear rates, but it is also very obvious during the test, with lubricant sounding very very much like all contamination added is soaked up and now part of the lubricant. And the chain certainly feels like it when handling between intervals.
- Compared to top tested wet lubricant to date, L.A.F wear rate in block 2 was 4.2 times greater than Silca Synergetic. That is like, a lot. Compared to the top chain coating lubricants (UFO drip / Silca SS Drip / Silca Hot Melt / Mspeedwax) that have exceptional resistance to absorbing dry contamination, L.A.F is over 15x the wear rate.
- Ok – so you have need to bet your bikes on which lubricant is lower friction. One that recorded a sub 5% wear result in block 2, or one that abraded through literally millimetres of steel to use up 78% of its 0.5% wear allowance.
- ZFC states that a notable increase in wear, directly linked to how much abrasive contamination is absorbed by the lubricant, will directly link to a correlating increase in friction losses for that lubricant over its clean performance baseline. The larger the increase in wear over baseline, the larger the increase in friction losses.
- The dry contamination block is harsh enough to ensure a measurable change in lubricants performance, it is not unduly harsh vs what many offroad riders face in their own worlds of dirt and dust. It will be harsher than some, less so vs others. If a lubricant performs very poorly in block 2, it is not a lubricant ZFC can use for offroad use.
- This will carry over to a degree to road riders as well. There is more airborne dust than you think that you do not see. Shine a good bright torch into the sky and night and watch what floats through the beam. Your chain is whizzing through the air at high speed when you are riding, and especially for wet lubricants, any particles of dust

that come into contact with the lubricant stick on contact and become part of the lubricant. The greater the resistance to becoming contaminated by airborne dust, the lower friction the lubricant will remain.

- I am often asked – “what is the best lubricant” – and my main answer is the one that will REMAIN the lowest friction for the type of riding you do. It is no good having a lubricant that is fast in a clean lab but readily becomes an abrasive paste once you starting riding it outside.
- Muc-Off L.A.F became extremely abrasive in the ZFC test. Based on the wear rate data for L.A.F vs its main competitors, it is clear to ZFC that users of L.A.F vs those competitor products, cyclists would wear through multiple chains, cassettes and chainrings on L.A.F per one chain for competitor products.
- Example – at the end of main test, 6000 km’s – comprising clean block 1, dry contamination block 2, clean block 3, wet contamination block 4, clean block 5, and extreme contamination block 6 – Ceramic Speed UFO drip had used 92.2% of its 0.5% wear allowance. Muc-Off L.A.F, at the end of only 2000km and at the end of only dry contamination block 2, had used 89.6% of its 0.5% wear allowance. It had not seen the much harsher 1000km of wet contamination block 4, nor the 1000km of extreme contamination block 6, nor the other 2000km of running in between with whatever level of contamination was absorbed during those very harsh conditions. To reach the same 6000km in main test, I would have needed to use AT LEAST 3 chains, likely more as wear rates in block 4 are normally around double vs block 2, and block 6 can be double block 4. Realistically L.A.F would have needed 4+ chains, and at least one further cassette to reach end of main test. And the rings would have been badly worn. At the end of main test for Ceramic Speed UFO, the cassette was perfectly fine for another chain, and the rings had minimal wear, they would be able to see 3 to 4 chains easily on UFO drip despite the harsh conditions of the test.

- Until Muc-Off can explain to me otherwise, ZFC stands by the physics that the much lower wear lubricant is going to be the much lower friction loss lubricant in your cycling.

So at the time of writing this detail review – that is ZFC stance re Muc-Off contention re the link between wear rate correlation used in ZFC testing not being an accurate indicator of lubricant efficiency performance. I have sent all the above, and more questions, and requests for test data, and full test protocol (we really need to see some test data of L.A.F chains post harsh conditions / offroad events and also for control chains for team riders in same event on competitor products – before any cleaning or intervention like re lubrication has taken place, and I would like to see same from Ceramic Speed lab for second set of efficiency data).

Obviously, personally I cannot fathom how a lubricant that is abrasive and merrily eating its way through hardened steel at a prodigious rate is going to be the lower friction option vs one that is delivering extremely low wear rates.

Aside from the readiness of L.A.F to absorb contamination and become much more abrasive, i have severe doubts re the product that can condition chain metal is also going to be the lowest friction option outright, vs one product to condition the metal, an another whose sole job is to be the lowest friction lubricant. I just cannot see how this is not a flawed approach. The only other lubricant I can think of that tried this angle was Pro-Link Gold, and that was resoundingly proven by Friction Facts to be high friction and abrasive. How do you abrade metal without using more friction than if the products job is not to abrade metal?

Perhaps L.A.F is in itself in a clean lab test quite fast (very low stiction, viscous friction, high pressure performance etc) – I contend it would be faster yet again if its brief also didn't include the need to abrade metal. A lubricant conditioning metal surfaces via low friction modifier additives filling in troughs I can understand. Having your lubricant also have the job of removing peaks I do not understand.

### **The Prosecution rests, for the moment.**

Ok, so on the surface that may look like a pretty poor crack at a fair presentation of both side's arguments, with my side take up quite some more typing! However, I can assure you I put forth what M-O put to me on the call, and that things just did not get any deeper than that before things skipped on to the next fancy machine. As such, M-O have received all the above points & questions and more, so they will have full opportunity to clarify for us all why they are correct and I am incorrect – and assuming they respond – this document will be updated / their response added etc.

Also this detail review will be sent to them for review and their comments if they provide, added to the review, as is, unedited.

I look forwards very much to their response, because at the moment for them to be correct and ZFC incorrect, I am looking for them to re-write some physics, so that will be quite something. But it is always possible that I, and also a whole bunch of people with vastly greater IQ and experience than me, have missed something. I would love to know what that is so that I am not missing it any more. To always learn is to always stay young! So M-O, learn me up.

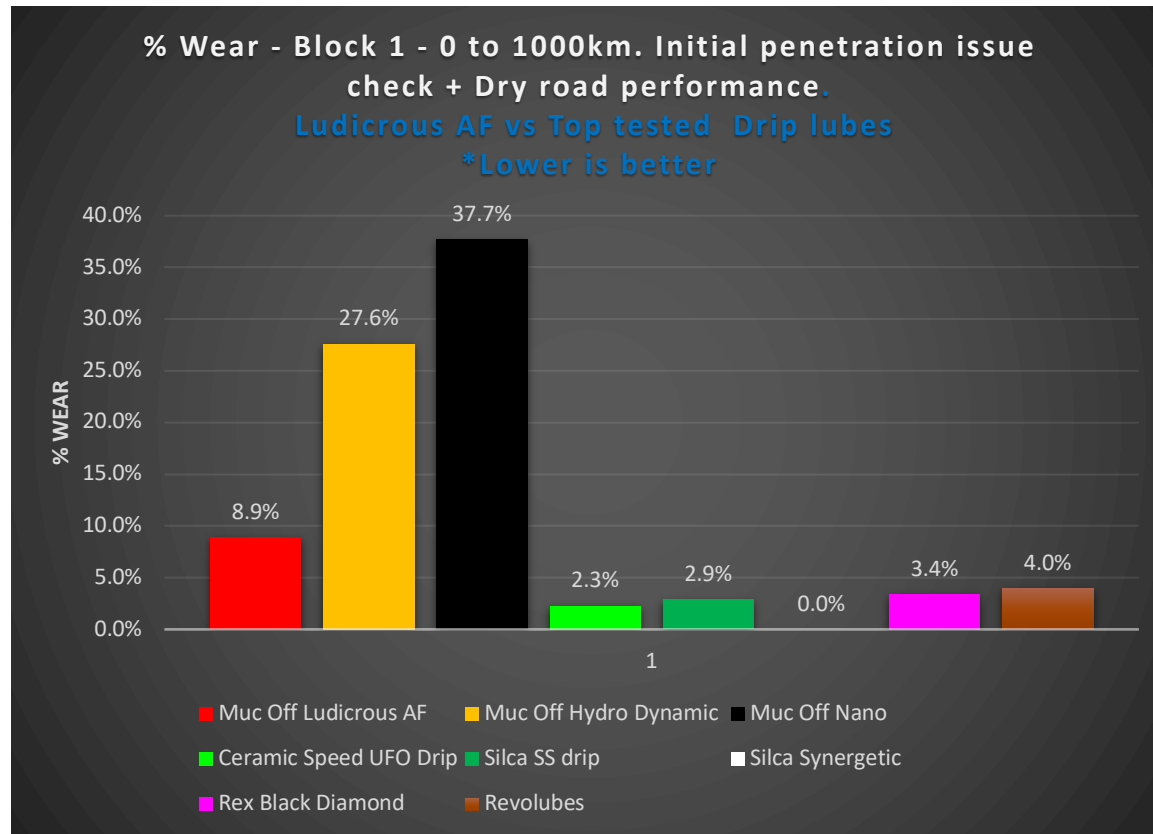
Till further info from M-O, the above is best summary of both cases I can present for you to make your own decision around whom is likely correct, and should you choose very low wear lubricants for a low friction option, or a really high wear metal conditioning option as your low friction lubricant. I know what I would do, you know what option I am going to strongly recommend you do, but – it is very important as an independent test facility to provide you with both sides of the coin as best I can, and I need Muc-Off to put a lot more information on their side of the coin, because in lieu of that, I'm sticking with physics.

It may not be lost on you (it isn't on me) that the manufacturer with lubricants that have continually demonstrated extremely high wear rate results is advocating that wear rate correlation testing to friction loss performance is not valid. And that this is as best I can tell an isolated stance, again with many industry leaders fully believing and backing the ZFC wear correlation testing. I believe the burden of proof to be on M-O to show why the above points are incorrect – and for that we need some REAL input, not marketing.

Alrighty, hard part done, to the actual test results – this next section will be a whole lot shorter and easier overall since really we have covered it above, but scroll to next page to get to the test data.

# Ludicrous AF Main Test results

Block 1 – 1000km, no contamination.



The good news is that unlike Muc-Off's previous two lubricant tests, Ludicrous AF is at least not terrible in block 1.

Whilst the clean block 1 results are not bad compared to many decent lubricants like Nix Frix Shun, we can see that it is still multiple times higher wear rate result vs the top drip lubricants tested to date.

Such lubricants are of course Ludicrous AF's key competitors in this space.

Overall for block 1 this puts Ludicrous AF basically mid pack out of all lubricants tested to date, which again, whilst not terrible, when we factor the extremely high cost of the lubricant at \$89.90 aud for a small 50ml bottle (Silca SS drip is \$55 for 120ml, UFO drip is \$55 for 180ml), I think most cyclists would have expected a result at the top end of town, but that is of course not factoring in the "Conditioning" that L.A.F is apparently doing.

The amount used per application for Ludicrous AF is also fairly high, about 3ml minimum if being extremely careful, but will more likely be around 5ml, so you will go through a very expensive bottle very quickly vs SS drip / UFO. You will go through many bottles of Ludicrous before one would even make a dent in their bottle of Silca Synergetic).

As such even if you were to ride in perfect dry road conditions, the still moderate component wear rate coupled with the extremely high product cost + usage rate, has Ludicrous AF drivetrain cost to run modelling coming out as very expensive indeed – it is basically 4x plus the cost to run vs Ceramic Speed UFO on a dura ace drivetrain in dry road conditions (selected as an example as Muc-Off often benchmark their performance claims vs Ceramic Speed UFO).

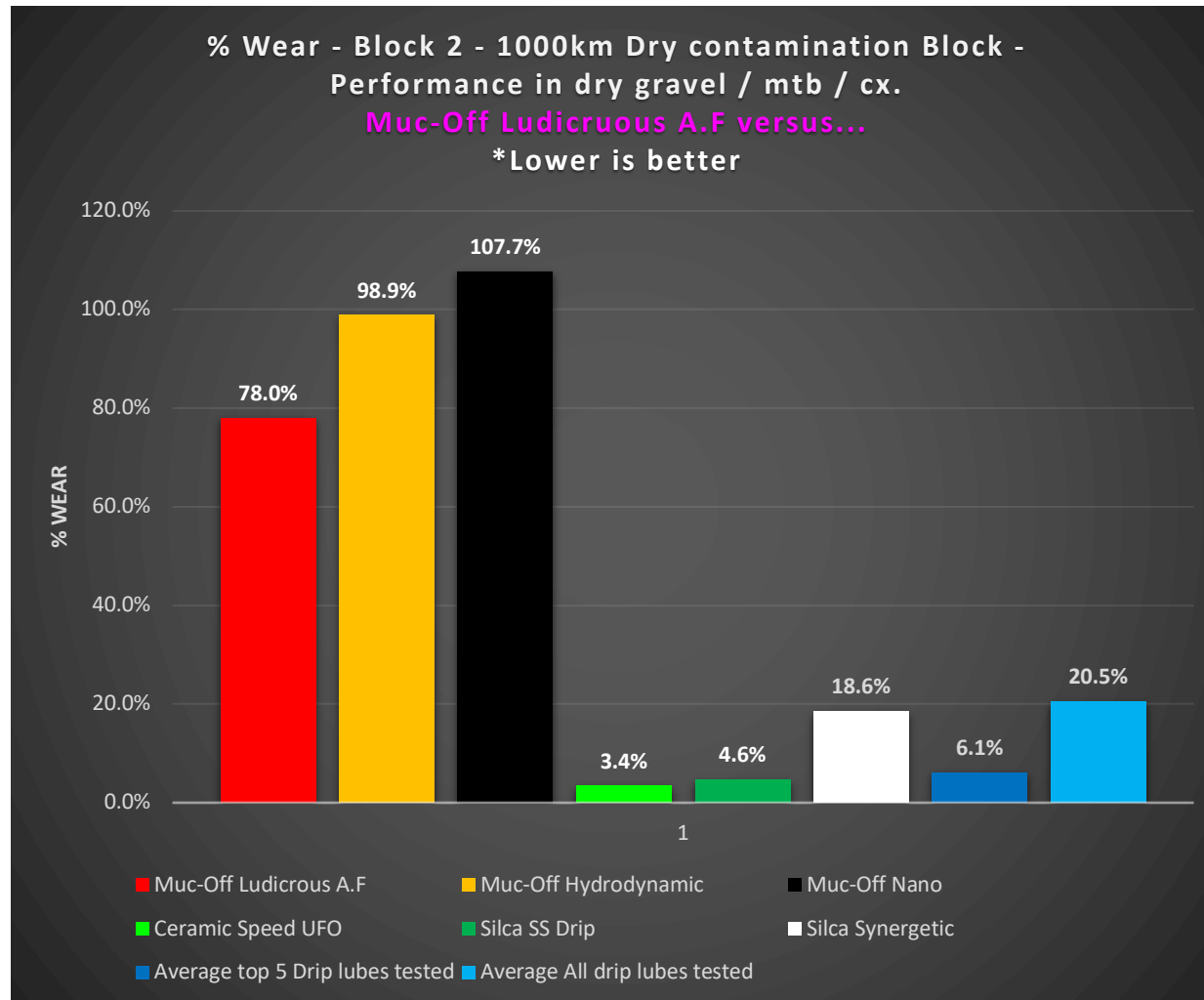
Muc-Off Hydro Dynamic and the very expensive Nano Lube – their previous top race lubricant before Ludicrous AF, remain by far the two highest wear rate products ZFC has ever tested. It is good to see Ludicrous AF improve on those at least, but room for improvement indeed to catch key competitors in outright performance, and Ludicrous AF is still the 3<sup>rd</sup> highest cost to run lubricant tested to date, only beating its own two worst ever tested products of Hydro & Nano. That is not a great trifecta from ZFC perspective.

It is worth noting also that clean block 1 in ZFC test is easier vs most dry road riding as the test environment is cleaner vs outdoors. Depending on where you live / ride – you will be surprised just how much airborne dust there is, and as we will see in the next test block, Ludicrous A.F is nothing if not keen to absorb every particle it can and become more abrasive.

It would be expected that most will experience a higher wear rate in clean dry road riding compared to the wear rate attained in clean block 1 of the ZFC test. I do not normally make a point of comparing clean block 1 vs outdoors, however in the case of Muc-Off wet lubricants – their propensity to absorb any contamination is simply much higher than other wet lubricants tested. Wet lubricants that show a more “normal” contamination gathering rate – I do not believe users will see to much difference in their dry road riding wear rates vs block 1. However in this case I believe L.A.F has a reasonable chance of showing a tangibly greater wear rate when even a low exposure to contamination is present. I believe at this time for most the cost to run modelling for L.A.F based on its clean block 1 result is on the generous side.



## BLOCK 2 – Dry Contamination – Performance assessment for dry gravel / Mtb / Cx riding.



I think the above graph simply says so much about, well, everything that is the concerns re Muc-Off L.A.F.

- Ludicrous AF wear rate was 22.9 times greater than UFO drip and 17 times greater than Silca SS drip. Due to also much higher cost of the lubricant, running your drivetrain on Ludicrous AF in the world of dirt and dust will be more than 17 or 22 times more expensive vs its key competitors. That is like, a lot. A lot a lot a lot. To be kind on Muc-Off I have not reached for a Thesaurus to try to find suitable adjectives to truly describe the performance difference here between L.A.F and its key competitors. But, yeah, its like, A LOT. It's a lot vs other very average lubricants tested, let alone vs the highest performing tested.
- I know the above numbers really speak for themselves and this is a completely superfluous bullet point, but such a frankly ginormous performance difference between lubricants that are fighting to take the position of worlds fastest bicycle chain lubricant – it should not be possible. It was all covered in the initial pages of Muc-Off contending that wear rates do not correlate to higher friction, but I am sorry, I will bank my money on the lubricant with the 17 or 22 times lower wear rate to be the lower friction lubricant in the world of dirt and dust.
- Even if by some physics busting phenomena yet to be forthcoming L.A.F was somehow faster (and that is the biggest IF I have typed in my life), who could afford to run those wear rates if you ride offroad?! Unless you get your parts for free (and very often...) – who could afford it?!
- Ludicrous AF demonstrated a wear rate 4.2 times higher than the best performing WET lubricant to date in this test block (Silca Synergetic). This may seem small after reading the above, but it really isn't. If one (VERY EXPENSIVE!!!) lubricant choice is going to eat through your lovely drivetrain 4x faster than the top wet lubricant choice, unless you

have money to burn, instead of buying 4 new drivetrains to the other lubricants one drivetrain, would you rather not spend that on other fun stuff like new helmet / kit / shoes / glasses that you may have been coveting. Or a new set of wheels. Or a cycling holiday. I know what I rather spend my money on.

- Ludicrous AF demonstrated a wear rate 12.8 times greater than the average of the 5 top drip lubricants tested to date. It is 30x greater if I factor Silca Hot Melt and Mspeedwax into the results for top 5 lubricants outright tested to date. They are frankly nuts numbers. I cannot imagine when I am typing such comparative numbers again.
- Ludicrous AF demonstrated a wear rate 3.8 times greater than versus the average of **all DRIP** lubricants tested to date (higher again if factoring in Mspeedwax and Hot Melt). And there are some shockers in that average. Again to be 3.8 times greater wear than the average of all. It is just a really, really bad result.
- If you think I have gone too hard re wear rates here, take a moment to think of....
  - Cassettes like axs road cost around \$700 for Red level. Chains over \$100. Chain rings if you have integrated power meter at around \$1500.
  - Xx1 cassettes can easily cost around \$800, and xx1 chains \$150 to \$170
  - Cost of XTR 12 cassettes around \$600 as less hardy against wear vs xx1.
  - It will be less traumatic on lower tier / cost components, but less traumatic is a long, long way from great.
  - Remember the above wear rate comparisons re Muc-Off's contention that wear rates and friction losses do not necessarily correlate. I am again going to state, that especially when the wear rate is due to absorbing contamination, they really do correlate. And the wear rates are just SO MUCH HIGHER.
  - As my test is wear rate correlation based, when a test records exceptional wear rate numbers, it is going to elicit an exceptional response from me in the review.

The only lubricants ever tested with a worse wear rate are Muc-Off's Hydrodynamic and Nano lubes. I do not understand why Muc-Off lubricants so readily absorb contamination vs any other lubricants. I feel this property simply MUST be known at Muc-Off labs. This feedback is not difficult to find in reviews for Muc-Off lubricants, and I am positive their athletes would be feeding this back. Especially offroad athletes. I have a guess as to why, note however that this is simply a guess, and so I look to Muc-Off to advise I am incorrect, but as the situation is long term across multiple of their top wet lubricants – it is time to put forward the only explanation I can think of at the moment.

- As per the video covering Lubricant efficiency testing, it is firmly believed that Muc-Off conduct their efficiency testing using only Full Tension Test machine, not Full Tension Test + Full Load Test machines (if you are confused, stop, watch this video which will make this section all clear - <https://www.youtube.com/watch?v=aROF7EFSgXc&t=1623s>)
- Many lubricants – especially many waxes – can experience run away efficiency loss results when tested for longer periods on FTT machine only.
- Some lubricants are not affected at all by long runs on FTT machine only.
- If a company is going to test just using an FTT machine, and they note this gives really bad results for some competitors, it would be best to use a lubricant base that is not affected by long runs on an FTT machine so that their efficiency test results look comparatively great.
- My guess is Muc-Off use a base that is not affected, but this base absorbs contamination extremely readily.

- I cannot yet think of another reason behind why from Team Sky Hydrodynamic, to Nano chain lube, to Ludicrous A.F – that we see such high contamination absorption and such phenomenal wear rates – which they must be aware of, and yet here we are still with lubricants that just become so dirty and gritty so quickly.
- Muc-Off – pls advise the above is incorrect, and what can Muc-Off advise re their very dirty and very high wear lubricants. And also how that very high wear does not correlate with a high increase in friction losses. Please.

### **BLOCK 3 – No Contamination – Performance assessment re clearing any contamination absorbed in dry contamination block 2.**

Not tested in this block as chain had effectively reached test wear allowance.

Some wet lubricants have demonstrated an ability to improve wear rate vs block 2 wear rate result, but they do not rocket back down from where they were, so had it been tested, an extremely optimistic projection would have been maybe a 60% wear rate for this block. It also could have been just as bad as block 2 if no ability to clear any contamination – which happens.

### **BLOCK 4 – Wet Contamination Block– Performance assessment riding in harsh wet conditions.**

Not tested in this block as effectively reached test wear allowance.

The average wear result for this block is 2.5 times greater than the wear rate for block 2. There is nothing to suggest that Ludicrous AF would be an outlier in a good way in this block. Even if it is only double, that is a 156% wear rate for this block.

In the much harsher contamination block 4, UFO Drip recorded a wear rate of 32.3%. That is nearly 10 times its dry contamination block 2 result, and yet its wet contamination block result is still under half of Ludicrous A.F result in the much easier dry contamination block 2. It would likely be under 1/5<sup>th</sup> the wear rate of Ludicrous AF in this test block assuming only a doubled wear rate for L.A.F, which again, is an optimistic extrapolation of its block 2 result.

#### **BLOCK 5 – No Contamination – Performance assessment re clearing any contamination absorbed in Wet contamination block 4.**

Not tested in this block as effectively reached test wear allowance.

#### **BLOCK 6 – Extreme Contamination Block– Performance assessment riding in extreme conditions – very wet and harsh contamination ie events containing lots of mud..**

Not tested in this block as effectively reached test wear allowance.

**Total Cumulative wear end of test at 6000km with 3 x 1000km harsh to extreme contamination blocks. *(In case of L.A.F – End of test at 2000km with 1 x dry contamination block)***

For brevity I am only going to compare Ludicrous A.F versus Ceramic Speed UFO drip, as that is the top competitor product that Muc-Off highlight the most in their marketing.

Alright let us compare.

At the end of 6000km of testing in the extremely harsh ZFC test, which includes a 1000km dry contamination addition block, a 1000km wet contamination block, and 1000km extreme contamination block – Ceramic Speed made it all the way to the end of the test using up 92.2% of the chains wear rate allowance.

Muc-Off Ludicrous A.F reached the end of block 2, so 2000km only into the test, having used 89.6% of the chains wear rate allowance. The test was stopped there as it would have recorded a mark well over 100% at the end of first interval in block 3, and it is just a waste of time and resources to continue testing.

So the L.A.F chain did not see 1000km of running with contamination in the lubricant post block 2. It was not subjected to the very harsh 1000km of wet contamination in block 4. And then 1000km with even more contamination in it post block 4. Nor 1000km of the extreme contamination in block 6. And yet despite not being subjected to a further FOUR THOUSAND KILOMETRES of testing, containing much harsher contamination blocks than the warm up contamination block 2, its total wear rate was nearly the same as UFO drip.

At the same 2000km point where L.A.F test was stopped with L.A.F at 89.6%, UFO drip had a total wear of 8%. This has L.A.F at a wear rate of 11.2 times greater than UFO drip.

Again, so like, not close.

If you watch the you tube video on efficiency testing, you will see that one manufacturer's testing claims (Ceramic Speed) align with my testing, with physics, and also with observation on what I can see, hear and feel occurring with the lubricant during testing (ie resisting or absorbing contamination).

Muc-Off's testing claims just do not align with my testing, or in my opinion (and others...) the laws of physics. I cannot think of any explanation for extremely rapid wearing of steel and very low friction both being true at the same time. If anyone can, let me tell you, I am open and all ears / eyes.



## Single application longevity results.

Ludicrous AF was not tested for single application longevity results. There was no point. The treatment itself seems to last quite awhile – i.e it was still clearly wet and “lubricated” – using term loosely, there was no sign of treatment lifespan struggling in reasonable interval lengths in the ZFC test protocol. The trouble is, your chain is wearing at a pretty solid rate whilst it is being “lubricated” – so there is not really much point in whatever it’s treatment lifespan is – had I tested it, L.A.F would have zoomed past the 20% wear allowance allocated for the S.A.L tests whilst the chain was still nicely “lubricated” – so there was nothing to gain allocating the time resources and components to that test. I am having trouble getting stock of chains, chain rings and cassettes for testing, I am not wasting them.

Unless Muc-Off can provide a bunch of really insightful information re how the ZFC test results do not raise a concern, ZFC places the strongest possible DO NOT BUY rating on this lubricant. If you do purchase, you will soon simply have greater worries than how long a treatment will last.

## Overall Test observations and review

Ok not really too much really to type here that wouldn’t be repeating myself. I will just re-iterate again that observations during the test when I reached dry contamination block 2 matched the wear rate results. It is quite easy when you are adding the contamination to hear just how much is being absorbed. When little is absorbed, there is a small audible change to the sound of the chain running through the drivetrain under load, and this change dissipates fairly quickly over the next few minutes of running. Lubricants that absorb a lot of the contamination deliver quite a notable audible change

with a very loud and distinct grinding sound, and this sound continues on for some time (half an hour ish) as it much more slowly dissipates as the contamination itself is ground into finer and finer particles.

Not surprisingly I can predict with reasonable accuracy before I do the check measure at end of the block if the lubricant will have seen low, medium or significant change in its wear rate vs clean block 1.

It was abundantly clear that like Hydrodynamic and Nano before it, L.A.F was loathe to let any particle of contamination escape capture, and whilst the result for block two was REALLY BAD, it was at least pleasing to see it was markedly improved vs Hydro / Nano.

**Whilst we are here though I am going to quickly take up Muc-Offs penchant for ensuring all of the OUTSIDE of your chain is WET with a wet lubricant. Why do they do this?!**

**IT HELPS FOR WET LUBRICANTS TO BE NOT VERY WET.**

The contrast between say L.A.F and something like Silca synergetic wet lubricant could not be more stark. Synergetic needs an extremely low application amount – about 1ml, to provide brilliant lubrication INSIDE chain where it is needed. And so after wiping excess post lube and work in, the chain is vastly less wet on the outside vs L.A.F. This means vastly less contamination adhering to chain, and vastly less migrating from outside to inside where it will cause friction and wear.

And everything is just so, so much cleaner with this approach. Whilst Silca rightly recommend wiping excess wet lubricant from the outside of the chain, Muc-Off for most of their lubricants provide a UV light to ensure that all of the **OUTSIDE** of your chain is **covered in a WET lubricant**.

This is a frankly horrendous idea. I can put the \*in my opinion\* disclaimer here to be safe, but honestly give me strength re this one. The marketing may have initially fooled you, but hopefully, if you think about it for a moment, all the work and load is taking place **INSIDE** the chain. That is where you need great lubrication. Wet lubricant **OUTSIDE** the chain is just going to gather more contamination more quickly.

This should obviously be (now that you think about it...) rather undesirable, and so it is no surprise that the best wet lubricants tested to date work by being the least wet **OUTSIDE** whilst providing amazing lubrication **INSIDE**.

**This is another of my key concerns with Muc-Off and marketing.** I can understand how many cyclists would on first thoughts think oh yeah ok cool, makes sense, I should make sure the chain is properly covered in lubricant as I want to make sure my chain is well lubricated. And those cyclists are the target for the marketing. But yet again I find it **improbable in the extreme** that the highly qualified staff in the R&D lab would think it is a great idea for a part operating completely exposed to contamination, that ensuring the greatest possible rate of contamination gathering is the best way to go.

So how, how, how on earth is there on the market a UV light for cyclists to ensure they properly coat the **OUTSIDE** of their chain?!

**DO NOT DO THIS.**

**Muc-Off – pls explain.**

Any wet lubricant, wipe excess from the outside thoroughly, and do so after every ride. Keep your wet lube chain the least wet possible on the outside.

Anyhoo, back to finishing off L.A.F.

Summary;

- It is extremely expensive for a very small amount, which will not last very long as application amount is reasonably heavy through the nozzle they have which seems to be to ensure a liberal application. A liberal application, if you want to minimise the damage / how extremely dirty your drivetrain will become, just means you need to work oh so much harder to remove excess after application. In this case, removing a lot of excess, means you are working hard to remove a lot of REALLY EXPENSIVE liquid you just applied. I would not be surprised if L.A.F performed overall tangibly better with a needle applicator like Synergetic vs a liberal amount nozzle that looks to help you ensure you cover all of the outside of your chain in lubricant too, which is just a bad, oh so bad, way to go.
- Very high wear rate of metal parts sure makes the probability of this lubricant being very low friction outside of a clean lab in the extremely low odds department - **\*In my / ZFC opinion based on ZFC test results.**

- The lubricant becomes very dirty very quickly, which, wear rates that inevitably accompany this attribute aside, it is just never fun for one's lovely bike to have a black gritty mess to try to fight with cleaning all the time. Or you put up with a not great looking drivetrain. Again, Muc-Off dry aside, this is a common trait of Muc-Off wet lubricants. A trait / lubricant approach I do not understand at all at this time. (oh – unless it is to help sell Muc-Off's cleaning products?)
- If you only ride on road, in good (aka amazing) conditions, then it may be a not terrible lubricant, but even then the wear rates are mid pack at best, well short of leading competitors extremely low wear rates, and at a much higher product cost, making L.A.F overall one of the most expensive cost to run lubricants tested (again the only lubricants modelling out with higher cost to run and Muc-Off's other lubricants).
- If you ride offroad, **in my opinion** based on what occurred in dry contamination block 2, it would be chain and drivetrain suicide to use this lubricant for gravel / mtb / cx. Remember wet lubricants are already really up against it vs wax / chain coating type lubricants in the world of dirt and dust. The average wear rate of the top 5 wet lubricants ever tested in dry contamination block 2 is TEN TIMES greater than the wear rate average of the Top 5 non wet lubricants tested. **So I do not recommend using any wet lubricant for offroad use at this time**, but if you must, again compare the top tested wet lubricant in Silca synergetic with an 18.3% wear rate in dry contamination block 2 vs 78% for L.A.F. If you like the idea of replacing your chain, cassette and chain ring/s four times as often – then sure, go for it. Personally, as stated before, I have stacks of other fun cycling stuff to buy with that money instead.

## **ZFC Overall Performance Ratings**

**\*\*I am not going to take the time to rate L.A.F in main demographic use cases with commentary substantiating that rating. It is very expensive, delivered extremely high wear rates, and is very dirty very quickly. As such ZFC simply places the strongest DO NOT BUY rating on this product for any use case at this time until Muc-Off can provide information that holds my concerns incorrect. Until that time in any use demographic, in ZFC opinion, you have vastly better options from competitor products.**

**Race Day Lubricant Road – ?/10**

**Race Day Lubricant - MTB / CX – ?/10 to ?/10**

**Everyday Lubricant – ?/10**

**Harsh Conditions Lubricant – ?/10**

**Single Application for Long event – ?/10**

## Pictures From test

Ludicrous AF **after just 2000km** of testing (test stop point).





Compare to – Synergetic after 6000km. This is after many more re-lube applications as well as two further and more extreme contamination blocks.





Ludicrous AF after just 2000km of testing (test stop point).



**ON the plus side, things look better vs Muc-Off Nano chain after just 2000km!! This remains still, by far, the highest wear rate test, recording 145% of wear rate allowance by just the 2000km mark. Test stopped, and with chain looking like a coherent joining of black sludge – this lubricant proved not to be a fan favourite for those that ever tried it!**





Ok finally - Below is my personal mtb drivetrain post the 213km XC marathon event using Silca Hot Melt. Overall this drivetrain is now 3400km old at time of picture, and I have never, ever cleaned the cassette except for jet wash post full mudders.

Over the last 3400km this drivetrain has been running either mspeedwax, Silca hot melt or silca ss drip or Ufo drip. Again **ZERO** cassette cleaning aside from water, and that is how it looks after a couple of years of mtb training and racing. No solvents, no cleaning maintenance time aside from what is needed to clean bike overall post mud rides, cassette is measuring basically zero wear (you can track cassette wear by measuring distance from tip to tip of cassette teeth with digital calipers. Hard to beat. Just, extremely, hard to beat. Most mtb drivetrains do not look like this after 3400km of hard training and racing with no cleaning....

*(\*update on this at time of writing, I have just built up new mtb and moved this cassette across. It is just on 7000km old, and still looks **exactly** the same as pic taken 3500km ago. The largest cog which is soft alloy – try not to use, is measuring 9.7mm gap between teeth vs 9.5mm brand new. The steel cogs still measure either 9.55 or 9.6mm. Replacement mark for my power is normally around 9.8 to 9.9mm. on current trends, I will easily get this mtb cassette to around 12,000km + of hard mtb training and racing in all conditions If you not getting something similar, better lubricant choices likely await thee).*

The worlds best lubricants really are something. If you are not experiencing this but would like to.. well all the testing, knowledge and products are there for the reading at [www.zerofrictioncycling.com.au](http://www.zerofrictioncycling.com.au)

