VVEL Technology Briefing
Variable Valve Event & Lift System
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Agenda

1. The Powertrain Concept
2. Benefits of VVEL
3. VVEL Structure
4. VQ37VHR
1. The Powertrain Concept

1-1. Core Values of Nissan Technology

**Trusted Driving Pleasure**

*Trust:*
- Environment
- Safety

*Driving Pleasure:*
- Dynamic Performance
- Life on Board

Environment

Dynamic Performance

Quality, Cost

Safety

Life on Board

Environment
1-2. Powertrain Engineering Concept

Nissan's powertrain development aims to develop an ultimate powertrain which balances 3 factors [Emotion, Efficiency, Emission] at a high level.

1-3. VVEL Concept

VVEL highly-balances 3 factors [Emotion, Efficiency, Emission].
2. Benefits of VVEL

- What is VVEL?
- Benefits of VVEL

2-1-1. What is VVEL?

- Conventional engines have one-type cam lobes, limiting it to one pattern of movement.
- VVEL combined with C-VTC enables continuous valve movement.
2-1-2. What is VVEL?

- VVEL controls intake amount through intake-valves of the combustion chamber, where conventional engines used throttle valves.

Benefits of VVEL

- What is VVEL?
- Benefits of VVEL
2-2-1. Benefits of VVEL – Fuel Efficiency
(When throttle opening is small)

In driving condition on a flat road at constantly 40km/h (when accelerator is pressed halfway or less) there is little pumping loss with VVEL-equipped engines.

Conventional Engine

VVEL-equipped Engine

2-2-2. Benefits of VVEL – Fuel Efficiency
(When throttle opening is small)

In driving ranges of small throttle opening, intake-valve lift can be kept low to reduce camshaft friction compared to conventional engine.

- VVEL-equipped engines control air amount at intake-valve by the combustion chamber entrance, which enables necessary air to be sent promptly to combustion chamber, resulting in better response.

2-2-4. Benefits of VVEL – Better Response

- With a short hose, water flows out right after the tap is turned (with VVEL)
2-2-5. Benefits of VVEL – Better Response

With a long hose, when the tap is turned it takes a while before water flows out (without VVEL).


Torque is improved by optimized valve open-close movement, adjusted accordingly to engine revolutions.
2-2-7. Benefits of VVEL – Cleaner Emissions

At timing of ignition when air is being warmed and combustion is unstable, if valve lift amount is small, air flow velocity rises. Fuel is then atomized by vaporizing effect and combustion is stabilized, resulting in clean emissions.

Valve Lift 2mm
Average Particle Diameter 9 μm

Valve Lift 8mm
Average Particle Diameter 157 μm

2-2-8. Benefits of VVEL - Summary

VVEL is a system which controls the amount of air intake directly at the intake-valve right before the combustion chamber. VVEL combined with C-VTC, creates continuous movement of valve.

<table>
<thead>
<tr>
<th>Benefits</th>
<th>VVEL throttle valve remains open, causing little pumping loss (little resistance)</th>
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<tr>
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<td>As valve lift amount is small, there is little friction</td>
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<td>Fuel Efficiency</td>
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<td>(when throttle opening is small)</td>
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<td>Better Response</td>
<td>Allows necessary air to be sent promptly to the combustion chamber, resulting in better response</td>
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<td>More Power</td>
<td>Torque is improved by optimized valve open-close movement, adjusted accordingly to engine revolutions</td>
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<td>Cleaner Emissions</td>
<td>As VVEL stabilizes combustion even when engine is cool, rise in exhaust emissions temperature enables quicker warm-up of catalyst, resulting in clean emissions</td>
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3. VVEL Structure

3-1. Basic Structure of VVEL System
3-2. Valve Lift Amount/Operating Angle Conversion

- DC Motor
- Ball Screw Shaft
- Nut
- Control Shaft
- Output Cam (oscillating cam)
- Fragmentary View (direction of arrow)

3-3. Valve Drive of VVEL System

- Drive Shaft
- Valve Lifter
- Valves
- Fragmentary View (direction of arrow)
3-4. VVEL Motion

Maximum Valve Lift

3-4. VVEL Motion

Maximum Valve Lift

Minimum Valve Lift
3-4. VVEL Motion

VVEL is capable of continuously changing valve lift amount (between min - max) freely.
4. New-Generation VQ37VHR Engine

4-1. Evaluation of the VQ Engine

- VQ35HR awarded “Ward's 10 Best Engines” for 13 consecutive years

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<tbody>
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<td>Nissan VQ</td>
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4-2. Aim of the New Generation VQ37VHR Engine

Based on the VQ35HR engine, further improvements on engine performance, fuel efficiency, and clean emissions

- Smooth, pleasant drive
- Response
- Exhilaration
- Acceleration Sound
- Fuel Efficiency
- Cleaner Emissions

1) High rate of revolution
   Max 7500rpm

2) Pleasant acceleration sound
   Clear sound

3) Top level power performance in class
   Improved intake/exhaust/combustion efficiency

4) Increased practical fuel efficiency
   Reduced friction

5) Best-in-class emission standard

4-3. Technology of VQ37VHR Engine

New design for VQ37VHR

| Increased height of cylinder blocks | Symmetric twin intake system | Asymmetric piston skirt |
| Revised cylinder head | Sound insulating engine cover | Equal length exhaust manifold |
| Straight inlet port | Enhanced durability of rocker cover | High ignitability for iridium plug |
| Enhanced durability of chain cover | High flow exhaust port | Lengthened connecting rod |
| Ultra-wide phase angle C-VTC on intake side | Extended amount of valve lift | Hydrogen-free DLC valve lifters |
| VVEL system on air intake side | | Enhanced valve spring |
| Revised oil pump rotor | | Enlarged diameter of crank journal |
| Enhanced durability of upper oil pan | | Revised diameter of valve |
| Enhanced durability of lower oil pan | | Processing PVD piston ring |
| Enlarged diameter of crankpin | | Ladder frame set |
| Cooling water flow structure | | M12 Spark plug |
| Twin knock sensor | Extended cylinder block liner | Enhanced compression ratio |
| Thin-lined umbrella of intake valve | Ladder frame of cam bracket | High flow intake manifold |
| | | High flow resin collector |
VVEL will be debut on the SKYLINE Coupe VQ37VHR engine to be launched this fall

Thank you for your attention