In the "powertrain" which transmits the engine power to the wheels, the transmission constantly plays an important role.

As a manufacturer specializing in transmissions for automobiles, JATCO has produced numerous "world’s firsts" to date.

Of these, JATCO is a leading CVT (Continuously Variable Transmission) company and occupies about half of the global market.

Through transmissions, which play a hidden leading role by providing support for driving vehicles, JATCO will continue to take the lead in the future of mobility.

JATCO — Leading Transmission

World’s First
- 1-motor, 2-clutches type transmission for Hybrid vehicles – 2010
- Steel belt CVT for 2L class – 1997
- Toroidal CVT – 1999
- CVT for 3.5L class – 2002
- CVT with an auxiliary gearbox – 2009
- 5-speed automatic transmission – 1989
- 5-speed transmission for FWD vehicles – 1995
A steel belt CVT for 2-liter class vehicles and the world’s largest CVT for 3.5-liter class vehicles. JATCO, always leading technologies of CVTs for high-torque vehicles, was strongly determined to integrate CVTs for medium and large-sized vehicles and to make it a standard for the next generation CVT. The Jatco CVT8 (hereafter, CVT8) was developed as a unit with the ability to cover vehicles up to a torque capacity of 380Nm.

Expanding ratio coverage
The first issue was expanding ratio coverage (transmission gear ratio width). Although it would be possible to expand ratio coverage simply by increasing the diameter of the pulley, the overall size of the CVT would increase, and vehicle-mounting performance would decline. Conversely, we focused on the inside of the pulley and explored methods for expanding ratio coverage. First, we reduced the shaft diameter of the pulley and secured space closer to the center for winding the belt. After that, we reviewed the shape of the belt element and adopted a belt that would transmit torque efficiently when wound around a small diameter. This was because transmission efficiency would decline if the winding angle became too small. Through these measures, we succeeded in expanding ratio coverage from the previous 6.0 to 7.0, thereby contributing significantly to striking a balance between powerful drive at low speeds (low gear ratio) and low fuel consumption and quietness at high speeds (high gear ratio).

Hydraulic control system with numerous improvements
In a mechanism that operates pulleys for shift change, the mechanical loss of the seal ring is reduced and further changed from a step motor type to a direct acting type through hydraulic pressure. The mechanism for switching between moving forward and reversing was changed to a variable hydraulic system. As a result of thorough efforts to optimize the oil passage in the control valve body, the three-tiered structure was converted to one with two tiers while the number of spool valves was reduced from 12 to 8. Furthermore, by reviewing the clearance of the spool valves and other measures, oil leakage within the control valve was suppressed as far as possible. As a result of all these efforts, it became possible to provide coverage with a small-discharge oil pump. In addition, by reviewing the lubrication system around the differential gear and raising a baffle plate, we succeeded in eliminating the condition whereby the gear is constantly immersed in oil. As a result, friction was reduced by 40% in total, contributing significantly to fuel efficiency improvement.

Jatco CVT8, completed in relentless pursuit of wide range and high efficiency for fuel and driving performance of a CVT, even in high engine displacement vehicles.
Transmission for FWD Hybrid vehicles

Jatco CVT8 HYBRID*, the transmission for hybrid vehicles applying 1-motor, 2-clutches system

When developing a hybrid version of a certain model, it would not be necessary to make significant revisions to the car if the size of the transmission (in particular, its length) could be maintained at the same level. In the Jatco CVT8 HYBRID (hereafter, CVT8 HYBRID), the torque converter is simply taken out of the Jatco CVT8, originally developed for medium and large-sized vehicles, and a driving and regenerative motor as well as the dry multi-plate clutch that connects the engine with the motor is placed into that space in a compact manner.

Driving/regenerative motor and intermittent clutch of the engine
To disconnect the engine and motor, a dry multi-plate clutch (Clutch 1) has been adopted instead of a wet clutch that tends to increase drag torque to a larger extent when the range of speed is lower. This is the first in the world for hybrid systems. Although the transmission for RWD hybrid vehicles that was developed before CVT8 HYBRID utilized a dry single-plate clutch, transmission for FWD vehicles should be more compact to fit into a narrower mounting space. Not only does the CVT8 HYBRID consist of a simple arrangement of the motor and the clutch, it also succeeds in minimizing the length of the axial direction by placing a dry multi-plate clutch inside the hollow portion of the donut-shaped motor.

Use the clutch for switching between forward and reverse as the clutch for starting up
In CVT8 as the base unit, the clutch positioned in front of the pulley takes the role of switching between moving forward and reversing. This clutch has been diverted for use as a clutch for starting up (Clutch 2). However, this system has an issue to be solved. In this system, the required start-up torque is secured through sliding the clutch. If this continues for a long time, a large amount of heat would be generated, and the clutch surface temperature would rise gradually. With regard to the CVT8 HYBRID, efforts have been made to place a dedicated electric oil pump on the exterior and improve cooling performance, with a view to using this transmission in medium-class SUVs and other vehicles to be sold in the North American market. It comprises a system that cools down the starting-up clutch effectively where necessary and has been finished as a tough transmission that can stand even in long periods of high-load operations.

Dedicated electric oil pump for cooling the clutch used to start up the vehicle
SUVs in North America are often driven over sand or used to tow trailers and boats. The transmission controls driving force while sliding the clutch used for starting up the vehicle under such tough conditions. In order to cool down the heat that is generated during this sliding operation, a dedicated electric oil pump has been installed. This minimizes the damage to the clutch even under driving situations that impose a strong burden on the transmission systems.

Jatco CVT8 HYBRID* is jointly developed by Nissan Motor Co., Ltd. and JATCO Ltd.
The Jatco CVT7 W/R, for improved fuel performance and better drivability

Jatco CVT7 W/R (hereafter, CVT7 W/R) was developed to maintain the outstanding mounting performance of the CVT while improving transmission efficiency in order to meet the demand for better fuel consumption and also creating a more direct driving feeling.

Ratio coverage of 8.7 realizes high fuel performance

A new belt & pulley are adopted for CVT W/R. The maximum high position has moved on the further high side to realize a ratio coverage of 8.7, the largest in the world for a CVT. Furthermore, we have narrowed the groove pitch of the contact surface with the pulley of the belt metal element to improve the torque transfer efficiency.

In addition, in the oil pump, which is one factor in friction loss, we changed the shape of the suction port for the oil in order to eliminate the oil pump flow control valve, thereby reducing friction by approximately 30%. These changes have resulted in a transmission that greatly contributes to the actual fuel consumption. Not only in the fuel consumption mode but also at high-speed, fixed driving, etc., and can therefore meet the diverse needs of markets.
JR712E*, the transmission for RWD hybrid vehicles installed a 1-motor, 2-clutches system without changing the transmission size.

The JR712E, the transmission for RWD hybrid vehicles, represents the culmination of JATCO’s knowhow and control technology. If we were to pursue new packaging for a hybrid system from the beginning, the production cost would not meet the expected cost for the vehicles. Conversely, an easier method would be to replace the existing torque converter in the transmission with a motor. However, this method offers limited benefits for a hybrid transmission system. JATCO has pursued the ideal balance between the two by taking the perspective of the users.

Birth of this packaging realized by an ideal balance between production cost and performance

“We want to keep production costs lower and allow as many people as possible to enjoy the benefits of a hybrid system.” This desire became the starting point for the concept. If we were able to maintain the mountability for vehicles, we would be able to minimize the change of the base vehicle. The JR712E holds the motor and clutch in the space created by removing the torque converter from the existing 7-speed AT for RWD vehicles. It is the world’s first 1-motor, 2-clutches transmission for hybrid vehicles, with the newly added clutch serving as Clutch 1 and the original gearshift clutch in the 7-speed AT serving as Clutch 2.

Originally, a torque converter plays the roles of increasing torque when the vehicle is started up and accelerating and of easing shift shock. The issue of inadequate torque when the vehicle is started up, which arises as a result of the omission of the torque converter, is countered through a newly added electric motor. In addition, shift shock is absorbed through the more advanced control of the gearshift operation of Clutch 2 that comes after motor output. The ability to execute timely connection and release of the two clutches (switch shifting) is a result of the shift control technology for step ATs that JATCO has developed to date.

Reason for using two clutches

Of course, there is a significant reason for adding not only the motor but also the clutch. In typical hybrid driving modes, such as “motor driving” or “energy regeneration in deceleration,” if the engine remains connected, energy would be lost as a result of excessive drag resistance. With an additional clutch, the engine would be disconnected when necessary to realize an even more efficient hybrid system.

Transmission for RWD Hybrid vehicles

JATCO JR712E

*Jointly developed by Nissan Motor Co., Ltd. and JATCO Ltd
JATCO has established a global business structure that includes its production bases in China, Thailand, and Mexico. All of the three overseas bases are CVT production plants that deliver products to customers around the world.

Continuously Variable Transmission

Continuously evolving JATCO CVTs

The evolution of CVTs, such as ratio coverage expansion and friction reduction, enables a balance between excellent fuel performance and comfortable driving at an even higher level. The high potentiality has been recognized, and JATCO CVTs are spreading across markets around the world.

The CVT recognized by global markets

In the beginning, CVTs were particularly noted in urban areas, where drivers had to repeatedly start up and accelerate their vehicles. Thus, CVTs were getting popular in the Japanese market, becoming increasingly popular across the globe. As a result, JATCO’s three overseas production bases, including China, Thailand, and Mexico, have been recognized in global markets.

The latest CVT7 and CVT8 have achieved ratio coverage equivalent to an 8-speed AT.

Ratio coverage comparison between step AT and CVT

Ratio coverage comparison between step AT and CVT

In order to realize start-up and acceleration at even lower gear ratios, as well as quietness and low fuel consumption at high gear ratios, the ratio coverage of step ATs has been expanded through an increase in the number of steps, from 4-speed to 5-speed, and to 6-speed. CVTs, on the other hand, have been steadily evolving.

Taking reference from the benchmark for step ATs in the market, ratio coverage is expanded through increases in the number of steps. Conventional CVTs were equivalent to 7-speed step ATs, but the latest CVT7 and CVT8 have a ratio coverage that is even wider than that of an 8-speed AT.

*Based on investigations conducted by JATCO

Ratio coverage comparison: step AT and CVT

In the beginning, a CVT’s performance was particularly noted in urban areas, where drivers had to repeatedly start up and accelerate their vehicles. Thus, CVTs were getting popular in the Japanese market, becoming increasingly popular across the globe. As a result, JATCO’s three overseas production bases, including China, Thailand, and Mexico, have been recognized in global markets.

The latest CVT7 and CVT8 have achieved ratio coverage equivalent to an 8-speed AT.

Ratio coverage comparison between step AT and CVT

In order to realize start-up and acceleration at even lower gear ratios, as well as quietness and low fuel consumption at high gear ratios, the ratio coverage of step ATs has been expanded through an increase in the number of steps, from 4-speed to 5-speed, and to 6-speed. CVTs, on the other hand, have been steadily evolving.
Taking the global lead with a wide and unique product line-up as a manufacturer specializing in the production of transmissions

JATCO’s CVTs have the highest market share in the world. JATCO is the only CVT manufacturer in the world to cover vehicles from mini to 3.5-liter class vehicles. In addition, it offers a rich line-up of conventional step ATs. Various vehicles that are manufactured around the world today are mounted with JATCO products, and JATCO has won the strong support and high appraisal of many customers. As a manufacturer that specializes in transmissions, JATCO aims to be the global leader going forward.

There are other products besides the transmissions featured in this brochure. For details, please inquire with JATCO staff or refer to the company’s website.

<table>
<thead>
<tr>
<th>Torque Capacity (Nm)</th>
<th>CVT</th>
<th>CVT</th>
<th>HEV</th>
</tr>
</thead>
<tbody>
<tr>
<td>600</td>
<td>JF015E</td>
<td>JF016E</td>
<td>JF018E</td>
</tr>
<tr>
<td>500</td>
<td>JF016E</td>
<td>JF017E</td>
<td>JF018E</td>
</tr>
<tr>
<td>400</td>
<td>JF015E</td>
<td>JF016E</td>
<td>JF018E</td>
</tr>
<tr>
<td>300</td>
<td>JF015E</td>
<td>JF016E</td>
<td>JF018E</td>
</tr>
<tr>
<td>200</td>
<td>JF015E</td>
<td>JF016E</td>
<td>JF018E</td>
</tr>
<tr>
<td>100</td>
<td>JF015E</td>
<td>JF016E</td>
<td>JF018E</td>
</tr>
</tbody>
</table>

CVT for medium and large-sized FWD vehicles. With maintaining the smooth driving of the CVT, it pursues high efficiency even down to the details and reduces friction by as much as 40%. It achieves a balance between a sporty and powerful drive and outstanding environmental performance.

CVT for medium and large-sized FWD hybrid vehicles. The dual-stage variable-motor, as well as the dry clutch, achieves a balance between high fuel efficiency and a smooth, powerful driving experience.

Transmission for medium and large-sized RWD vehicles. It realizes a balance between fuel efficiency and high performance, while taking full advantage of the ample torque, as befits a vehicle with high engine displacement.

Transmission for medium and large-sized RWD hybrid vehicles. Through the adoption of a 1-motor, 2-clutches system, it strikes a balance between powerful drive in line with the driver’s intentions at all places and high fuel efficiency through motor drive and efficient energy regeneration in ways that are possible only for hybrid cars.

<table>
<thead>
<tr>
<th>Torque Capacity (Nm)</th>
<th>CVT</th>
<th>CVT</th>
<th>HEV</th>
</tr>
</thead>
<tbody>
<tr>
<td>600</td>
<td>JF414E</td>
<td>JF613E</td>
<td>JF507E</td>
</tr>
<tr>
<td>500</td>
<td>JF414E</td>
<td>JF613E</td>
<td>JF507E</td>
</tr>
<tr>
<td>400</td>
<td>JF414E</td>
<td>JF613E</td>
<td>JF507E</td>
</tr>
<tr>
<td>300</td>
<td>JF414E</td>
<td>JF613E</td>
<td>JF507E</td>
</tr>
<tr>
<td>200</td>
<td>JF414E</td>
<td>JF613E</td>
<td>JF507E</td>
</tr>
<tr>
<td>100</td>
<td>JF414E</td>
<td>JF613E</td>
<td>JF507E</td>
</tr>
</tbody>
</table>

Transmission for medium and large-sized FWD hybrid vehicles. Through the adoption of a 1-motor, 2-clutches system, it strikes a balance between powerful drive in line with the driver’s intentions at all places and high fuel efficiency through motor drive and efficient energy regeneration in ways that are possible only for hybrid cars.