So, first of all, I want to make some introductory notes which, while being obvious for some, might be of great value to others, who aren't so technically inclined, or just simply haven't had it explained this way.

The Mini Cooper S R53, because of the way the intercooler sits on top of an already very tight and supercharged engine, once tuned, starts struggling with heat. While the coolant temperature is easy to address, installing a lower temperature thermostat, for instance, the Intake Air Temperature (from now on referred to as IAT) not so much.

The Mini Cooper S R53 is not like the Mini Cooper S R56, in which you can "easily" get 70 ft-lb from a tune.
The easiest way to notice a bump in performance on a Mini Cooper S is to install a reduction pulley on the supercharger (which is about the only mechanical way, along with the enlarged crank pulley, that you have to add more boost) and increase the rev limiter.
But each of these mods will, in turn, demand more from the supercharger and take it beyond its optimal working range. Why? Because it will spin the supercharger faster, thus generating more heat.

For you to have an idea, with the stock pulley and rev limit, at 6950 RPM, the supercharger is spinning at 14749 RPM. With a 17% reduction pulley installed, the supercharger will be spinning at 14749 RPMs at 5761 RPM, so, almost 1200 RPM down the rev range. At 7500 RPM, with the 17% reduction pulley, the supercharger will be spinning at 19200 RPM, which is 30% more than with the stock pulley at the stock rev limit (6950 RPM). We all know that manufacturers build stuff with tolerances, but 30% will always be 30%, and the supercharger's flow chart/efficiency map are not merely indicative.

The stock IC copes well with the original stock pulley and rev limiter, but it just can't cope with a reduction pulley and higher rev limits, because it starts dealing not only with its own inefficiency, but with the supercharger's as well.

And why is this added heat so prejudicial? Well, not all air is equal... when you crank up the boost you will be generating more air, but because of the way the air is compressed, the air will present less density, thus the need to cool it down to increase density. Think of density as the air's quality.

That's why in a colder day/night, the car responds better than in a warmer day/night... the air density is better.

So, now that we understand that with more heat comes more responsibility, it's time to address the variable we can address... the intercooler!

We have different intercooler systems (Top-mount; Chargecooler; and Front-Mount) available to our Mini Cooper S R53, each with their advantages and disadvantages.

I don't want to go to great lengths exploring all the different solutions between the 3 types of available systems, so I'll focus on the more generic ones and sum it up like this:

Top-mount:

Advantages: Easy installation; Maintenance free; Plug and Play
Disadvantages: Worse in keeping intake temperatures down

Front-mount:

Advantages: Good at keeping intake temperatures down
Disadvantages: Loss of boost due to piping re-routing. Not plug and play; many require A/C removal.

Chargecooler:

Advantages: Good at keeping intake temperatures down
Disadvantages: Not plug and play; Adds the weight of the water from the circuit; the electric water pump; external reservoir and the radiator; May lose a little bit of boost when compared to some top-mounts.

I decided to do this review because I was going crazy with the fact that there was no data available on the Pro-Alloy Top-Mount intercooler, which had a unique design and, from my understanding, all it needed to perform quite well. Thing is, not only we had no data, as there was some kind of criticism in the air regarding fitting, but without being very objective about it... how it fails, why it fails, etc...

So, I came to the conclusion that, in this particular case, if I wanted data, I would have to collect it myself. And if I wanted to know exactly what was going on with the fitting, I'd be better speaking directly to the source. And this was when I decided to get in touch with Pro-Alloy. So, I sent them an e-mail, providing some background on myself, the questions I had and what I had to propose: A discount in return of a complete review of their intercooler. And, although my main objective had always been the Pro-Alloy, I also sent a similar e-mail to another company, proposing the exact same thing, while letting them both know of this fact.

The other company's reply made me laugh, as I had been quite thorough in my explanation, and they simply pointed me to a site where I could see the result of their IC on a dyno, it was like: Dude, this is all you will ever need to know about our IC. I didn't even bother replying.

And then, when I was starting to lose hope, Pro-Alloy answered...

Regarding the fitment issues they had, this is what Chris Hazell wrote me:

"Hi Citro, many thanks for getting in touch. As you correctly say, we did have some issues in the early days when we first developed this kit and we did make a few subtle revisions to remedy this. Quite often, especially when looking to create an upgrade of really significant proportions, we do have to work to very close tolerances and in the case of the R53, some of these tolerances proved to be a touch too far in some fitments. We noticed that there were a few discrepancies between vehicles, and some cars did have clearance issues where others did not. We made some small alterations to the air guide which has corrected the fitting issue and we haven't had any repeat problems since.

We also noticed that there was the potential for a boost leak from the bolt on flange assembly. This was due to slight distortion from the welding process and we have put a system in place to deal with this once the unit is complete. Following completion of a new project like this, it is not uncommon to come across small areas that need attention, and the professional way to deal with this is to listen to customers' views and act accordingly. We are immensely proud of our handmade products and we believe we took the right approach to correct these minor issues from the early production batch."

So, contrary to the other company, they did take the time to read my whole e-mail, found it to be a very interesting approach, and treated me with due respect (things that I do value). So, after discussing all the details, and making sure we were on the same page, we were good to go. Oh, one aspect I must highlight is that I told him I would compare their IC to as many others as I could, but that in no way I would alter the data in their favor. So, whatever their IC would show, would be exactly what I'd be showing in the review. And to this, he also replied with no hesitation, telling me that that was precisely what they were after, showing the utmost confidence in their product, which, in turn, gave me the confidence to keep their product.

Almost all of the tests (only the Airtec wasn't) were made in my private road, in the exact same places. The aim of the tests was to try and replicate real life situations with which one can easily relate to and even compare, if curiosity arises... so, the tests consisted in:

A 3rd gear pull in a straight line, from 2600 to 7200 RPM
A 4th gear pull in a straight line, from 3150 to 7250 RPM
A 3rd to 5th gear pull (from 2600 in 3rd gear until 6500 RMP in 5th gear) in a straight line, with a 30 second rest period, and a new pull, 2nd and 3rd gear, but now uphill

All these logs were at WOT (Wide Open Throttle).

Almost all of the logs (again, with the exception of the Airtec) were captured via my ByteTronik data logger, which captures data with 150ms intervals.

What I couldn't control: The weather.

Relevant notes:

The ICs I tested directly on my car were: Chargecooler (my previous setup); stock; and Pro-Alloy. I feel it's important to highlight this as these are the more "apples to apples" comparison, although I do feel there is room for some extrapolations, based on the data collected from the other cars. But we'll get there...

My car has: A Sprintex supercharger with a 60mm pulley, a TPR-1 Cylinder head; a Newman cam (the first ones); Mynes V2 headers with tomcat and JCW catback; ByteTronik tune;

The car with the GRS Motorsport IC has: Eaton M45 with a 17% reduction pulley; 1320 Catcam; TPR-2R Cylinder head; Janspeed de-cat headers with JCW catback; custom tune.

The car with the Airtec IC has: Eaton M45 with an 18% reduction pulley; Worked cylinder head; Newman cam (ph2); Milltek de-cat headers; Milltek catback; custom tune.

One of the cars with the GP IC has: Eaton TVS900 with 60mm pulley; Worked cylinder head; Newman cam (the first ones); OBX headers with tomcat; Direnza catback; custom tune.

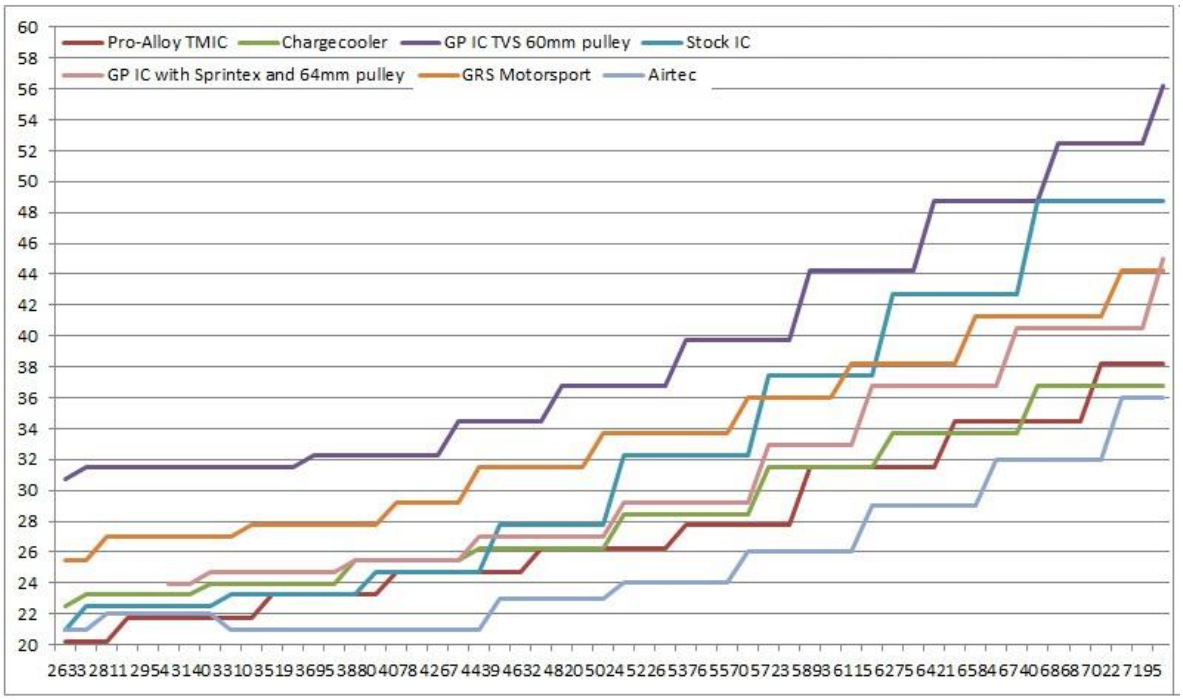
The other car with the GP IC (from which I only have data for the 3rd gear pull) had: Sprintex supercharger with 64mm pulley, TPR-2R cylinder head; 1320 Catcam; Mynes V2 headers with de-cat; JCW catback; ByteTronik tune.

I focused on boost, IATs and, when possible (only on my car which has the Bytetronik software installed), on Air mass as well.

So, enough chatter for now, let's get down to the numbers and charts...

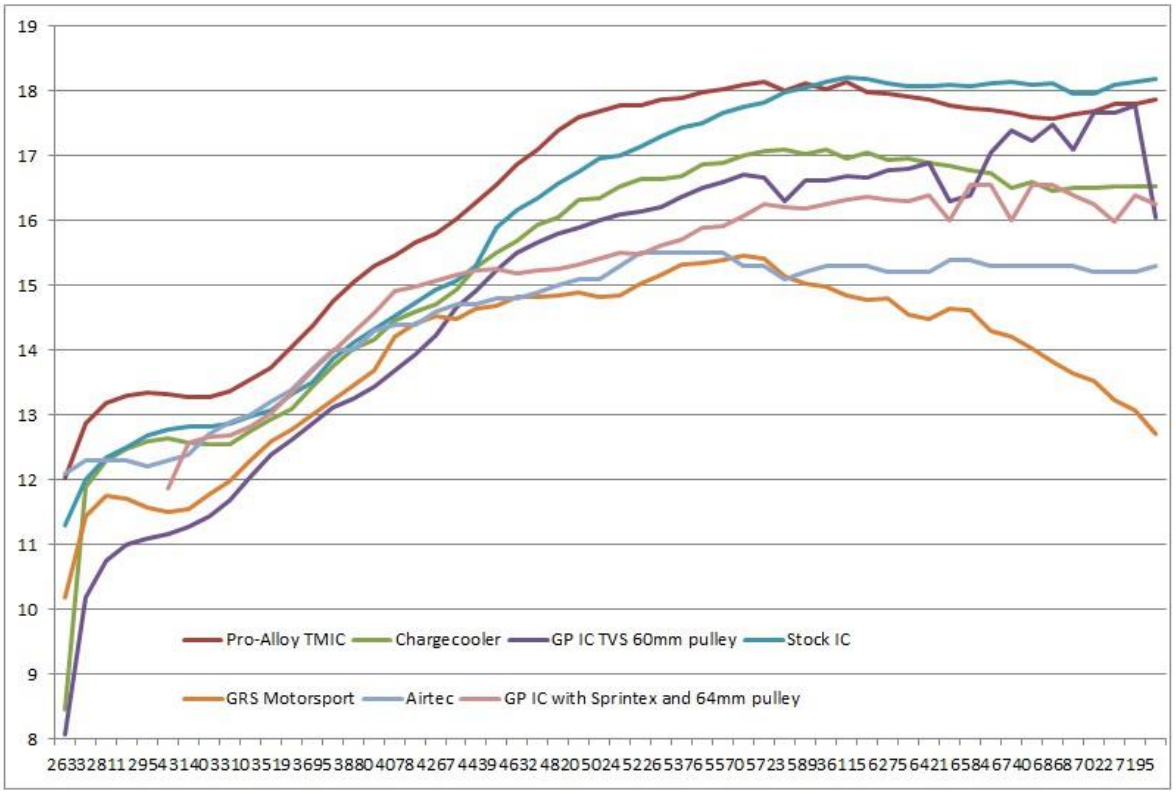
3rd gear pull, IATs

3rd gear pull (from circa 2600 to 7200 RPMs) IATs in degrees celsius



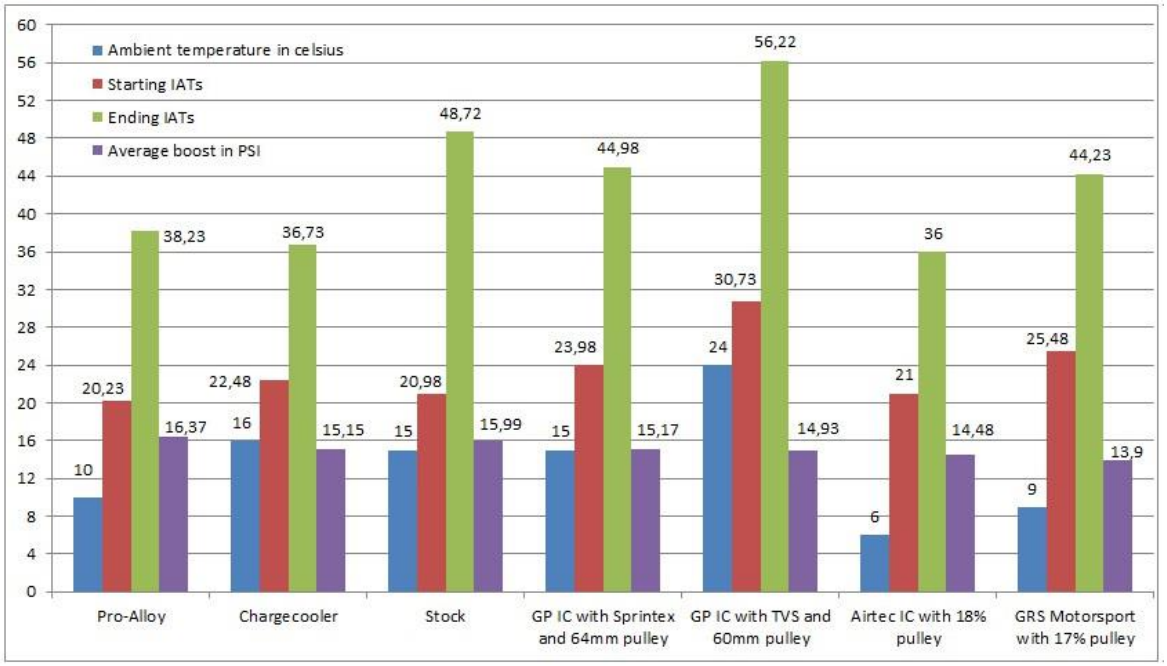
3rd gear pull, Boost

3rd gear pull (from circa 2600 to 7200 RPMs) Boost in PSI



3rd gear pull summary

3rd gear pull (from circa 2600 to 7200 RPMs)



3rd gear pull summary in numbers

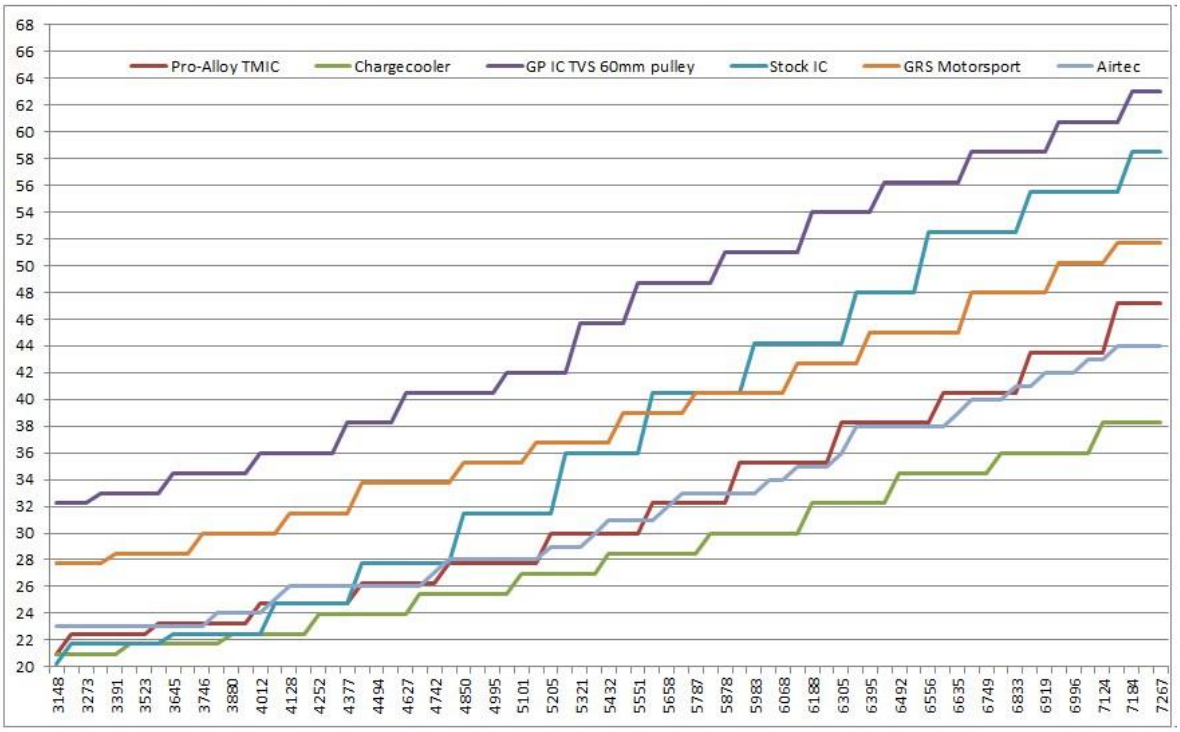
3rd gear pull

	Pro-Alloy	Chargecooler	Stock	GP IC with Sprintex and 64mm pulley	GP IC with TVS and 60mm pulley	Airtec IC with 18% pulley	GRS Motorsport with 17% pulley
Ambient temperature in celsius	10	16	15	15	24	6	9
Starting IATs	20,23	22,48	20,98	23,98	30,73	21	25,48
Ending IATs	38,23	36,73	48,72	44,98	56,22	36	44,23
IATs Delta	18,00	14,25	27,74	20,99	25,49	15,00	18,75
Average boost in PSI	16,37	15,15	15,99	15,17	14,93	14,48	13,9
Average Air Mass in g/s	158,45	149,13	153,40				
Average Air Mass in g/s divided by Average boost in PSI	9,68	9,84	9,59				

The car with the GP IC and Sprintex with 64mm pulley started pulling only from 3000 RPMs onwards

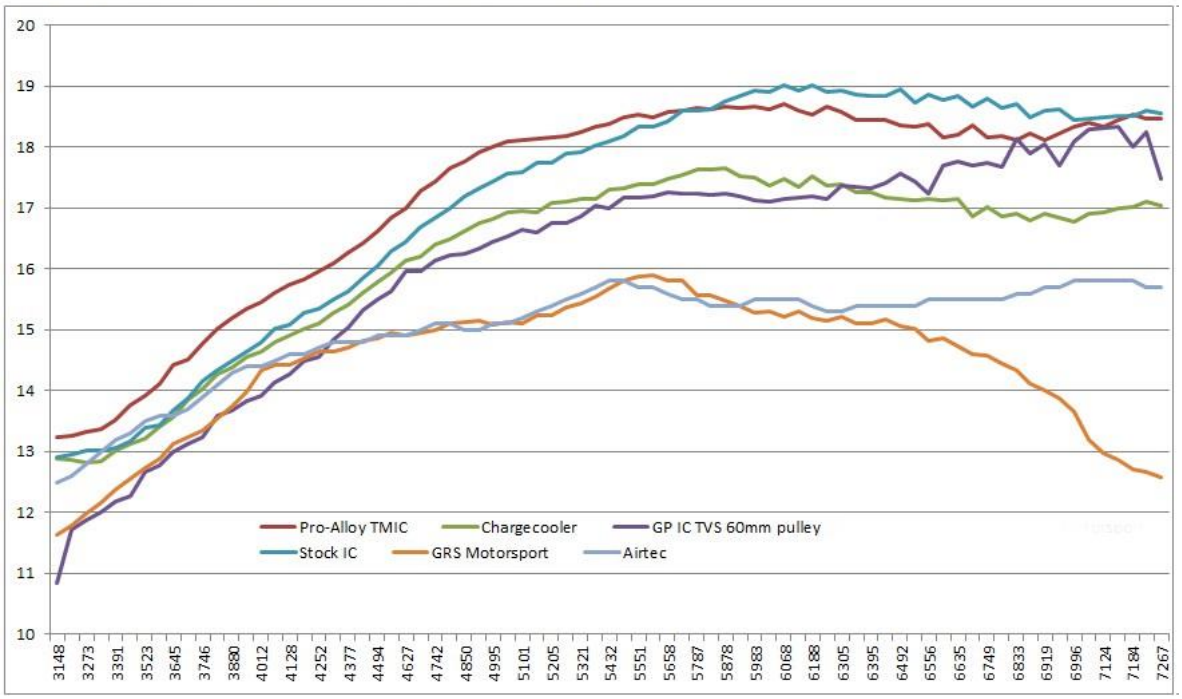
4th gear pull, IATs

4th gear pull (from circa 3150 to 7250 RPMs) IATs in degrees celsius



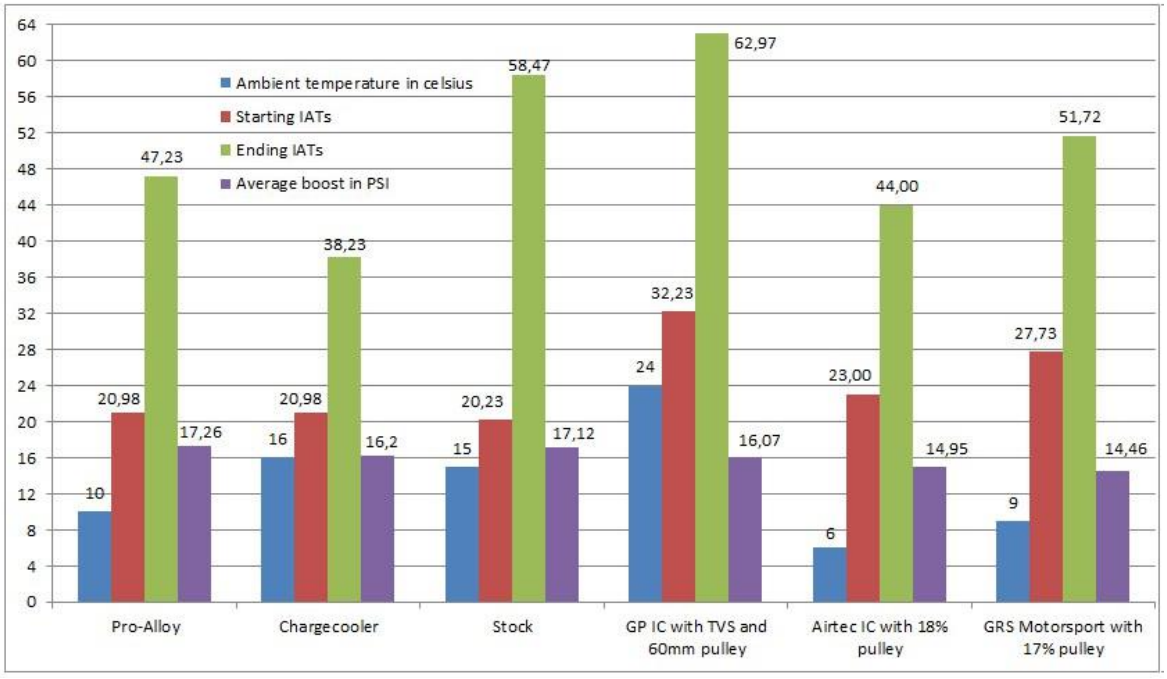
4th gear pull, Boost

4th gear pull (from circa 3150 to 7250 RPMs) Boost in PSI



4th gear pull summary

4th gear pull (from circa 3150 to 7250 RPMs)



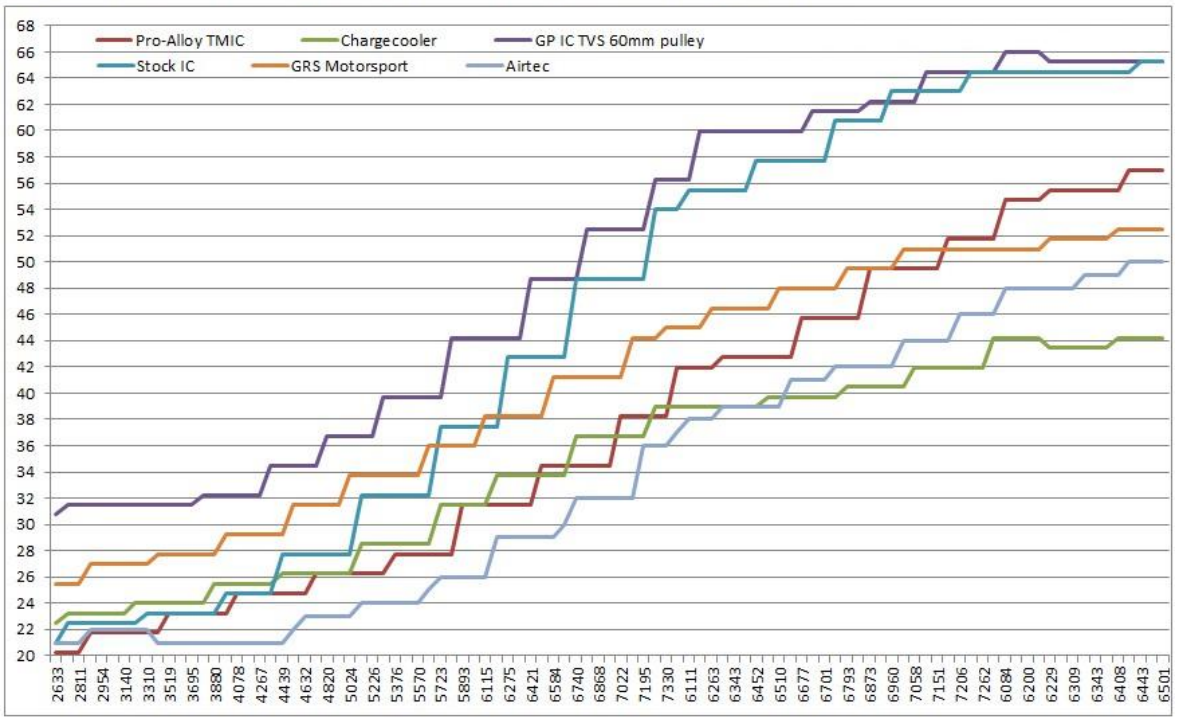
4th gear pull summary in numbers

4th gear pull

	Pro-Alloy	Chargecooler	Stock	GP IC with TVS and 60mm pulley	Airtec IC with 18% pulley	GRS Motorsport with 17% pulley
Ambient temperature in celsius	10	16	15	24	6	9
Starting IATs	20,98	20,98	20,23	32,23	23,00	27,73
Ending IATs	47,23	38,23	58,47	62,97	44,00	51,72
IATs Delta	26,24	17,25	38,24	30,74	21,00	23,99
Average boost in PSI	17,26	16,2	17,12	16,07	14,95	14,46
Average Air Mass in g/s	172,28	166,77	167,50			
Average Air Mass in g/s divided by Average boost in PSI	9,98	10,29	9,78			

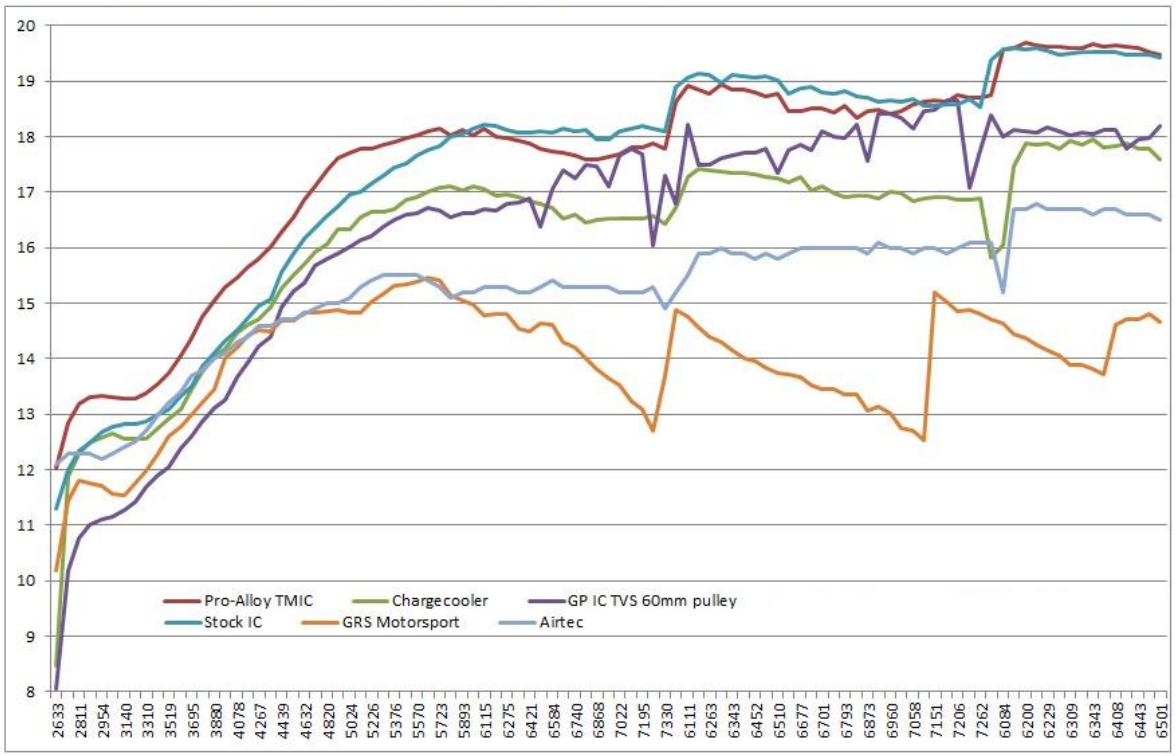
3rd gear to 5th gear pull, IATs

3rd (circa 2600 RPMs) to 5th gear (circa 6500 RPMs) pull IATs in degrees celsius



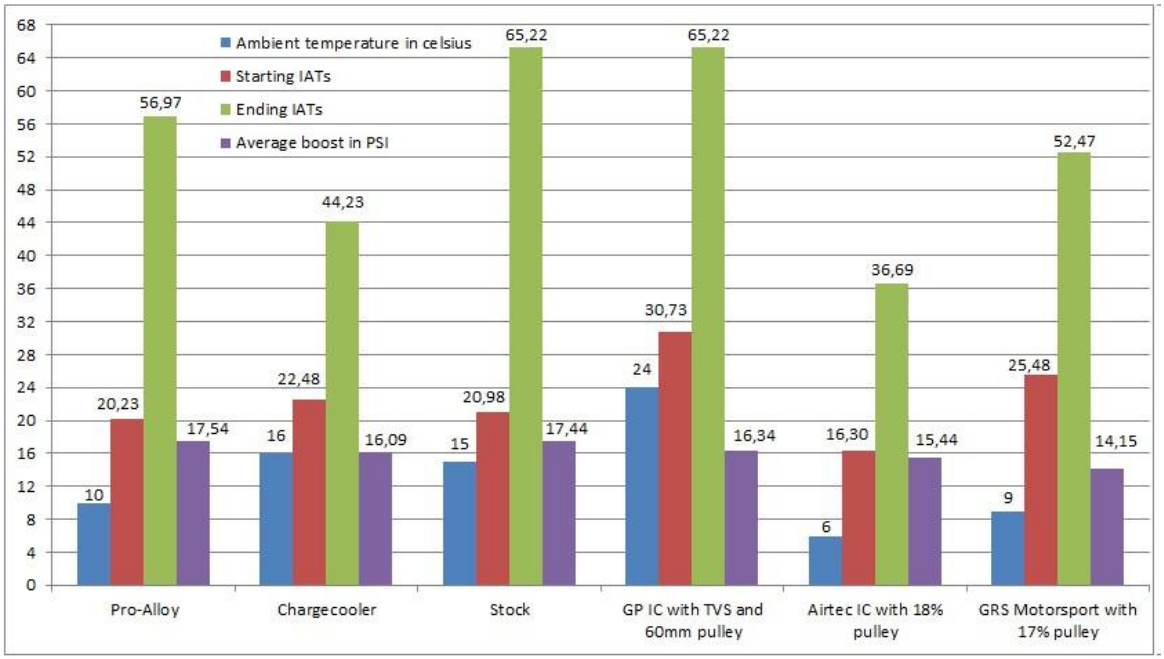
3rd gear to 5th gear pull, Boost

3rd (circa 2600 RPMs) to 5th gear (circa 6500 RPMs) Boost in PSI



3rd gear to 5th gear pull summary

3rd (circa 2600 RPMs) to 5th gear (circa 6500 RPMs) pull



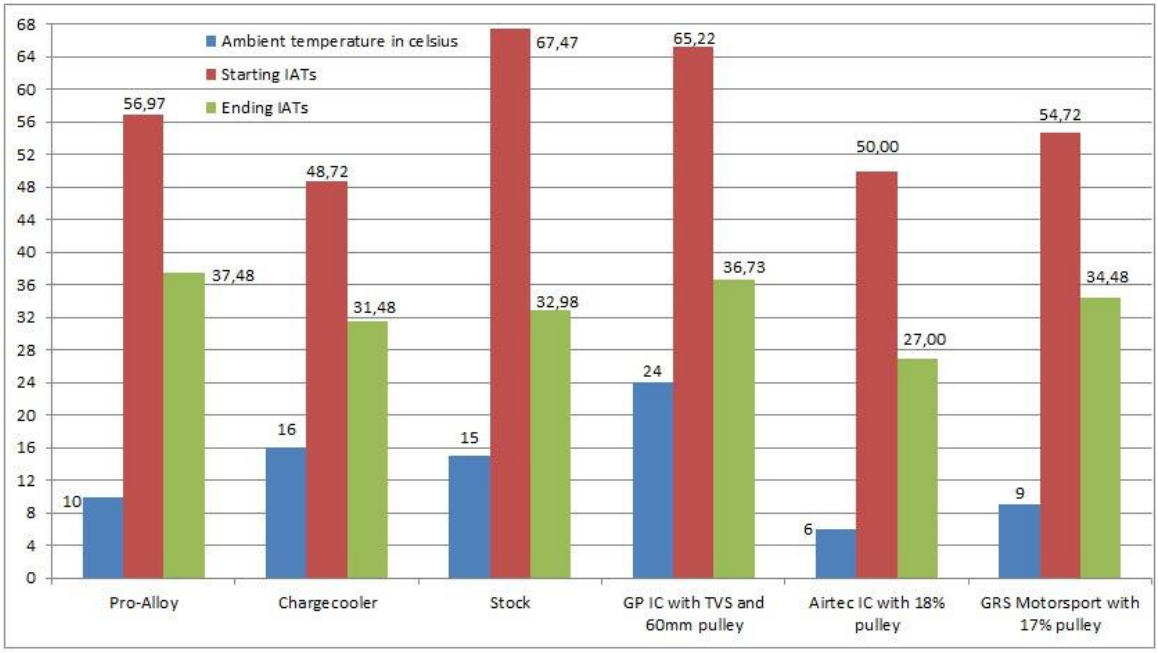
3rd gear to 5th gear pull summary in numbers

3rd to 5th gear pull

	Pro-Alloy	Chargecooler	Stock	GP IC with TVS and 60mm pulley	Airtec IC with 18% pulley	GRS Motorsport with 17% pulley
Ambient temperature in celsius	10	16	15	24	6	9
Starting IATs	20,23	22,48	20,98	30,73	16,30	25,48
Ending IATs	56,97	44,23	65,22	65,22	36,69	52,47
IATs Delta	36,74	21,74	44,24	34,49	20,39	26,99
Average boost in PSI	17,54	16,09	17,44	16,34	15,44	14,15
Average Air Mass in g/s	182,98	174,26	179,14			
Average Air Mass in g/s divided by Average boost in PSI	10,43	10,83	10,27			

30 second recovery

30 second recovery

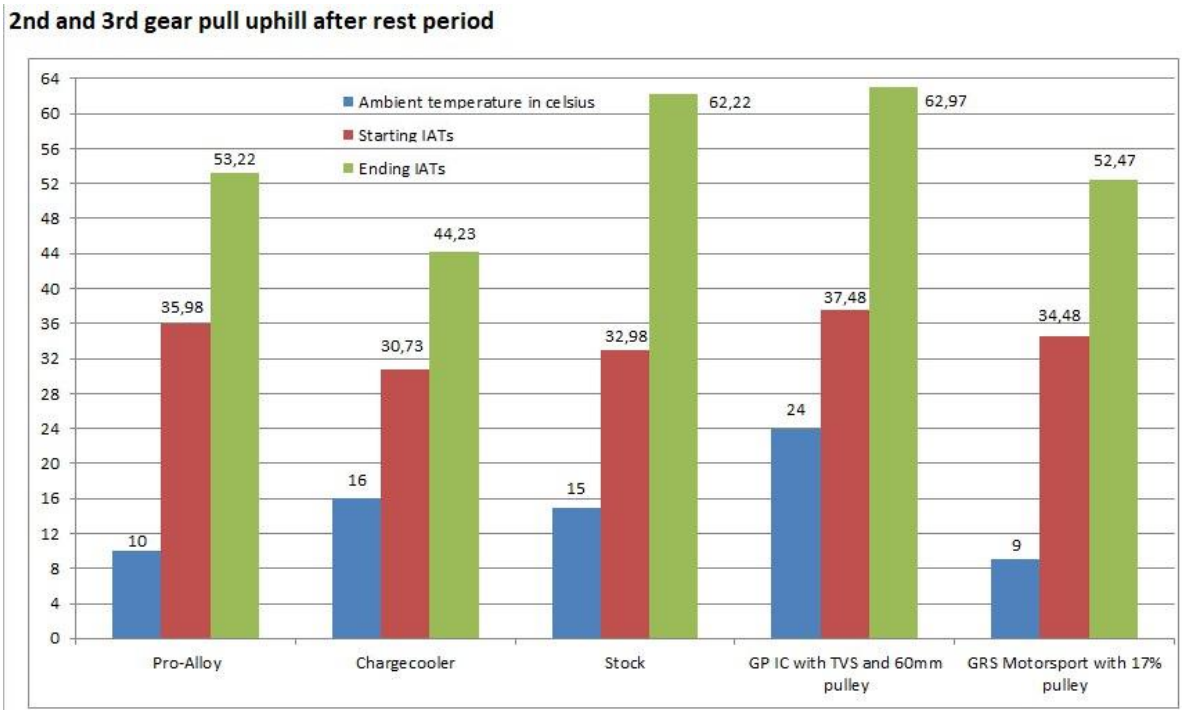


30 second recovery in numbers

30 second recovery

	Pro-Alloy	Chargecooler	Stock	GP IC with TVS and 60mm pulley	Airtec IC with 18% pulley	GRS Motorsport with 17% pulley
Ambient temperature in celsius	10	16	15	24	6	9
Starting IATs	56,97	48,72	67,47	65,22	50,00	54,72
Ending IATs	37,48	31,48	32,98	36,73	27,00	34,48
IATs Delta	-19,49	-17,25	-34,49	-28,49	-23,00	-20,24

2nd and 3rd gear pull uphill after rest period



2nd and 3rd gear pull uphill after rest period in numbers

2nd and 3rd gear pull uphill after recovery

	Pro-Alloy	Chargecooler	Stock	GP IC with TVS and 60mm pulley	GRS Motorsport with 17% pulley
Ambient temperature in celsius	10	16	15	24	9
Starting IATs	35,98	30,73	32,98	37,48	34,48
Ending IATs	53,22	44,23	62,22	62,97	52,47
IATs Delta	17,25	13,50	29,24	25,49	18,00

My considerations and analysis:

An IC, just as another component of the car you choose to change, should be well thought, so you know it will work its best in your given application.
I can't determine if a certain IC will be the best for your particular application, but I think I can give you a rough guide, based on my example. With the chargecooler, I had best IATs than with the Pro-Alloy, but I was also seeing roughly less 1.5-2 psi than I am seeing now with the Pro-Alloy. If I had a conservative pulley on the Sprintex, I could try and put an even smaller pulley on it and keep the chargecooler, but that's not the case, as it's already near its limit (reduction pulley wise). So, in order for me to win back some boost, once a smaller pulley wasn't an option, I had to look elsewhere, hence I tried going with a different IC. Once I put the stock IC on in another situation, the boost came up, but the IATs were just too high, so I knew that would not be a valid option for me. With the Pro-Alloy, my honest expectations were to pick-up some boost (compared to the chargecooler setup), and that my IATs wouldn't fall in the danger zone. And WOW, I was really surprised in the way the Pro-Alloy performed. It was a massive difference in average boost, and hell, I only lost 0.2 peak psi (in the lower gears) when compared to the stock IC! In the higher gears, I think the Pro-Alloy will see even more boost than the stock. And fortunately, not only the Pro-Alloy excels in terms of boost, but it also performs wonderfully in terms of keeping those IATs down!

So, how does it compare to the others (GP; Airtec; stock; GRS and chargecooler)?

Let's see...

The Airtec data is the only one I couldn't capture with my ByteTronik data logger, or do the tests in the same place, as my friend lives 200 miles away (my own private road can only stretch so far :)) His data was captured by other logging software, which is not as fast as the ByteTronik, so, not ideal, but it is what it is. For a fact, I might also add that my friend has now changed the Airtec for a GP IC and picked-up around 2 psi of boost, subsequently, seeing higher IATs as well.

The Airtec seems good at controlling IATs but at the expense of losing you boost, so, as boost and IATs rise proportionally, it's not directly comparable, i.e. it holds IATs better because it's doing less boost, which leads me to believe that, probably, at similar boost levels, it wouldn't cope as well as we are led to believe at a first glance when looking at the numbers. I know this is just speculation, but I don't think I'm that far off, to be honest, at least, considering what I saw in my car with the three different setups (Chargecooler, stock and Pro-Alloy).

The stock IC: Not much to say, really... basically, it's great for boost alone, but it just can't keep the IATs down.

The chargecooler: Great at keeping IATs down, but it robs you boost, so, if you're already at the limit of your pulley choice and don't live in a very demanding climate/terrain, maybe you could do better with a Pro-Alloy TMIC.

The GP IC: It's also good for boost, but from what I could see, it can't match the Pro-Alloy in terms of keeping the IATs down. If you look closely to the data, you will notice that there is only another car which is close in peak boost to mine with the Pro-Alloy, which is the car with the TVS900 and 60mm pulley. But, even that one, sees

considerably less average boost than I do, so, mine, despite having more average boost in all the pulls, was able to keep lower IATs than the GP. We could argue it could be due to the Sprintex being more efficient than the TVS, but if you take a look at the "3rd gear pull summary in numbers" you will see that the other car that also has a GP IC, has a Sprintex with a 64mm pulley, thus seeing considerably less average boost than mine (15.17 psi vs. 16.37 on the Pro-Alloy), and yet, IATs rise 3 Celsius degrees more (21 Celsius degrees rise vs. 18 degrees rise on the Pro-Alloy).

The GRS Motorsport version: As some of you might have noticed by the odd boost curves, my buddy had a problem in his car (and this is also one of the reasons why data logging is so important), we suspect that it was his tensioner that must have been very near the end of its life, as his belt snapped the week after we logged his car.
But even though the boost loss he was seeing, which actually ends up being favorable to an IC on the account of what I've explained earlier (higher boost will see higher IATs), the GRS didn't excel in any particular category. For the record, from older logs, his car was seeing around 15.6 psi of maximum boost. So, if the car wasn't losing boost on the day we've logged it, the IATs would have been higher, for sure. He says it's not uncommon to see 60-70 degrees Celsius when at WOT. My friend who bought me my Chargecooler, previously had a GRS Motorsport, and he also told me it was pretty common to reach those high temperatures... and this, with a still conservative 15% reduction pulley. He lives in a very demanding terrain, but now, with the chargecooler, I think the maximum he saw was 42 degrees Celsius. He is now thinking of going to a 17% pulley, as IATs wise, he has margin for it ;)

A little note on the Air mass data, which I find really interesting, as it gives you an idea on how your boost is being "eaten" by the engine... the more the better.
You will see that the Chargecooler has the best ratio of produced Air mass vs. Boost, meaning that despite robbing you a little bit of boost, it is indeed very efficient at what it does, hell, in some cases, it almost manages to reach the stock IC Air mass values, with circa less 1 psi in average boost. But the Pro-Alloy is king in this value as well.

Regarding one thing people often talk about, which is the recovery rate, I did try and replicate it with the 30 second rest period. Yes, the GP and the Stock ones excel at this, but they do get hotter than the other contenders, so, yeah, they do recover faster, but I'm really convinced that is mainly due to having more heat to recover from, at the first place. If you take a look at how fast the IATs rise, after pulling a 2nd and 3rd gear uphill once the rest period is over, in both cases, I think you will corroborate just that.

Hope you guys have understood and enjoyed this review, and that this information can actually shed some light on the Pro-Alloy, as well as in some of the more popular solutions available out there.

I want to thank Pro-Alloy, in the person of Chris Hazell, for sincerely trusting and valuing my work. I also want to thank all my friends that came to meet me in my own private road, as without them, it would not have been possible to conduct all the testing, data compilation and analysis, that, hopefully, will help the MINI community.