Zero Friction Cycling

Key Learnings from Lubricant Testing – Update v2.

Hello there and welcome to whomever has taken the inclination to click on this document and obtain a summary of the key learnings to date from the worlds most robust and exhaustive bicycle chain lubricant testing. With a further nearly 200,000km of controlled testing since the initial Key Learnings document was published, it was high time for an update.

Especially so as since the initial key learnings document, there have been a number of manufacturers who have invested a huge amount of R&D into the bicycle chain lubricant space, resulting in a number of new and outstanding product options that we simply did not have in the v1 edition.

The best lubricant in the world is.....

That is probably the quick answer you are looking for in this document right?! That is the most common question ZFC receives, and a logical question to ask indeed.

The answer is:

The lubricant that REMAINS the lowest friction for your particular riding (factoring your environment) and your maintenance ability.

Sadly I cannot just say it is product X. Us humans are wonderfully varied creatures, and there simply is no single answer to this question, any more than there is a single “Best Bike” that every cyclist in the world would find is perfect for them and their cycling.

We need to factor your riding demographic (Dry road / wet / offroad etc), your volume, your application and maintenance abilities / preferences.

But the good news is this is not too tricky to get to this answer if you are prepared to invest probably 10 minutes reading the detail in the sections most applicable to you below. From the now over 300,000km of controlled testing, ZFC can absolutely ensure you are on a brilliant product for YOUR cycling & maintenance, and saving a lot of friction and drivetrain wear.

QUICK CAVEAT;

There are no doubt a host of truly great lubricants I have not yet been able to test. To any manufacturers who believe that is them, please email me. To any cyclists who believe their current chosen lubricant is all that and a bag of chips, email me (note you will need some robust lifespan data not just subjective I reckon its great cos… its great).

Finally before we crack on take heed;

“The greatest enemy of knowledge is not ignorance, it is the illusion of knowledge”

There is more voodoo and misinformation pumped out across all mediums re bicycle chain lubrication & maintenance than any other aspect of cycling I can think of.

It is a minefield of miss information, sponsored content, flat out completely incorrect advice, reviews and more – and it is a nightmare for cyclists to try to work out what guidance to follow without spending huge time resources investigating. The below is a textbook example of how easily what should be a trusted source can be off the mark.

https://www.youtube.com/watch?v=9Oyzo5CZby8

Lubricants are very difficult for most major media to properly assess and review. Some publications are definitely doing a solid job due to a proper focus and effort (Cycling tips David Rome / James Huang, and more recently Road.cc's Mike Stead, Bike Radar's Simon Bromley have been working well in this area). Many others sadly it is just an assessment based on zero tangible data, rehash of marketing, or they have been paid to say nice stuff about the product. Remember also it is a brave publication that will say something negative about the really really big sponsors like Muc-off etc. Yes there is independent editorial control. And there is also the survival of the publication. Some publications have secure enough footings to have absolute independent editorial control, some do not.

A key focus of ZFC (and this document) is to ensure you receive the most accurate and highest integrity information derived from the worlds most robust independent testing. That is why ZFC exists. That is why ZFC is successful.

How to tackle this document.

Apologies I just cannot help myself, my spots wont change. If I find myself going to cover some information, I simply must do it in full, and in a manner that I think if one takes the time to read, they will UNDERSTAND why the information is correct.

Í will put the key learnings just listed one after the other on the next page for those who just want the straight finding no hoohaa. If you wand to understand the findings, I recommend just read one section per day etc that is relevant to

you. You will learn lots, and you will have the understanding to help your friends.

Key Learnings Summary!

1) **Do not use wet lubricants if you ride offroad.**

2) **Remove Factory Grease before use.**

3) **Immersive waxing is still the lowest wear option**

4) **If you ride in wet weather, you must reset contamination in chain.**

5) **We now have some amazingly long lasting lubricants**

6) **Do not underestimate the drivetrain cost to run difference between lubricants.**

7) **The best options for multi day events / bike packing / holidays**

8) **If you race, have a dedicated race chain**

9) **E-mtb's eat drivetrains. How to avoid.**

I could have easily made a 10th, but I ran out of time at 11,000 words in 😊

Key Learning 1 - Do NOT use web lubricants if you ride off road.

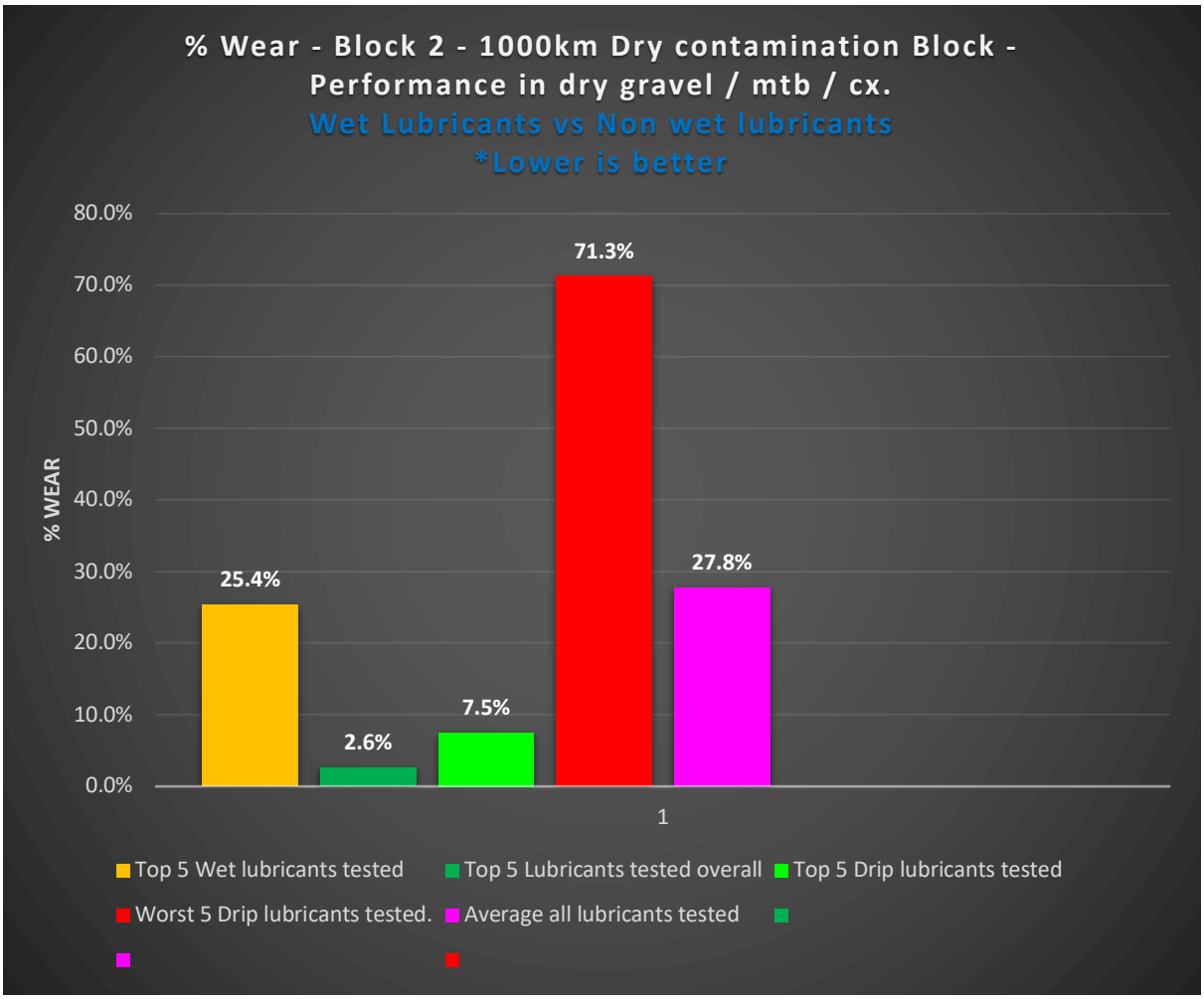
There is dust off road. Often lots of it. And it will be abrasive.

- Dust WILL stick on contact to a wet lubricant treated chain. This is physics. There is no getting around it.

- Wet lubricants DO NOT CLEAN AS THEY LUBRICATE. They are actively attracting and holding contamination. The ratio of abrasive contamination to lubricant will continue to degrade the longer you keep riding without fully solvent flush cleaning the chain.

- Dust is not low friction. The level of abrasiveness varies a lot (ie quarry rock dust vs soft soil dust). But it is all abrasive against your chain metal under the enormous pressures found inside your bicycle chain under your pedaling load.

DATA!!



Alrighty, hopefully the above data really helps drive home the preceding bullet points. It is of course very handy that objective testing results lined up nicely with both the laws of physics as well as basic logic re what is happening if you head out with a wet lubricant into the world of dirt and dust.

Honestly it is just a complete mismatch of product to purpose. And it is a VERY common mistake, especially in Mtb demographic that is badly lagging behind other disciplines re saving a huge amount of drivetrain wear and cost every year. Thankfully the high cost of higher tier eagle and shimano 12spd components is slowly, slowly bringing some focus in this area, but holy batman I have some work to do to increase the awareness rate in mtb demographic.

Gravel riders often come from road and so have been in general much more

focused on not wanting to wear out their beautiful groupsets in short order, but still wet lubricant use in gravel riding is far too prevalent.

Enormously better options!!!

Ok I need to not make this a 50 page document (only 40..) so I will be brief (for me) if I can and keep it detail light here, and refer to website / ZFC you tube channel for further information to see which option suits best.

Option 1 - Immersive waxing with a proven top wax (Mspeedwax / Silca Hot melt, recommend STRONGLY avoid absoluteBLACK Graphenwax and for the love of your drivetrain avoid Wend wax).

- Immersive waxing – all parts of chain are sliding on a solid coating of super slippery wax, and a solid lubricant has highest level contamination resistance possible
- When you re-wax – whatever small amount of contamination may have penetrated is reset by the re-wax. This cannot be beaten.
- Immersive waxing is extremely easy, and not time consuming. If your LBS or other source tells you otherwise, quite simply – they are wrong, very wrong, and you should never ask them a question about chain lubrication ever again as they simply possess the dreaded illusion of knowledge – the arch enemy of actual knowledge.

Refer here for a quick look at how easy immersive waxing really is;

https://www.youtube.com/watch?v=NdmriYX76NE

Option 2 – Chain coating lubricant WITH periodic immersive waxing.

- Despite immersive waxing being super easy, quite simply popping a chain off every time one needs to re lube is just not going to fly with some.
- Your next best option – and this is still extremely high performing / very low wear – is to start waxed, re lube next say 5 or so re lubrication with one of the current top known chain coating type lubricants, then do a re-wax to reset whatever contamination may have started building up.
- Chain coating lubricants differ to more traditional wax emulsion lubricants by way of setting to a MUCH more solid / true solid coating,

and their highly refined wax bases make them compatible to use in conjunction with your immersive waxing.

- Top choices at time of writing are Silca SS drip, Ceramic Speed UFO drip, Tru-Tension Tungsten all weather, Tru Tension Tungsten Race - *****Note TT race has a very short lifespan but is probably the cleanest drip lube on the market- just be prepared to re-lube every 100km max****

Option 3 – Wax emulsion lubricants

- These are wax based lubricants (different wax type to above) typically in a water carrier – Best known will probably be Squirt and Smoove, and recently released Grax.
- Smoove is better than the data shows – it was still showing wear in block 2 from penetration issues. Squirt and Grax are solid choices that whilst not showing a big difference vs wet lubricants in the raw data (still notable enough), this difference will continue to grow as the km's clock up.
- These types typically have very good treatment lifespan, but will gunk up over time, are a tougher clean when it is time to clean, and have penetration issues to negate post clean – but still, this is all much better than running a wet lubricant offroad.

HOT TIP!!

Even if following top option and waxing or chain coating lubricant (or both), some dust is going to stick to the outside of your chain due to static electricity from chain whizzing around through the air. Exactly the same as dust sticks to your frame and wheels but you don't lubricate those.

You DO NOT want to drag this dust from outside your chain to inside your chain with the lubricant on re-lube, nor do you want to bring all that dust into your wax pot if you are waxing.

Spray some denatured alcohol / methylated spirits onto a microfiber cloth and wipe chain. This will lift off surface dust. Wipe chain again with dry part of cloth and re-lube / re-wax.

Are there caveats as to when one is ok to use a wet lube offroad?

Yes. Life would be too simple if we could just pump out inviolate golden rules!! There are always exceptions to rules (well, nearly…).

THERE ARE cases where a wet lubricant may need to be chosen, such as if the length of your ride / race is going to exceed the treatment lifespan of your non wet lubricant. Having lubrication is way better than not having it – even if your lubricant is a bit contaminated. The top couple of wet lubricants tested to date will remain in a very good place for that ride, and have very long application lifespans to go the distance if you need such an option.

Just know that post event, if you do not fully flush clean that chain and revert back to something NOT WET for your offroad riding – you will be merrily absorbing a lot of abrasive contamination into your lubricant in fairly short span (a few rides), and it simply WILL cost you in friction and wear.

Lastly if for some reason you must run a wet lubricant for offroad riding, because that is just how you like to roll / or you have been convinced by X party who have the illusion of knowledge and advised X is your best product (and it is wet) – I can only recommend at this stage that the top tested wet lubricants performed **less worse** by way of needing very little product to very effectively lubricate, and as such are **far less wet.**

Lubricants that have the outside of your chain notably wet, honestly there is only one direction things will trend, and quickly, and this direction is not great for your drivetrain or wallet.

THERE IS SO MUCH terrible information pumped out re lubricants! – From GMBN advising the number one mistake is to remove factory grease (paid to say by KMC) to Muc-Off providing you with a UV light to ensure all of the OUTSIDE of your chain is COVERED IN A WET LUBE.

I pride myself on mostly being very diplomatic but stuff like the above just has me wondering if I need a script for some horse tranquilizer. Major companies literally making big money to tell you absolutely horrendous information, that will absolutely shorten the lifespan of your drivetrain – by a lot, AND it is abusing YOUR trust that you placed in them.

Not cool. Not at all. It is this stuff that gets me fired up and has me typing out novella's to correct.

If anyone is recommending anything like the above including simply just a pretty wet wet lube, in full knowledge you are going to be riding offroad – Slowly back away from them until out of sight, then run, then never consult them for lubrication advice ever again.

We will be now moving into area's where it really is easy to for many to attain the wrong information / conclusion – i.e thinking waxing is not suitable for wet weather riding, but I have to be honest here for this first section – I hope that if you had not initially twigged re wet lubricants and offroad that you have now, and you can hopefully help any friends who have yet to understand.

If you have a question about e-bike specific lubricants for your e-mtb and they are wet – head to the E-mtb section on this document.

Key Learning 2 - Remove Factory grease before use.

Apologies on behalf of chain manufacturers claiming their factory grease is amazing stuff, and for some major media channels that have been happy to pump out terrible information, in the full knowledge that it is terrible information (in my opinion) – because they were paid by manufacturers to do so.

Terrible information like the biggest mistake you can make is to remove factory grease (thankyou again KMC & GMBN for the early deaths of countless tens of thousands of drivetrains). Shimano's head chain tech guy has not helped the knowledge cause either on this front.

So, this one is a bit like a zombie apocalypse that will not die. If you are a cyclist - and hear or read information from the head tech guy from one of cycling's top manufacturers, and he says you should leave the factory grease on because it is amazing, why would not believe that? Same if the world's biggest cycling you tube channel advises that removing factory grease is the number one mistake you can make with your chain – why would you think they have it wrong?

Since it is little ZFC vs industry titans - again pls forgive I need to cover properly why they are for not great reasons telling you terrible information, that will cost you – so that you hopefully believe little ZFC over the industry titans – once and for all, and get your cycling friends on board as well to save their chains and drivetrains.

I have something in my information arsenal however that they do not.

Independent AND EXTREMELY ROBUST objective data (and not just mine)

Is factory grease terrible?

Honestly it is typically better nowadays than it used to be, but compared to the top lubricant options, it is just not even a competition.

To start with, outright efficiency for the best factory greases is typically around the 6 to 7w loss mark, whereas the fastest lubricant options are in the 3 to 4w loss mark. Some of the worst factory greases are around 10w loss.

And that is in a clean lab test.

Have you noticed how dirty factory grease becomes oh so quickly? Hopefully obviously, this rapid contamination absorption does not make it faster. So the performance gap between factory grease and top lubricant options which stay vastly cleaner for vastly longer – grows very quickly indeed.

This efficiency data (from Friction Facts then Ceramic Speed) is handily backed by my wear rate correlation testing.

The wear rate for clean block 1 in zfc test had shimano factory grease recording almost 5x the wear rate vs the average of the top 5 DRIP lubricants tested to date – and nearly 10x if I included mspeedwax and Silca hot melt in the average.

And as above, due to rapid contamination absorption, things do not improve even if you move to start adding a quality wet lubricant like even NFS – with wear rate with NFS over factory grease in Dry contamination block 2 at 27.4%, whereas average of the top 5 drip lubricants in this block is 6.1%. And it is 2.6% if I include mspeedwax & Silca hot melt in the top 5 average.

Pretty safe to say, that Factory Grease IS NOT your best option. Pretty safe to say that removing it will not be the number 1 mistake you make with your chain, but one of the best things ever that you can do for your chain.

It gets worse.

The best lubricants known to date work best, by far, if they are able to bond to clean & clear chain metal. Especially chain coating & wax lubricants.

They do not mix / work well at all if applied over the top of factory grease. It is like mixing water and oil. It is just a fail. You will end up with gunky mess doing nothing great for your chain and drivetrain as well as your chains efficiency.

If you spend the money on what you KNOW to be a top lubricant because you saw it recommended by ZFC, or, you simply hope it is a top lubricant – you are just throwing lipstick on a pig and wasting your money on that product if you are just going to apply it over the top of your factory grease. Don't do that.

It still gets worse.

If you go to clean factory grease off your chain when it is new, it takes very little solvent (normally 3 baths at 250ml of mineral turps + 2 baths of methylated spirits and woohoo perfect prep). The last 2 turps baths and final metho bath can be saved for the first baths of next chain.

Refer to chain prep guide on zfc website for full prep instructions as it can vary slightly by brand

Once you ride that factory grease though, be prepared to literally put multiple litres of mineral turps through your chain to get it properly clean.

YES – those of us in the business of making fully optimized race chains do a break in run with factory grease as part of full race optimization prep – but that is a very different process to going and riding your bike with factory grease on the chain. It is a controlled run (power and time) in an extremely clean environment, for a specific purpose as part of the prep. Refer to Ultrasonic and Race chain guide for further information.

Outside of that very specific process;

DO NOT. I repeat DO NOT leave factory grease on, unless your specific aim is for your chain to have a dramatically shorter lifespan vs if you had cleaned it off to run a proven top lubricant choice.

If you see anyone / anywhere promoting leaving factory grease on as the best thing or that removing factory grease is a mistake – please help me kill this zombie that just wont die and diplomatically refer them to this document.

Key Learning 3 - Yes Immersive waxing is still Number One.

Lets see if I can be concise here (ha! 😊)

Firstly a caveat to the above, it must be with a proven top wax – currently those being mspeedwax and Silca Hot melt. Unfortunately absoluteBlack Graphenwax tested very high wear – my opinion is it is too pliable / soft (AB deny of course and re-iterate their product is amazing). Wend wax is – just – please, read the wend wax detail review.

And I hate to break a lot of DIY waxers heart, especially those that follow a very worrisome persons you tube channel – he has mislead you. I have an entire

separate document on the Oz Cycle video in the instructions tab. If you read it, you will agree with me. I get non stop emails from all around the world from people who read it, and email me to advise they are so glad they did.

As much as I am a huge proponent of immersive waxing, DIY waxing has become a bit of a bain of my low friction existence. It just goes so badly so often and I have lost too many hours of my life to sorting out DIY waxers gone wrong – and this is time I need to devote to catching up on testing and detail reviews and information updates.

Yes it can be done well, but 99% of the time it isn't, at all, and overall it just gives immersive waxing such a bad reputation. Almost all of the information out there on the internet re how to DIY wax is complete and utter rubbish. Most especially if it involves candles. Pls do not write to me about your DIY wax, pls refer to the relevant section in the WAX FAQ guide for further detail why.

Why is immersive waxing with a top wax is number 1.

- All parts of the chain are sliding on a SOLID super slippery coating of wax, leaving the chain metal out of it = no wear.
- It has the highest contamination resistance possible
- Every re wax re sets what small amount of contamination may have snuck in, and you are back to near perfect again.
- Every time you remove chain from wax pot it looks brand new, and you have never had to clean it.
- You do not have to do any chain cleaning maintenance.
- You do not have to do any drivetrain cleaning.
- Due to above factors, you will typically attain circa 3 to 5 times the chain and drivetrain parts lifespan vs medium to decent drip lubricants. Much more again vs poor lubricants.

Main immersive waxing myths and utter bulldust.

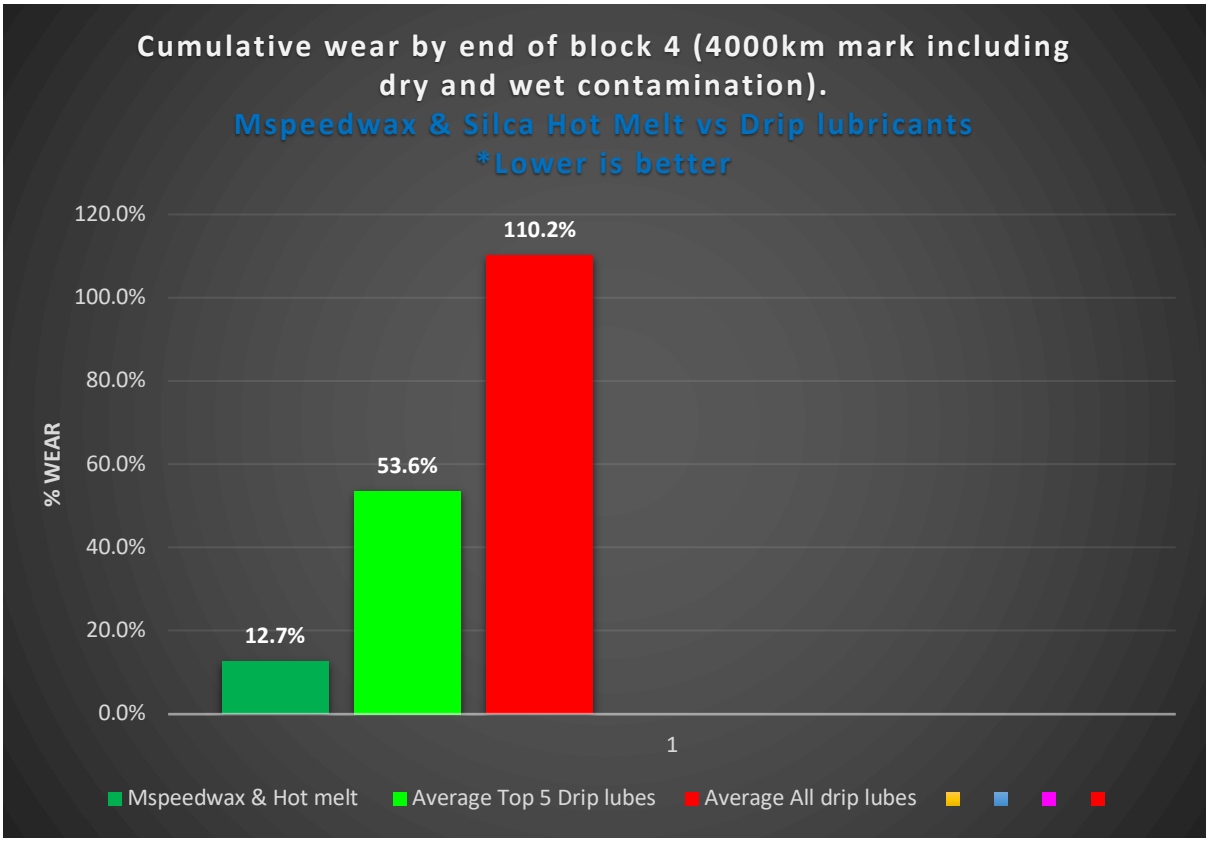
- It is way more time consuming. On balance for most cyclists, it will SAVE a lot of time.
- It doesn't make that much of a difference vs drip lubricants. Aside from the very very best drip lubricants, which it still beats, again it is **multiple times lower wear rates.** You cannot class multiple times as not that much of a difference.
- It is hard. It most certainly isn't. Refer to video below, it is super easy. https://www.youtube.com/watch?v=NdmriYX76NE
- It is dangerous. It is no more dangerous than making a cup of tea unless you are a very special person.
- It is not suitable for those who often ride in wet conditions. It is the absolute best and easiest choice for those who ride in harsh conditions as it is by far the easiest lubricant option to reset contamination after riding in such conditions. Pop chain off and put into wax pot and turn pot on. That is oh so much easier vs flushing litres of solvent through your chain to properly reset contamination in a drip lube chain post harsh conditions riding.
  (and if you don't do either of those things – say hello to lots of friction and wear. Where do you think all the contamination has gone that your wet ride dragged in if you don't remove it? Is your drip lube magically taking it somewhere? Hint : NO).

Where do these myths come from?

- Again refer to those presenting an illusion of knowledge, vs actual knowledge
- Mechanics who have seen a lot of DIY waxing gone wrong.
- Mechanics who see the results of poor commercial wax products
- Mechanics who have not updated their lubricant knowledge for like, ages.
- Bike stores who have stuff other than a top immersive wax to sell you.
- Cyclists who tried it but failed due to a) not following instructions, or b) By following instructions – they were just really bad instructions (DIY).

DATA!!!

Alrighty – Average wear rate for all drip lubricants tested to the end of block 4 (wet contamination block) for Drip lubricants vs average for Mspeedwax & Hot Melt.



Again the above graph is at the 4000km mark in the main test, and includes a 1000km dry contamination block, a 1000km wet contamination block, and 2 x 1000km clean blocks with no contamination (set re lube / re wax points are done throughout test)

The victory is pretty clear. The gap is not small. Immersive waxing's unassailable ability to reset contamination when doing a re-wax (which is the waxing equivalent of a re-lube), and re coating all parts of the chain in a solid super slippery wax – it is just extraordinarily hard for a drip lubricant to match that.

For a drip lubricant to try to match immersive waxing, some how you are going to need to remove any contamination that has become part of the lubricant

every time you re lube. There is just no quick, easy and cost effective way to do this to any level that would remotely approach what you achieve by simply popping your wax chain back into a spa bath of molten wax.

The gap HAS shrunk however.

Since Key learnings v1 document, we have some amazing chain coating drip lubricants on the market that we did not have at that time.

Whilst they cannot quite match immersive waxing day in day out over thousands of km's – they can be just as fast for a single ride / race, and they do remain much closer to the top immersive waxes for much longer vs previous options – especially in dry road conditions.

Ceramic Speed UFO drip and Silca Super Secret drip both efficiency test under 4w (UFO is at 3w), and have outstanding contamination resistance in dry dust conditions. UFO & Silca SS drip cumulative wear at end of dry contamination block 2 is only just over 5% more than Mspeedwax / Hot melt.

They do suffer more – like ALL lubricants – once things get wet, as water brings contamination deep into chain where it is pressed into lubricant, and simply adding 5ml more drip lubricant over your 100 link+ long chain – it cannot clear contamination like putting chain in a hot bath of wax does (it is around 0.05ml per link which can only do so much obviously).

If however you only ride dry road, dry offroad etc – whilst the top options still cannot match immersive waxing, they are still amazing products, and if you are not going to immersive wax, you should have them at the top of your list.

A bottle of UFO / SS drip may look expensive, but check out the cost to run tables on ZFC website, the savings in parts wear rates has them much cheaper to run overall vs cheaper lubricants with higher parts wear rates. More on this further in the document.

In summary though, if immersive waxing clicks as Captain Obvious why am I not doing that already – then you are in for a grand ol time, and your drive train will love you. There are other benefits as well such as each time you pop chain off you can easily check your bb bearings / pulleys / rear wheel bearings. And everything is always so clean. And you fingers stay super clean when you have to repair a rear puncture etc etc. Day in day out, it cannot be beaten.

- **Stay away from candles!!**
- Stay away from anyone telling you to add 50grams of ptfe into your wax.
- Stay away from cheap paraffin from ebay / Alibaba / hardware store.
- Don't add paraffin oil or lanolin or whatever else the strange voices in your head / cycling forum may be telling you to add.
- Don't use Wend wax.
- I caution strongly against AB graphenwax.
- Pls don't write to me to tell me about your paraffin lanolin beeswax + ptfe and graphite wax blend and why I should test it. I am not going to test it. If I tested every DIY wax request I would be testing DIY waxes until I am around 700,000 years old. If it works for you, great. But pls do try to ensure you don't give the top immersive waxing products a bad wrap by riding with your mates with a gunked up drivetrain from your home blend wax / candles, and having a mechanic shaking their heads at waxing next bike service.

The top products have so much R&D into the base wax blend that in my humble opinion you should be DIY waxing to the same extent you would DIYíng your car's engine oil. You will not match the top products, and you may well do your drivetrain a great injustice – again there is just SO, SO MUCH horrendous info and advice re DIY waxing, it is a dumpster fire + minefield combined.

Key Learning 4 - Wet weather riding = YOU MUST RESET CONTAMINATION.

Wet Weather Riding is an EXTREME lubrication challenge.

When you think about it, there are not that many lubrication challenges as tough as this one. You have a part doing a huge amount of mechanical work under very high pressure load. It is completely exposed to the elements. And the elements are ensuring your front tire is hosing your chain with gritty water from the road / trail.

Water is the great transport medium to bring that abrasive contamination deep inside your chain, whereupon the load pressures will press this contamination into your lubricant, no matter what it is.

From there, a few things happen.

- Top immersive waxes / chain coating lubricants will have some self cleaning effect, but at the cost of treatment lifespan. The abrasive contamination will abrade the wax / coating off, often taking some of the contamination with it. Such lubricants tend to remain impressively low friction in harsh conditions for awhile - until suddenly you have very little lubrication left and friction & wear will rocket up very quickly. As such treatment lifespan for that lubricant vs your ride / event duration is an important factor.
- There is a big difference in treatment lifespans for lubricants in such conditions – so reading the next key learning may be of interest if you do a lot of long harsh conditions riding.
- Wet lubricants made for running in wet weather can hold fast and last, but friction and wear will start increasing from KM zero and continue to do so.

It is really post wet ride however that is most important however.

It is extremely important to remember that pretty much whatever abrasive contamination the water brought into your chain & lubricant is not going anywhere unless you remove it.

You are going to need to be prepared to pay the piper one of two ways. Either leave the contamination in there and pay for it in high friction and wear, even if your next rides are in the sunshine, or pay for it post wet rides with some maintenance time to reset contamination in your chain.

Lubricants DO NOT clean as they lubricate.

Let us please just get that out of the way before we start. It is a common claim. But manufacturers can claim whatever the heck they like as there is zero accountability. Wend wax initially went to market claiming that you could rub a solid lubricant on the outside of your chain and magically have great lubrication inside your chain, and sooooo many people believe them.

Not always of course, but too often there can be marketing claims, there can be physical realities (and laws of physics), and the two are as close as Donald Trump is to attaining his PHD in climate science.

Please believe me, lubricants do not actually clean as they lubricate. What they do is minimally, and temporarily – improve the ratio of lubrication to contamination when you add more lubricant. But without active cleaning, this is a ratio that will continued to degrade – and very rapidly if you are riding in harsh conditions.

If you want to rely on such things to "reset" the contamination in your chain post harsh conditions rides, well, it is your drivetrain. Friction increases from abrasive contamination from wet rides can very easily reach multiple watt increases very quickly.

Have a chain that is 3w higher friction than when it started as a perfectly prepped and lubed chain? That is 3watts of energy every pedal stroke going directly into wearing out your chain and then drivetrain faster.

5 watts higher friction from a few wet rides? Or 8 watts higher? Well – if you just keep adding lube and not fully flush resetting chain – Hopefully this helps paint the picture.

Few cyclists who frequently ride in the wet boast about achieving amazing km's to 0.5% wear mark. Almost always it is whoa things are wearing out fast. So fast I cant be bothered keeping up with chain replacement during winter I will just ride it through and then replace everything.

We can do a lot better with a bit of understanding.

What is the solution?!

The solution to a low friction chain day in day out if your frequently ride in harsh conditions is the lubricant that is the quickest, easiest and cheapest to reset contamination post wet rides.

This may not be the answer many were hoping for, but again, nothing but nothing can beat immersive waxing here.

Pop chain off, put in pot of wax, turn pot on. Go have a shower, eat, watch Stranger Things on Netflix. Come back whenever to swish and hang to set, and its job done ready to pop back on before next ride.

There are hints and tips re how to reduce the amount / rate you import contamination into your wax pot so you can do a lot more rewaxes before worrying about it being time to change to a fresh bag of wax, but even if never do those (boiling water flush rinses / two pot system – refer to ZFC you tube channel) – you will still be MILES AND MILES ahead re what the options are for trying to reset a drip lube chain post wet rides.

If re-waxing post each harsh ride is going to be tricky, just run two or three chains on rotation. Wipe dry remove and wrap in a microfiber cloth, pop fresh waxed chain on. Then re wax two or three at once when you need.

This super smart method also guarantees two or three chains through same cassette vs just one. Yeehaa. You always need another chain sooner or later (often sooner for those who frequently ride in wet conditions), so pre buying your next chain or two to run in rotation is just really smart.

If immersive waxing simply isnt your bag baby and you must run drip lubricants, then yet again fall back number 1 is to see if you can run an immersive wax compatible lubricant (UFO drip / Silca SS drip / Tru-Tension Tungsten all weather) in conjunction with an immersive re wax to reset every approx 5 re lube.

If that is not for you still and you simply must run drip lube only – unfortunately there is no really easy solution.

Really you are left with doing at least periodic solvent flush cleans to reset (fairly often if you want to make a difference). Spray cleaners do something, but far from great. Clip on cleaners do something, but far from great. If that is all you can do, do it – especially if running expensive bits, but don't expect amazing results. But it will help.

Off the bike, into a container, agitate – that is really the only way to properly flush clean your chain. Expect to have to do multiple baths. Each bath will go black for awhile. Dry chain (depending on lubricant choice really you should finish with a methylated spirits bath to remove film & dry as well), then re lube. And hope your lubricant doesn't have penetration issues (Smoove / Squirt / Grax – seemingly most traditional type wax emulsion lubricants. Silca ss drip & UFO drip do not have penetration issues).

There are tips to try to reduce the amount of solvent – but it's a lot of faffing with letting contamination settle, carefully decanting into another container etc.

Honestly, re-setting contamination in drip lubricant chains post wet riding is just difficult, time consuming and expensive. And it is why this approach is so rarely done, mostly people just keep adding more lube, and cop the drivetrain wear and friction. If you are running Tiagra or Sora on your commuter, sure. If you are running Axs Road or Dura Ace or Campy record…. Big ouch. Next levels down less Ouch, but still, a fair bit of ouch.

Resetting contamination in an immersive wax chain is just so darn easy. And cheap.

It is a huge misconception that immersive waxing is not suitable for those who frequently ride in wet conditions.

Honestly I cannot think of anyone for whom immersive waxing is more suitable. I hope the above makes this fairly clear as to why.

Yes there are stories abounding of wax chains rusting – and that is true. It is simply not understanding waxing.

Wax will be abraded off the outside of your chains rollers first, and then rest of the chain. The rollers especially are usually a high carbon steel for hardness, and high carbon steels readily oxidise / rust.

So yes, you cannot just come home from wet rides, and leave bike for a day or so. You will come back to a rusting chain.

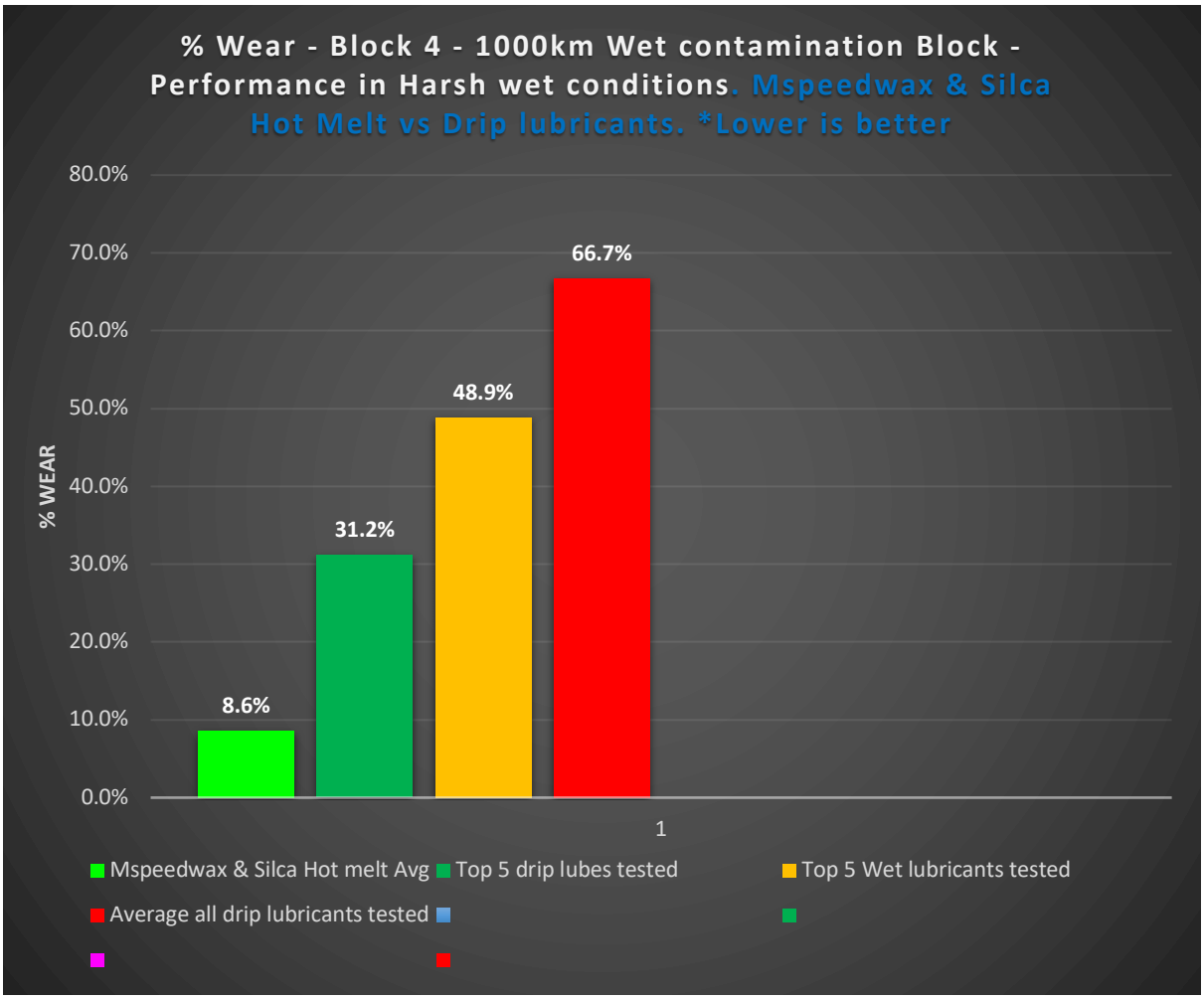
All you need to do is just pop chain off when get home and either pop it in pot and turn pot on, or wipe and wrap in a dry microfiber cloth. If you can do that 1 minute job, you are golden.

Sure many wet lubricants especially you can just park for days then go ride again, just remember, you will now be riding a grinding paste masquerading as your chains lubricant.

You are now forearmed for your decision making!! Take this knowledge and go forth and be low friction.

DATA!!!

The data below is pretty conclusive. This data is from wet contamination block 4. Remember there is NO cleaning during test. Drip lubricants continue to rapidly increase in wear rate as the test block continues despite frequent re lubrication intervals. Immersive waxing just resets what contamination is in chain each re-wax.



For drip lubricants to try to attain similar very low wear rates to the top immersive waxes, that is simply going to flat out take a ton of solvent use and time to reset before each re lube. No thanks. I will just put my chain back into its spa bath and enjoy my time doing one of many other fun things on my fun list.

If you have queries re master link use for this approach, pls refer to master link FAQ guide on website.

And remember, if ANYONE tells you that immersive waxing is not suitable for wet conditions riding….. THEY ARE WRONG. No ifs, no buts, no maybes. They are simply just flat out wrong (again only caveat being ensuring your harsh conditions ride is within the waxes treatment lifespan – data on website).

Many people can be very adamant re opinions on things they frankly just lack the knowledge to properly understand. If they can explain to me why the above information is wrong, I am absolutely open to being corrected and updating my documents and recommendations. Honestly, I can't lose. My lifes mission was never to convert the world to waxing, it is to get everyone on the best possible option for their cycling. If there is a better option, I would simply stock it, recommend it, and update my documents. This is not a fixed position – so if anyone can explain how the above information / recommendations is incorrect – I am all eyes and ears. To always learn is to stay young.

But, at the time of writing - all knowledge, data and logic points to immersive waxing with its ability to simply re-set contamination each re-wax, to all knowledge, test data and logic —as by far the fastest, easiest and cheapest way to keep your chain/s very low friction day in day out in wet weather riding.

Key Learning 5 - We now have some amazingly long lasting lubricants!!

Again there has been a really strong focus from a lot of players into bicycle chain lubricant market, and from that, we have a number of products proven to be pretty amazing stuff, especially if you a) have a super long event or b) just like to go ages without needing to re lube.

Now what will last the distance can vary a bit depending on if it is wet or dry, and cost is also a consideration for some options as they can be on the pretty pricey side of things.

I wont list the leaders here as these things are subject to change of course as more products are tested and I don't want to have to remember to update documents like this post any particular test.

Just head to the lubricant test data page on website, click on the spreadsheet for Single application longevity, and then look up which test is most applicable to you – Dry road, Dry offroad, Extreme Conditions.

Sometimes a lubricant that performs very well in one doesn't necessarily mean it will be great in all. Ie some of the longest lasting options for dry road really struggle in the wet. Wet lubricants that do really well in dry road may struggle in dry offroad due to contamination gathering shortening lifespan.

Overall however the testing has been completed for a number of top lubricant options, and so if you need to know what will go the distance, or if simply wanting to re lubricate as infrequently as possible is what you really like – then check out some of the top products as honestly, they are amazing.

Some of the longest lasting can also be super handy for dedicated ergo bikes etc where total km's for many may not be that high and one can go months or maybe even a year between re-lubes, and with super low wear. Or if you have an e-cargo bike for taking kids to school / shopping and you just do not want to have to think much about its lubricant for long periods. Handy!

With well over a 1000km difference in treatment lifespan between the longest lasting lubricants tested and the worst tested thus far, don't get caught short! There is no other independent test data on bicycle chain lubricants effective treatment lifespan I am aware of, so check it out if you need, or prefer, to go long.

Note the single application longevity data is not as comprehensive as I would like at the time of compiling this document. I changed test protocol for this to a much more accurate protocol in 2021 and so had to scrap previous data. I need to re-test quite a few lubricants under the new protocol, but time and test resources have made this slow going

Key Learning 6 - Don't underestimate cost to run difference between lubriants.

Over time I have expanded and improved the cost to run modelling, and this is now one of the most helpful guides overall for most cyclists when trying to choose what lubricant.

It can be daunting for many to pay a high price for a bottle of lubricant on the promise by the manufacturer that it will pay you back with extended drivetrain lifespan.

And let me tell you that is most definitely not always the case, with some of the most expensive lubricants tested (Muc-Off Nano, Muc-Off Ludicrous AF), eating chains and drivetrain components at frankly astounding rates, whilst other very (but not as) expensive lubricants like Silca SS drip and Ceramic Speed UFO delivered amazingly low wear rates and therefore the high cost of a bottle is paid for many many times over in drivetrain lifespan extension – as always, the more so the more expensive the drivetrain.

If you are running Axs road / Campy record / Eagle x01/ xx1, Dura Ace / XTR – even ultegra, or XT or chorus – honestly the cost difference going from say a $20 bottle of lubricant to a $55 dollar bottle of lubricant is utterly inconsequential IF the more expensive lubricant does ACTUALLY deliver you notably lower wear rates and extended parts lifespan. The component parts cost obviously dwarfs the cost of the lubricant. Saving $30 on bottle of lubricant if that lubricant doubles the lifespan of parts worth hundreds, or even over a thousand dollars – it is a pretty big false economy to buy the cheaper lubricant in this example.

The key of course is to ensure the lubricant you are buying IS PROVEN to deliver much lower wear rates, and of course, you have ZFC data for that.

This modelling has been very much needed as it is just really hard for most cyclists to try to calculate all the factors when looking at a bottle of lubricant and reading the marketing claims. Factors such as;

- Cost of lubricant usage. Some lubricants are cheap but you need to apply frequently and generously. Others are very expensive but a treatment lasts a long time and you apply very sparingly.
- Cost to run including wear rate and cost of chain, subsequent wear and cost of cassette, wear and cost of chainrings.
- Also need to factor in your groupset, and your type of cycling.

Alas I cannot model all groupsets and all ride demographics, but I have modelled the main ones, and from there you can easily just factor that over if your groupset is different.

Ie if you look at GRX groupset for dry offroad riding, and you run axs road mullet set up on your gravel bike – the parts cost a lot more, so simply increase the cost to run gap between the lubricant options accordingly. If your parts cost 50% more than GRX 810, then add 50% to the cost to run difference and you will be in a great ballpark comparison still between the lubricant options you are weighing up.

As per the title of this section – DO NOT underestimate how big the cost to run differences can be.

Choose the incorrect lubricant because the marketing was amazing but the lubricant itself leaves a lot to be desired – you will pay for it in rapid parts wear.

Choose the wrong lubricant for the type of riding you do, you will pay for it in rapid parts wear.

The aim here is to easily avoid a whole lot of really easily avoidable friction and wear.

We all have a discretionary amount of $$ we spend each year on cycling stuff. If you are coveting that new kit, goretex jacket, glasses, shoes, helmet, bike fit, coaching etc – it is oh so much more fun to spend your hard earned $$ on such things vs blowing that money on burning through your lovely drivetrain because of something so innocuous as going meh – that lube has good marketing / bike store sells it as good – that'll do.

Check.

Ie the cost to run per 10,000km for dura ace 11spd, based on the wear rates achieved in the extremely robust main ZFC test;

Number one at time of writing is Mspeedwax at $240.

Mid league table is Squirt at over $1200.

Top **drip** lubricant tested (at time of this document publish) for cost to run is Revolubes basically matching Mspeedwax due to extremely low product usage rate and extremely low wear across all the test.

Your riding will of course produce different results to any modelling – it is modelling based on a control test that whilst the best such test I know of (not just being biased I promise!), my test still does not mimic your riding.

Maybe you will save a cool approx. on thousand bucks just like the modelling. Maybe it will be a bit less because you never ride in the wet, do some good periodic maintenance, lower power etc. Maybe you will save a bunch more vs the modelling due to high power, harsher conditions, no time to do any maintenance.

The modelling gives you great ballpark to work from. It is accurate within itself versus other lubricants tested in the cycling type tested.

The cost to run numbers for the worst lubricants tested are frankly as scary as any horror movie ever released, so if I was me, I sure as heck would not have those anywhere near my drivetrains. In some cases I think you could probably just randomly mix anything that is liquid in your pantry and attain a better result vs the worst lubricants tested, and it wont cost you $100 a bottle. Unless you have one very fancy pantry. In which case when am I coming over for dinner.

Ignore those who tell you there really isn't much difference when it comes to lubricant advice. Even some of my favourite cycling podcasters on some of my favourite cycling podcasts have said such things, multiple times. On many subjects they provide great information. On lubricants, really not good.

A textbook example. One serious industry heavy weight has stated on a pretty big podcast channel talking chain lubrication that basically anything will do, "they all work" (This was from the top chain tech guy at shimano on a velonews podcast. Not velonews fault, why wouldn't they believe a guest of this calibre on their show – they would believe they scored a solid guest to have on and talk chains & lubrication).

I initially typed this sentence with a lot of swearing in it. But more normal more diplomatic self would now just like to state, in the clearest of terms possible;

NOT ALL LUBRICANTS JUST WORK. THERE IS A HUGE PERFORMANCE GAP BETWEEN THE BEST AND THE WORST

And remember, many of the worst can be powerfully marketed as the best.

A tiny bit of data just to ram home.

Even clean block 1 we have a few top tested lubricants at **0.0% wear**, and some other top lubricants **under 5% wear** for that 1000km block. The average wear rate for the **5 worst lubricants** tested to date is **29.2%.** In a test block that is pretty close to riding on your ergo.

Things become much worse if you were to head out onto the trails, again the **top 5 lubricants tested average 2.6%, the 5 worst lubricants tested averaged 71.3% wear.**

I would like to state that I believe a lubricant that shows only 2.6% wear (of the chains 0.5% wear allowance), vs a lubricant that delivers me 70% or higher – who would categorize such a performance gap as basically the same – yep, both just work fine.

If you caught ebola, and one medicine has you with a 2.6% chance of dying, and the other gives a 70% + chance of dying – do both medicines "Just Work"?

If your local florist thought that yeah hey, all those countless bike lubricants just work – sure – they likely haven't really thought about this area much.

But when you are the head tech guy for cyclings largest company, and you are dispensing "knowledge" in this area – personally I think he has a responsibility to do much better. When such information comes from such levels, is it any wonder many others running cycling podcasts can get it wrong too, and more terrible information just keeps cascading.

And then more & more chains and drivetrains meet a very early death from oh so easily avoided friction.

Right, so, having hopefully established that they don't all "just work", and that you will be well rewarded for spending that little bit of time choosing a proven top product of just randomly anything / recommendation from those who know very little re lubricants - it is important to finish by reminding that you still need to ensure that this lubricant choice is a match for your type of riding.

As such check out the cost to run modelling data, there is no other such data in the world I am aware of that can more accurately point you in the direction of the right lubricant choice.

And then you can buy more fun stuff every year vs replacing chains / cassettes / rings!!!

Key Learning 7 - Great options for multi day events / bike packing.

This question comes in a lot, and really it needs to be broken down a bit into some main categories and options – but it is mostly easy, however can depend on budget.

I am going to assume that one is immersive waxing or with a chain coating lubricant like UFO / SS drip / Tru Tension Tungsten All weather, and wanting to ensure they keep their chain low friction / not contaminate when come back home to waxing. Those who run wet lubes just pack their wet lubes.

Firstly;

Is it a multi day Race or just a groovy cycling holiday?

Is it going to be dry or some wet stages / days.

It is a race, and it should be dry.

- Pack a bottle of UFO Drip or silca ss drip / Tru-Tension AW, re apply at end of each day and allow overnight set. You can then just re wax when you get home. Sweet.
- Start with a chain prepped with an extremely long lasting lubricant such as Rex Black Diamond / Revolubes / AB's Graphenlube (ouch expensive for the latter) for road. For offroad - Black Diamond + Race day spray / liquid. Depending on the event, these may easily last the entire event.

It is a race, and it is likely to be wet on some / all days.

- Ok so remember key learning 4 (or go read key learning 4 about what happens to your chain in wet weather riding). Effectively re-setting contamination whilst away can be tricky especially with packing restrictions.
- The absolute best option is to pack multiple chains. If you put on a freshly waxed / UFO / SS drip chain – you are back to super low friction again to start that day.
- Even if it is not feasible to pack enough chains for the wet days, then at least you can get back to a super low friction every second day etc, and do your best with what you have available to flush clean chain and re apply your go fast lubricant for next stage.
- NOTE – UFO drip / SS drip MAY not last through some long harsh stages. MSW / Hot melt likely will. Remember chain coating / wax drip lubes, half of what you apply is carrier (at least). Immersive wax is 100% lubricant. Take into account options for next day if it is going to again be long and wet. Ab Graphene lube (ouch) has very strong performance for wax lubricant in wet conditions – as does Tru-Tension Tungsten All weather albeit for medium length only. If AB too expensive, you may need to use a longer lasting lubricant that is not wax based, and also be prepared to re lube during the ride if you can & you need to.
- A chain without proper lubrication can easily hit 15w+ losses. That will be good 10w+ of energy every pedal stroke going into wearing out your chain and drivetrain vs pushing you forwards further. If your chain is clearly running badly – if you can (offroad event vs road race etc) – a quick re lube is well worth it.

- You may need to consult the Single Application Longevity data (lubricant test page) for long lasting lubricant options in wet conditions, and see if feasible to pack, or pre prep a chain or two with those options for known long & wet stages.
- Dont overly stress about having extra chains. If you race, you normally train a bit. If you train a bit, sooner or later you will need new training chains. Pre buying your next training chain/s to cover you for a major race event that you trained hard for and probably spent a bit of money getting to is a pretty smart decision. Your chain is by far your hardest working part, and it will eat the most watts if you get its lubrication wrong. Not all of your competitors will be as clever as you on this front. If they just hammer the one chain, and it's been wet, it will cost them quite some watts indeed in the latter stages (and drivetrain wear).
- Some of them will even turn up to race on the same chain they hammered away at in training! Don't do this. Use a dedicated race chain/s.
- If you snap a chain or bend a link, you have a spare fast chain to put on back at pits, and you are not buying a new very slow contamination magnet factory grease chain.

It is not a race

- Decisions are really going to depend on things like how many days, expected conditions etc.
- **It is pretty much same as if it was a race – refer above.**
- Sure you aren't worried about friction losses impacting your speed, but those same friction losses will increase your drivetrain wear.
- If it is going to be wet, definitely consider packing an extra chain at least to share the load.
- Packing an extra chain = more weight, but as a % of system weight of bike + gear + rider = 250grams is not so much, and it could really save your trip. Honestly sometimes you are just one bad shift away from bent link or chain snap, and that can really ruin your day depending on your spares and chain breaker (you packed one yeah?). We all know mechanicals can happen. And your chain is your hardest working mechanical part. By miles. Snapped chains / bent links happen. A smart rider packs a spare derailleur hanger / universal hanger. A smart rider

packs spare master link (a used one). A smart rider also packs a spare chain.

Key Learning 8 - If you race - have a dedicated race chain and training chain.

This one is pretty simple. Even on the best lubricants, your chain just does SO MUCH WORK, and it is completely exposed – that as the thousands of km's of training clock up, it will lose efficiency.

Especially so for those on drip lubricants that just keep adding more lubricant. There can for many drip lubricant users be an easy 3 to 5w gain just for them properly flush cleaning their chain and re lubing if using existing chain for an event / race. Less so if on one of the proven top lubricants and you just ride dry road, more so if you are on whatever random choice and especially if you are riding offroad / some wet riding.

You are always going to need another chain. Pre buying another chain to be your dedicated race chain costs you no more. Then when training chain is at 0.5% and should be replaced, your race chain moves over to be next training chain, one new chain as per normal to be dedicated race chain.

You do not see any pro racers (unless they are missing a circuit in the ol noodle) rocking up to an important race on the same chain they just hammered out their last few months training block on.

Yes sure, they may get free chains and you don't.

But if you race and you cannot afford to pre buy your next training chain to have as a dedicated race chain, then you need to follow some of the knowledge contained in sections above and you will soon have the money to do so.

I expect that most racers will be able to afford to buy one more chain. It is just a really simple, really smart way to roll.

You can look into fully optimized race chains (and also how to do yourself – Ultrasonic cleaning and race chain guide is in instructions tab) if you have more budget allowance.

With the right products, it is very easy to keep a dedicated race chain extremely low friction for many races, as you have more time to ensure it is re treated and kept mint ready for next race.

One very important point!

Nothing new on race day! Ensure you have checked your race chain under high load in ALL cogs and rings.

It can happen that one pops on a race chain, but their cassette / rings are worn from previous training chain running too long & or poor lubricant, and then the new chain will jump under power. That will really ruin your event. It can even jump off worn rings under stand up power and send you over the handle bars.

Not cool. All the better to ensure running a top lubricant choice for your training chains, and staying on top of your chain wear to avoid running a chain too long.

I test new chains by riding at about 5kmh, with the front brake on, and easing into the max torque power I can heave into pedals. I do so in each cog and both rings. I keep my weight back (ie even though I am standing up pedalling, I do not have my bodyweight leaning over the handle bars) – this way if it jumps, I won't hit the deck. If you cannot get it to jump doing this, you should be golden on race day. If it jumps in a cog – worn cassette, if it jumps off a chain ring, worn rings.

Key Learning 9 - E-Mtb's eat drivetrains

Not surprisingly, the combination of very high power and torque, and operating completely exposed to the world of dirt and dust – E-mtb's just love to eat through chains, cassettes and chain rings.

At this time the best options to prevent this may not be what E-Mtb riders want to hear, but alas – that can be the pesky nature of facts sometimes. They can be nothing if not factual.

If you have jumped to this section, I will now need you to scoot back up to section one and learn about wet lubricants and offroad riding.

That is a bonkers combo even when you do not have a motor.

There are some E bike specific lubricants, and they may indeed have amazing attributes like X % higher film strength for high pressure loading and the like.

But if there is contamination in the lubricant, and if it is a wet lubricant it absolutely will have a good bunch of that mixed in quite quickly – no film strength will prevent the contamination being ground into your chain metal every link articulation.

Absolutely everything covered in Key learning 1 applies here to E-bike lubricants if it is a wet lubricant, just add "more worse" due to more power.

If your e-bike is ridden on road only, then yeehaa the top wet lubricants may well be a great option for you – try them and track the km's to 0.5% (strava makes this easy, you can add chain as a new component to bike, and then km's for that component are tracked by strava).

Okay – I am now going to assume you have read key learning 1, and understand that riding offroad, and under high power, you probably really want to run the proven lowest wear lubricant options possible like mspeedwax, Silca hot melt, Ufo drip, Silca SS drip etc.

All you need to do, is simply not push treatment lifespans, and understand that riding with very high power and high torque load, their treatment lifespans will be reduced notably.

In my offroad cycling I might get 8 hours easy of silky smooth waxed goodness (msw or hot melt). If I was on an E-mtb, I am going to want to halve that and re-wax by 4hrs max.

UFO / SS drip - halve that again as they have lesser lifespans due to half of what is applied being carrier vs immersive wax is 100% lubricant.

Again if this seems like it may be a hassle, just run a couple of chains on rotation.

I don't have e-bike specific test data, but we can easily use the cost to run data we do have and just make it a lot worse for the fact that you are running a motor. And we can also see the carnage that occurs in general.

The wear rate and therefore cost to run difference between running a top wax / chain coating lubricant – that have the HIGHEST dry dust contamination resistance, simply ensuring you re treat frequently – will save you an immense amount of chain and drivetrain wear vs just running a wet lube, in the world of dirt and dust, under very high power - even if it is an e-bike specific wet lube.

Chains

There is also a huge difference in chain wear rate durability. Many e-bike specific chains have very poor wear protection because they decided not to bother doing that in lieu of giving you greater pin riveting strength.

I highly recommend Shimano link glide for 10 /11spd or even their normal 11spd chains as shimano chains are e-bike rated and 11spd have passable longevity.

For 12spd the shimano XTR chain is outstanding with near double wear rate longevity of their Dura ace 11spd, and are of course e-bike rated. XT is probably similar but I cannot state categorically yet as have not had a chance to test, but ultegra and DA have similar longevity, I expect XT and XTR will also be similar.

Srams x01 / xx1 chains are UNBELIEVABLY durable against wear. They are pretty much double the awesome XTR, and so are around 4x durability of many 11spd chains. There is nothing remotely close to srams x01 / xx1 chains re resisting wear.

However – they are not e-bike rated, so you need to take that into account.

It is worth noting that ALL bicycle chains have a tensile strength at minimum of 8000N (global standard), and many test well past this. There are some factors involved in converting that to pedalling watts (crank length, chain ring size, torque and cadence etc), but even worst case assumptions on those values we are looking at that equating to about 6000 watts.

If you have a 6000w e-bike, you are possibly skirting some local laws…

The problem is that we often don't ride with a straight chain line, and whilst in normal circumstances the tensile strength is not greatly impacted at all when running on chain line angles – the chains are designed for this – it can only take one poor rivet to let the whole shebang down.

Assuming though your chain does not have poor riveting on any link from manufacture (which should be most chains – but again, there is a reason pro's often check chains under full load and then visually inspect before race runs) – **then the main problem is shifting under load.**

There can be times where e-bike riders are shifting under high power, going up hill, on bumpy ground – and during pick up to next cog load may be running through only a few links for a split second, and at an awkward mesh time when moving between cogs. It is shifting that with a mechanical drivetrain and just a human doing the work, no sane person would try to execute such a shift, but… an electric motor can really mask just what you are doing to your chain.

An e-bike specific chains greater riveting strength gives you a lot more protection against ripping an outer link plate off the rivets in such behavior.

Some e-bike riders will have no issues whatsoever running a non e-bike chain. Others will snap them before they have made it to the end of their driveway. And obviously quite a spectrum in between.

So the world of astounding chain durability – especially with the right lubricant choice – may be open to you if you are fine to run a non e-bike rated eagle x01 / xx1 chain. If not, stay with shimano chains (note their 12spd chains you must run a **SHIMANO** 12spd compatible chain ring as their hyperglide+ chains need a specific chain ring tooth pattern, they will not run on narrow wide chain ring profiles).