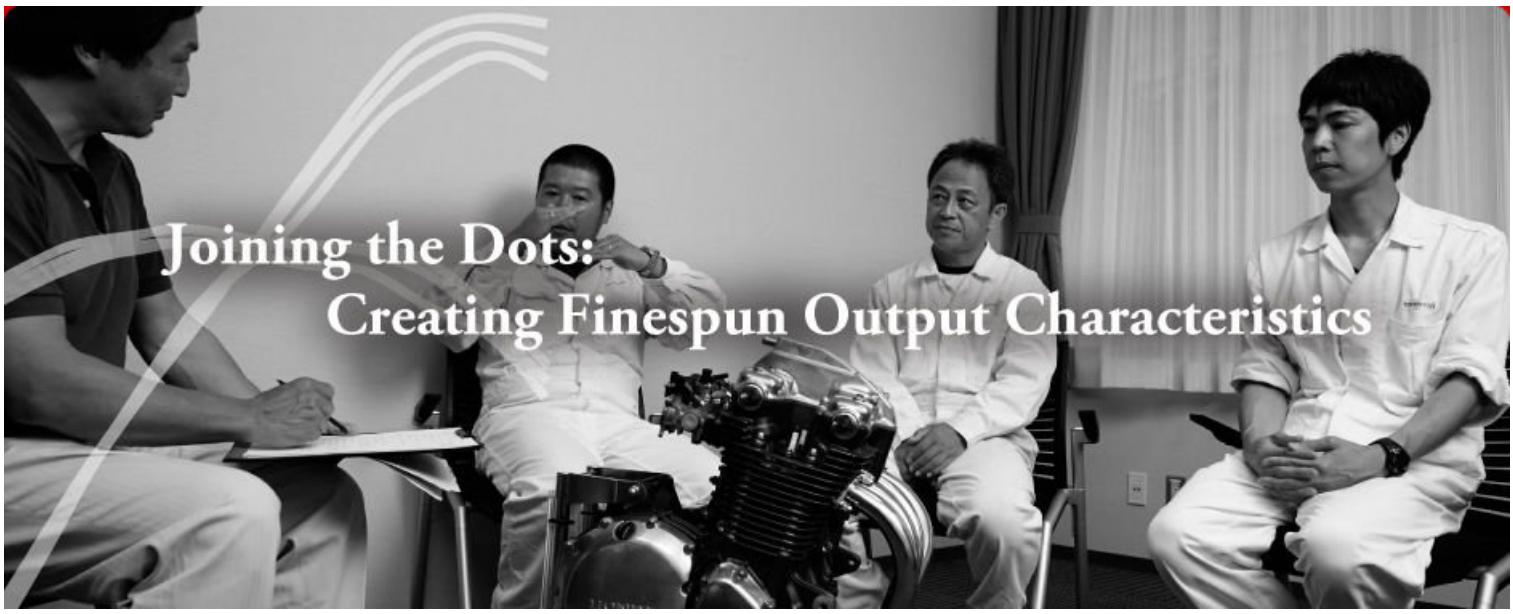
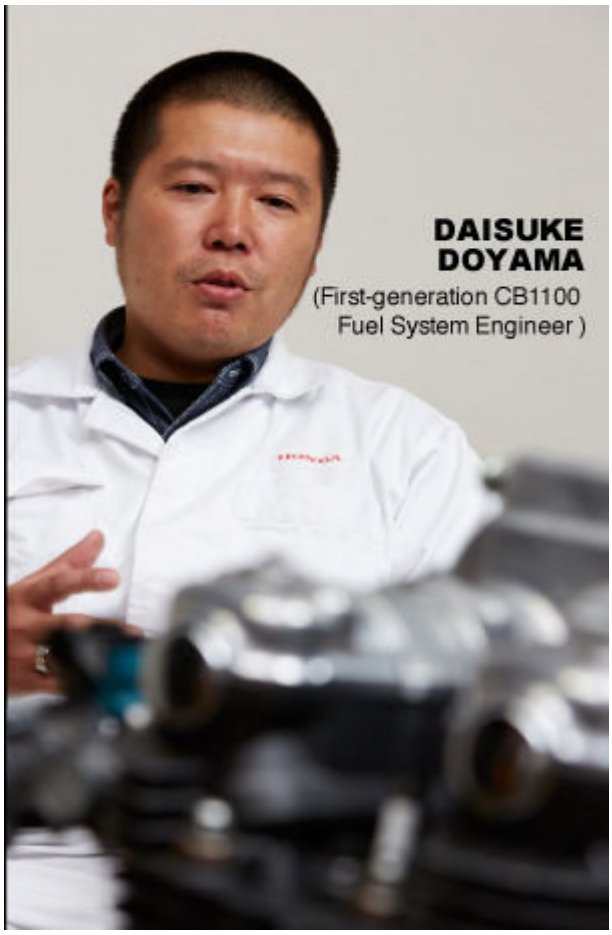


Output distribution for every 1° of throttle and 100 Revs



Sekiya:
Fuel injection is the crux of attaining the desired output characteristics. What did you do to fine-tune the deep rumble especially around the 3,000 rpm range?

Doyama:
It was no easy task, as what we were marrying the latest PGM-FI to old-fashioned, air-cooled hardware, clear emission regulations, and give it a personality on top of that.

We repeated the trial-and-error process to find how to express our goals of the bike's personality such as a 'freehearted' or 'relaxed' ride. It was like finding the 'point' or 'dots' of what we liked during testing, and then trying to join them up into a 'line .'

Sekiya:
How did you go about that?

Doyama:
Say, for example, we liked the feel of the bike when idling at 1,100 rpm and then opening the throttle just a bit to 1,500 rpm. What happens when we open it by another 500 rpm to 2,000?

If we liked the 1,500 rpm range, how do we adjust the

output curve? So, we'd search for these sorts of 'dots,' and find more, and join them up into a 'line .' We kept on doing this, a tedious, but necessary process. Since our bosses gave us more-or-less free reign, we could challenge the unknown. It was a satisfying, fun development effort.

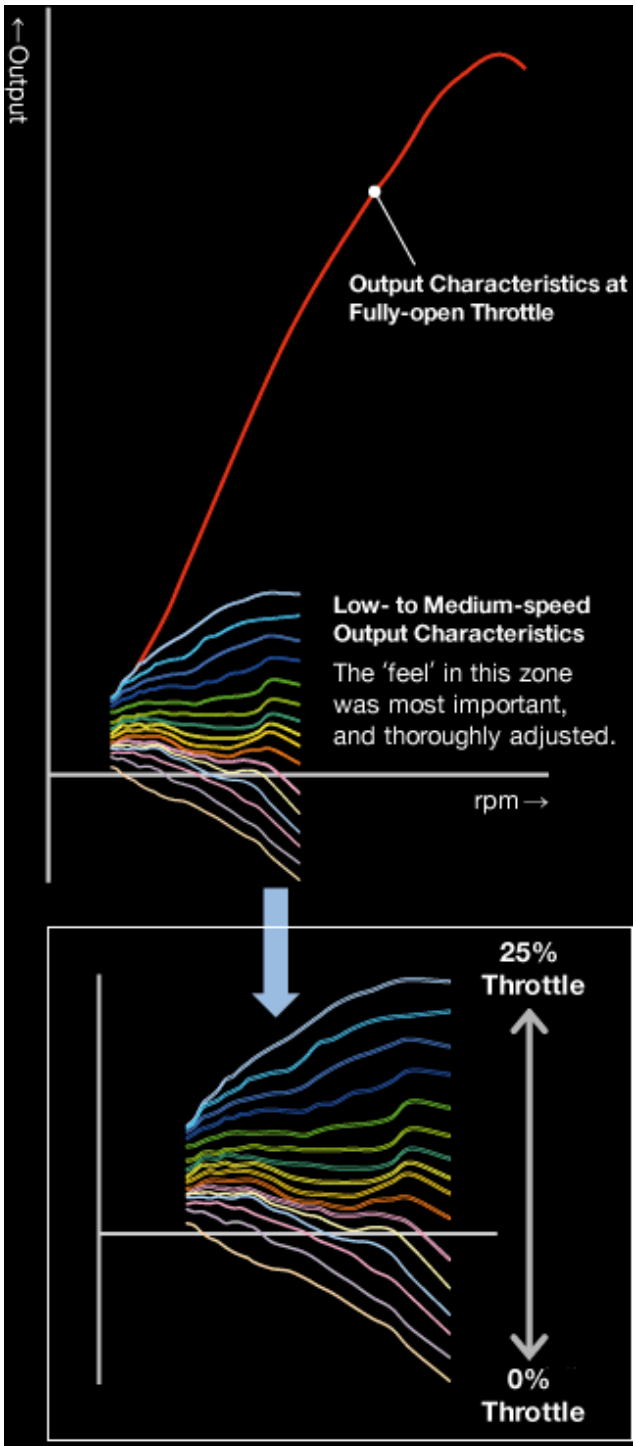
Sekiya:

Don't you usually do this?

Doyama:

The development process is mostly the same, but not as scrupulous. You don't have a 'relaxed' ride if you get a sudden push when partially opening the throttle from a closed position or opening the throttle during declarative minus output. By repeating road tests and theoretical analysis, we came to understand that low output transition and smooth output characteristics contribute to a 'relaxed' ride. So, we tuned the output distribution for every 1º and 100 revs between 1,500 and 3,000 rpm. With the CB1100, the correlation between the sort of feeling that 'it will be too fast at 1kW here' while on the bike and the actual output was important.

We therefore searched for the optimum output while asking ourselves 'how many kWs are the right kWs for a relaxed ride?' We had a lot of fun developing a mass-production model this way.



Output characteristics at each throttle amount at low- to medium-speed ranges

Output is maximum at 7500 rpm (full-throttle), but the 'feel' around the 1,500 to 3,000 rpm range was the priority, thus testing and intricate adjustment of output characteristics were repeated at each throttle amount between 25% and 0% throttle. The output is negative in the low throttle range, as internal friction is greater than engine output.

Sekiya:

I feel as if I'm speaking with a researcher, rather than an engineer.

Doyama:

Well, that's my field of expertise. The output curve in catalogs are graphs of the output per engine revs at full throttle, but we overlaid the output curve for every 1º between a closed and fully-open throttle. We

then identified on the graphs 'freehearted,' 'relaxed,' and 'deep rumble.' We then road-tested the bike, finding that some times we'd have 'deep rumble' but no 'relaxed,' and so on. Our work entailed modifying the CB1100's output characteristics from its base, the CB1300SF, and by this output distribution methodology, we can recreate on an air-cooled machine the feel of a water-cooled bike.

The engine feel for the 2014 model reflects and refines the opinions of our customers and the R&D Center, and we'll refine it even further. Maybe it will be a process of going as far as we can, then coming back to the beginning.

Sekiya:

I couldn't have guessed that the CB1100's low rev feel is founded on extremely scientific development. It's craftsmanship beyond the realms of the drawing board. I'm staggered at the intricate and even stubborn method of testing every 1º and 100 revs.

What is a deep rumble?

Sekiya:
What do you mean by 'deep rumble' at low revs when you talk about the CB1100's engine?

Korogi:
It's difficult to explain it in words. Personally, I think it's the feel of pre-1990 multi-cylinder engine with a carburetor at low revs.

Sekiya:
The range around 3,000 rpm is the 'sweet spot?'

Korogi:
At around 3,000 rpm, the four-cylinder engine vibrates strongly like a two-cylinder engine, and has a solid rev feel through the chain to the rear tire, giving a strong sense of traction, and finally a purposeful sound.
'Deep rumble' expresses the feel, through the five senses, of an air-cooled four-cylinder engine. When other members rode old air-cooled four-cylinder bikes for testing, they came to the conclusion that the CB1100's deep rumble feel is no different.

Sekiya:
In other words, it's the peculiarity, or taste, or character you wanted for the CB1100.

Korogi:
Large bikes are more a matter of personal taste than utilitarianism, so the character of the bike is that much more important. The exultant rise up the rev-counter and the unstoppable torque feel at low revs are fine, but an air-cooled four-cylinder engine has a unique stickiness to it, which gives it real character.

Sekiya:
In a time when design and manufacturing techniques were not as advanced, the designer could not get rid of the 'deep rumble' or 'metallic screech.' That became, what many riders considered, the feel of an air-cooled four-cylinder engine. But now, the accuracy we can achieve with our advanced technologies allow us to create the same feel.

Korogi:
That's right. The CB1100 is the result of taking the original 'feel' and refining it to what should be a modern air-cooled straight-four, fit for the 21st century. We'll be refining the deep growl even further, and I hope I'll be involved with the next model.

Behavior within the neutral area is paramount

Sekiya:
What did you focus on when developing the bike's handling and movement?

Korogi:
First I had to change my approach as I had been working on the super sports CBR's before. I moved to Kumamoto when I was assigned to the CB1100 project, and was able to ride around Mount Aso daily.
At that time I wanted to make a bike that the rider can enjoy the natural scenery on, a bike with a relaxed ride, and to do so, the bike would have to emanate a sense of stability and security.
The 3,000 rpm range is the 'sweet spot,' so on that basis we considered how the machine should move, and developed the handling and taste characteristics - and a response feel so the rider could 'talk' with the bike.

Sekiya:
What aspect was most important?

Korogi:
Handling composure. How the engine related to the frame. We wanted agility in the low-speed range, and a comfortable, confident upright position. In other words, the neutrality, or restoring moment was important to us.
The CB1100EX has two mufflers making it that much heavier, so we considered how to convey the weight mass smoothly to the body's movement. The answer we came up with was flexibility, like a fishing rod. The elasticity allows for a smooth input of the weight.

Sekiya:
How did you do that with the CB1100EX?
Korogi:
Take, for example, the rear axle. By reducing its diameter, the axle-shaft rigidity is reduced. The aim is to create a cushy feel, and increase the sense of security. By tapering the collar in the edge of the axle-shaft, we created a 'delay' or 'buffer' in the movement.
I think this delay, 'gentle,' or 'dull,' is what gives depth to the CB1100's character, and its an aspect we had a lot of trouble in perfecting.
Sekiya:
Developing a delay, to deliberately create a cushy feel, into a component you'd normally try to increase the precision for, seems refreshing to me.
Korogi:
Yes, it was refreshing. The development was fun, as our approach to designing the bike was opposite to developing a high-performance racer. We somehow managed to meet the production deadline, but we did a lot of apologizing because we were behind schedule. We're satisfied with the CB1100 as everyone involved worked as a team to overcome the various challenges and problems we faced.
Sekiya:
You took a very innovative approach by creating performance that naturally synchronized human sensitivities or emotions with the bike's mobility. I wish you the best in further technological advances, and the heightening of the CB1100's character.