

MOTORCYCLES

Overall Trends

1 Introduction

In 2020, motorcycle production in Japan fell by 14.6% from the previous year to 485,000 units. Affected by the COVID-19 coronavirus pandemic and other factors, this continued the downward turn that started in 2019. Furthermore, although exports also fell by 21.3% to 312,000 units, shipments inside Japan remained virtually unchanged, falling by only 0.9% to 328,000 units.

2 Production and Demand Trends

2.1. Production

As shown in Fig. 1, the number of motorcycles produced in Japan in 2020 decreased by 14.6% from 2019 to a total of 485,000 units. Exports fell by 22.3% to 312,000 units, while shipments inside Japan fell 0.9% to 328,000 units.

2.2. Demand in Japan

Figure 2 shows motorcycle demand in Japan based on engine displacement. Despite higher demand for mini-sized motorcycles, which increased by 28.4% compared to 2019, demand for all other categories of motorcycles decreased, causing overall demand to fall by 0.9% to 328,000 units.

(1) 50 cm³ or Less Displacement Motorcycles (Class 1 Motor-Driven Cycles)

In 2020, the demand for this class decreased by 7.3% from the previous year to 122,000 units.

(2) 51 to 125 cm³ Displacement Motorcycles (Class 2 Motor-Driven Cycles)

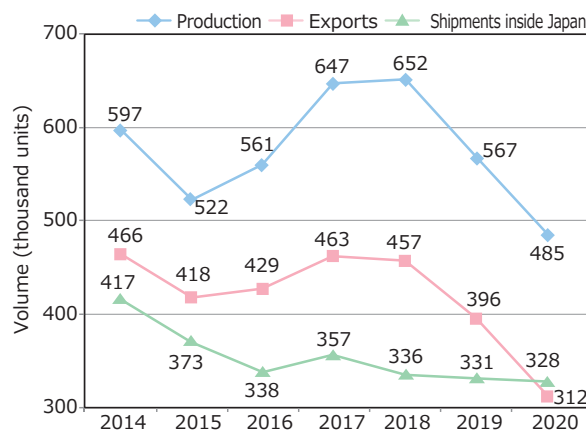
In 2020, the demand for this class decreased by 3.5% from the previous year to 102,000 units.

(3) 126 to 250 cm³ Displacement Motorcycles (Mini-Sized Motorcycles)

In 2020, the demand for this class increased again by 28.4% from the previous year to 67,000 units.

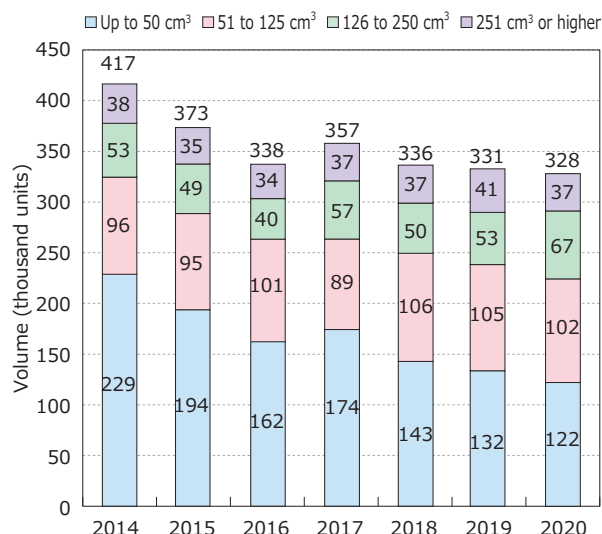
(4) 251 cm³ or Higher Displacement Motorcycles (Small-Sized Motorcycles)

Reversing the increase that occurred in 2019, demand for this class in 2020 decreased by 10.9% to 37,000 units.



* Source: Japan Automobile Manufacturers Association database <http://jamaserv.jama.or.jp/newdb/index.html>

Fig. 1 Trends for Production, Exports, and Shipments inside Japan



* Source: Japan Automobile Manufacturers Association database <http://jamaserv.jama.or.jp/newdb/index.html>

Fig. 2 Shipments inside Japan based on Engine Displacement

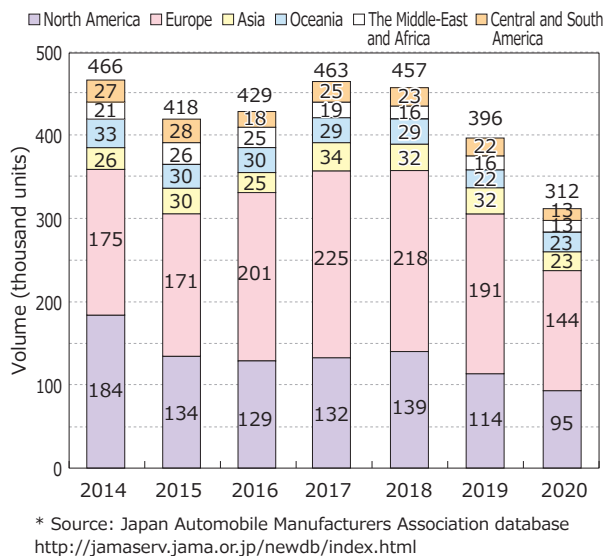


Fig. 3 Shipments per Market

2.3. Exports

Motorcycle exports in 2020 to all regions other than the Middle-East and Oceania decreased, falling by 21.3% from the previous year to 312,000 units due to disruptions to production and logistics caused by the coronavirus pandemic (Fig. 3).

(1) North America

In 2020, motorcycle exports to North America decreased by 16.7% compared to the previous year to 95,000 vehicles.

(2) Europe

Motorcycle exports to Europe in 2020 decreased by 24.6% from the previous year to 144,000 units.

(3) Asia

Motorcycle exports to Asia in 2020 decreased by 27.8% from the previous year to 23,000 units.

Table 1 Details of Main New Motorcycles Launched in 2020

Month of launch	New	Redesigned	Manufacturer	Name of model	Characteristics
January		○	Honda	CB1100 RS (limited order-based availability)	Air-cooled/4 -stroke/inline 4 -cylinder/DOHC/4 -valve/FI
		○	Honda	CB400 Super Four (limited order-based availability)	Water-cooled/4 -stroke/inline 4 -cylinder/DOHC/4 -valve/FI
		○	Honda	Lead 125 (limited order-based availability)	Water-cooled/4 -stroke/single-cylinder/OHC/FI
		○	Honda	Gold Wing Tour	Water-cooled/4 -stroke/horizontally opposed 6 -cylinder/OHC (uni-cam)/FI
		○	Yamaha	Serow 250 Final Edition	Air-cooled/4 -stroke/single-cylinder/SOHC/2 -valve/FI
	○		Kawasaki	Z H2	Water-cooled/4 -stroke/parallel 4 -cylinder/DOHC/4 -valve/FI
	○		Kawasaki	Ninja 1000 SX	Water-cooled/4 -stroke/parallel 4 -cylinder/DOHC/4 -valve/FI
February	○		Honda	CRF1100 L Africa Twin Adventure Sports	Water-cooled/4 -stroke/inline 2 -cylinder/OHC (uni-cam)/4 -valve/FI
	○		Honda	ADV150	Water-cooled/4 -stroke/single-cylinder/OHC/FI
		○	Honda	CB1000 R	Water-cooled/4 -stroke/inline 4 -cylinder/DOHC/4 -valve/FI
		○	Honda	PCX (limited order-based availability)	Water-cooled/4 -stroke/single-cylinder/OHC/FI
		○	Honda	PCX150 (limited order-based availability)	Water-cooled/4 -stroke/single-cylinder/OHC/FI
		○	Honda	Gold Wing	Water-cooled/4 -stroke/horizontally opposed 6 -cylinder/OHC (uni-cam)/FI
		○	Yamaha	YZF-R3 ABS	Water-cooled/4 -stroke/inline 2 -cylinder/DOHC/4 -valve/FI
		○	Yamaha	YZF-R25 ABS	Water-cooled/4 -stroke/inline 2 -cylinder/DOHC/4 -valve/FI
		○	Yamaha	YZF-R25	Water-cooled/4 -stroke/inline 2 -cylinder/DOHC/4 -valve/FI
		○	Yamaha	Tracer 900 GT ABS	Water-cooled/4 -stroke/inline 3 -cylinder/DOHC/4 -valve/FI
		○	Yamaha	Tracer 900 ABS	Water-cooled/4 -stroke/inline 3 -cylinder/DOHC/4 -valve/FI
		○	Yamaha	MT-09 ABS	Water-cooled/4 -stroke/inline 3 -cylinder/DOHC/4 -valve/FI
	○	Yamaha	XSR900 ABS	Water-cooled/4 -stroke/inline 3 -cylinder/DOHC/4 -valve/FI	
March		○	Honda	Rebel 250	Water-cooled/4 -stroke/single-cylinder/DOHC/4 -valve/FI
		○	Honda	Rebel 250 S Edition	Water-cooled/4 -stroke/single-cylinder/DOHC/4 -valve/FI
		○	Honda	Grom	Air-cooled/4 -stroke/single-cylinder/OHC/FI
	○		Honda	CBR1000 RR-R Fireblade	Water-cooled/4 -stroke/inline 4 -cylinder/DOHC/4 -valve/FI
	○		Honda	CBR1000 RR-R Fireblade SP	Water-cooled/4 -stroke/inline 4 -cylinder/DOHC/4 -valve/FI
		○	Yamaha	MT-07 ABS	Water-cooled/4 -stroke/inline 2 -cylinder/DOHC/4 -valve/FI
		○	Yamaha	YZF-R6 Race Base model (limited order-based availability)	Water-cooled/4 -stroke/inline 4 -cylinder/DOHC/4 -valve/FI
		○	Yamaha	MT-03 ABS	Water-cooled/4 -stroke/inline 2 -cylinder/DOHC/4 -valve/FI
		○	Yamaha	MT-25 ABS	Water-cooled/4 -stroke/inline 2 -cylinder/DOHC/4 -valve/FI
		○	Yamaha	XMAX ABS	Water-cooled/4 -stroke/single-cylinder/SOHC/4 -valve/FI
April		○	Suzuki	Gixxer	Air-cooled/4 -stroke/single-cylinder/SOHC/2 -valve/FI
		○	Honda	CRF1100 L Africa Twin Adventure Sports ES<s>	Water-cooled/4 -stroke/inline 2 -cylinder/OHC (uni-cam)/4 -valve/FI
		○	Honda	CRF1100 L Africa Twin<s>	Water-cooled/4 -stroke/inline 2 -cylinder/OHC (uni-cam)/4 -valve/FI
		○	Honda	Rebel 500	Water-cooled/4 -stroke/inline 2 -cylinder/DOHC/4 -valve/FI
		○	Honda	Monkey 125	Air-cooled/4 -stroke/single-cylinder/OHC/FI
	○		Honda	Benly e:	AC synchronous motor
	○	Yamaha	Cygnus-X	Air-cooled/4 -stroke/single-cylinder/SOHC/4 -valve/FI	
	○	Yamaha	Majesty S	Air-cooled/4 -stroke/single-cylinder/SOHC/4 -valve/FI	

Table 1 Details of Main New Motorcycles Launched in 2020 (Cont.)

Month of launch	New	Redesigned	Manufacturer	Name of model	Characteristics
April		○	Yamaha	BW's 125	Air-cooled/4 -stroke/single-cylinder/SOHC/4 -valve/FI
		○	Yamaha	NMAX ABS	Water-cooled/4 -stroke/single-cylinder/SOHC/4 -valve/FI
	○		Suzuki	V-Strom 1050 XT Heritage Special	Water-cooled/4 -stroke/V2 /DOHC/4 -valve/FI
	○		Suzuki	V-Strom 1050 XT	Water-cooled/4 -stroke/V2 /DOHC/4 -valve/FI
	○		Suzuki	V-Strom 1050 XT 1050	Water-cooled/4 -stroke/V2 /DOHC/4 -valve/FI
	○		Suzuki	Gixxer SF250	Oil-cooled/4 -stroke/single-cylinder/SOHC/4 -valve/FI
May		○	Honda	Super Cub 110	Air-cooled/4 -stroke/single-cylinder/OHC/FI
		○	Honda	Super Cub 110 Pro	Air-cooled/4 -stroke/single-cylinder/OHC/FI
		○	Honda	Cross Cub 110	Air-cooled/4 -stroke/single-cylinder/OHC/FI
		○	Yamaha	XSR700 ABS	Water-cooled/4 -stroke/inline 2 -cylinder/DOHC/4 -valve/FI
		○	Yamaha	MT-10 ABS	Water-cooled/4 -stroke/inline 4 -cylinder/DOHC/4 -valve/FI
	○		Yamaha	TMAX560 Tech Max ABS	Water-cooled/4 -stroke/inline 2 -cylinder/DOHC/4 -valve/FI
	○		Yamaha	TMAX560 ABS	Water-cooled/4 -stroke/inline 2 -cylinder/DOHC/4 -valve/FI
	○	Yamaha	Tricity 155 ABS	Water-cooled/4 -stroke/single-cylinder/SOHC/4 -valve/FI	
June	○		Honda	CT125 Hunter Cub	Air-cooled/4 -stroke/single-cylinder/OHC/FI
		○	Honda	Cross Cub 110	Air-cooled/4 -stroke/single-cylinder/OHC/FI
		○	Honda	Cross Cub 110 Kumamon Version	Air-cooled/4 -stroke/single-cylinder/OHC/FI
	○		Yamaha	Ténéré 700 ABS	Water-cooled/4 -stroke/DOHC/inline 2 -cylinder/4 -valve/FI
		○	Yamaha	Bolt R-Spec ABS	Air-cooled/4 -stroke/SOHC/V2 /4 -valve/FI
		○	Yamaha	Bolt ABS	Air-cooled/4 -stroke/SOHC/V2 /4 -valve/FI
	○		Suzuki	Gixxer 250	Oil-cooled/4 -stroke/SOHC/single-cylinder/4 -valve/FI
		○	Kawasaki	KLX110 L	Air-cooled/4 -stroke/SOHC/single-cylinder/2 -valve
	○		Kawasaki	KLX230 R S	Air-cooled/4 -stroke/SOHC/single-cylinder/2 -valve/FI
		○	Kawasaki	KLX230 R	Air-cooled/4 -stroke/SOHC/single-cylinder/2 -valve/FI
		○	Kawasaki	KLX230	Air-cooled/4 -stroke/SOHC/single-cylinder/2 -valve/FI
		○	Kawasaki	KX100	Water-cooled/2 -stroke/single-cylinder/piston reed valve
		○	Kawasaki	KX85	Water-cooled/2 -stroke/single-cylinder/piston reed valve
		○	Kawasaki	KX85-II	Water-cooled/2 -stroke/single-cylinder/piston reed valve
	○	Kawasaki	KX65	Water-cooled/2 -stroke/single-cylinder/piston reed valve	
July		○	Honda	CBR400 R	Water-cooled/4 -stroke/DOHC/inline 2 -cylinder/4 -valve/FI
		○	Honda	400 X	Water-cooled/4 -stroke/DOHC/inline 2 -cylinder/4 -valve/FI
		○	Honda	Super Cub C125	Air-cooled/4 -stroke/OHC/single-cylinder/FI
		○	Honda	Super Cub 110 Tenki no Ko (Weathering with You) Version (limited order-based availability)	Air-cooled/4 -stroke/OHC/single-cylinder/FI
		○	Honda	Super Cub 50 Tenki no Ko (Weathering with You) Version (limited order-based availability)	Air-cooled/4 -stroke/OHC/single-cylinder/FI
	○		Yamaha	Ténéré 700 ABS	Water-cooled/4 -stroke/DOHC/inline 2 -cylinder/4 -valve/FI
	○		Kawasaki	Ninja ZX-25 R	Water-cooled/4 -stroke/DOHC/parallel 4 -cylinder/4 -valve/FI
	○		Kawasaki	KX450	Water-cooled/4 -stroke/DOHC/single-cylinder/4 -valve/FI
	○		Kawasaki	KX250	Water-cooled/4 -stroke/DOHC/single-cylinder/4 -valve/FI
	○		Kawasaki	KX450 X	Water-cooled/4 -stroke/DOHC/single-cylinder/4 -valve/FI
	○		Kawasaki	KX250 X	Water-cooled/4 -stroke/DOHC/single-cylinder/4 -valve/FI
		○	Kawasaki	Z1000	Water-cooled/4 -stroke/DOHC/parallel 4 -cylinder/4 -valve/FI
		○	Kawasaki	Z900	Water-cooled/4 -stroke/DOHC/parallel 4 -cylinder/4 -valve/FI
		○	Kawasaki	Vulcan S	Water-cooled/4 -stroke/DOHC/parallel 2 -cylinder/4 -valve/FI
		○	Kawasaki	Ninja ZX-6 R (636)	Water-cooled/4 -stroke/DOHC/parallel 4 -cylinder/4 -valve/FI
	○	Kawasaki	Z400	Water-cooled/4 -stroke/DOHC/parallel 2 -cylinder/4 -valve/FI	
	○	Kawasaki	Ninja 400	Water-cooled/4 -stroke/DOHC/parallel 2 -cylinder/4 -valve/FI	
August	○		Yamaha	YZF-R1 M	Water-cooled/4 -stroke/DOHC/inline 4 -cylinder/4 -valve/FI
	○		Yamaha	YZF-R1	Water-cooled/4 -stroke/DOHC/inline 4 -cylinder/4 -valve/FI
		○	Kawasaki	Z H2	Water-cooled/4 -stroke/DOHC/parallel 4 -cylinder/4 -valve/FI
		○	Kawasaki	Ninja 1000 SX	Water-cooled/4 -stroke/DOHC/parallel 4 -cylinder/4 -valve/FI
		○	Kawasaki	W800 Street	Air-cooled/4 -stroke/SOHC/parallel 2 -cylinder/4 -valve/FI
		○	Kawasaki	W800 Cafe	Air-cooled/4 -stroke/SOHC/parallel 2 -cylinder/4 -valve/FI
		○	Kawasaki	W800	Air-cooled/4 -stroke/SOHC/parallel 2 -cylinder/4 -valve/FI
		○	Kawasaki	Z650	Water-cooled/4 -stroke/DOHC/parallel 2 -cylinder/4 -valve/FI
		○	Kawasaki	Ninja 650	Water-cooled/4 -stroke/DOHC/parallel 2 -cylinder/4 -valve/FI
		○	Kawasaki	Versys-X 250 Tourer	Water-cooled/4 -stroke/DOHC/parallel 2 -cylinder/4 -valve/FI
September	○		Honda	CBR600 RR	Water-cooled/4 -stroke/DOHC/inline 4 -cylinder/4 -valve/FI
		○	Honda	CBR250 RR	Water-cooled/4 -stroke/DOHC/inline 2 -cylinder/4 -valve/FI
	○		Yamaha	Tricity 300 ABS	Water-cooled/4 -stroke/SOHC/single-cylinder/4 -valve/FI
		○	Yamaha	NMAX155 ABS	Water-cooled/4 -stroke/SOHC/single-cylinder/4 -valve/FI
		○	Kawasaki	Ninja H2 R	Water-cooled/4 -stroke/DOHC/parallel 4 -cylinder/4 -valve/FI
		○	Kawasaki	Ninja H2 SX SE+	Water-cooled/4 -stroke/DOHC/parallel 4 -cylinder/4 -valve/FI
		○	Kawasaki	Ninja H2 SX SE	Water-cooled/4 -stroke/DOHC/parallel 4 -cylinder/4 -valve/FI
		○	Kawasaki	Ninja H2 Carbon	Water-cooled/4 -stroke/DOHC/parallel 4 -cylinder/4 -valve/FI
		○	Kawasaki	Versys 1000 SE	Water-cooled/4 -stroke/DOHC/parallel 4 -cylinder/4 -valve/FI

Table 1 Details of Main New Motorcycles Launched in 2020 (Cont.)

Month of launch	New	Redesigned	Manufacturer	Name of model	Characteristics
September		○	Kawasaki	Z900 RS	Water-cooled/4 -stroke/DOHC/parallel 4 -cylinder/4 -valve/FI
		○	Kawasaki	Z900 RS Cafe	Water-cooled/4 -stroke/DOHC/parallel 4 -cylinder/4 -valve/FI
		○	Kawasaki	Z250	Water-cooled/4 -stroke/DOHC/parallel 2 -cylinder/4 -valve/FI
		○	Kawasaki	Ninja 250	Water-cooled/4 -stroke/DOHC/parallel 2 -cylinder/4 -valve/FI
		○	Kawasaki	Z125 Pro	Air-cooled/4 -stroke/SOHC/single-cylinder/2 -valve/FI
October	○		Honda	CRF450 R	Water-cooled/4 -stroke/OHC/single-cylinder/4 -valve/FI
	○		Honda	CRF450 RX	Water-cooled/4 -stroke/OHC/single-cylinder/4 -valve/FI
		○	Yamaha	PW50	Air-cooled/2 -stroke/single-cylinder
		○	Yamaha	YZ450 F	Water-cooled/4 -stroke/single-cylinder/DOHC/4 -valve/FI
		○	Yamaha	YZ250F Monster Energy Yamaha Racing Edition (limited order-based availability)	Water-cooled/4 -stroke/single-cylinder/DOHC/4 -valve/FI
		○	Yamaha	YZ250 F	Water-cooled/4 -stroke/single-cylinder/DOHC/4 -valve/FI
		○	Yamaha	YZ250	Air-cooled/2 -stroke/single-cylinder
		○	Yamaha	YZ125	Air-cooled/2 -stroke/single-cylinder
		○	Yamaha	YZ85 LW	Air-cooled/2 -stroke/single-cylinder
		○	Yamaha	YZ85	Air-cooled/2 -stroke/single-cylinder
		○	Yamaha	YZ65	Air-cooled/2 -stroke/single-cylinder
		○	Yamaha	YZ450 FX	Water-cooled/4 -stroke/single-cylinder/DOHC/4 -valve/FI
		○	Yamaha	YZ250 FX	Water-cooled/4 -stroke/single-cylinder/DOHC/4 -valve/FI
		○	Yamaha	YZ250 X	Air-cooled/2 -stroke/single-cylinder
		○	Yamaha	YZ125 X	Air-cooled/2 -stroke/single-cylinder
		○	Yamaha	Cygnus-X Monster Energy Yamaha MotoGP Edition (limited order-based availability)	Air-cooled/4 -stroke/single-cylinder/SOHC/4 -valve/FI
	○	Kawasaki	Versys 1000 SE	Water-cooled/4 -stroke/parallel 4 -cylinder/DOHC/4 -valve/FI	
November		○	Yamaha	E-Vino	AC synchronous motor
	○		Kawasaki	Ninja ZX-10 RR	Water-cooled/4 -stroke/parallel 4 -cylinder/DOHC/4 -valve/FI
	○		Kawasaki	Ninja ZX-10 R	Water-cooled/4 -stroke/parallel 4 -cylinder/DOHC/4 -valve/FI
December	○		Honda	CRF250 L	Water-cooled/4 -stroke/single-cylinder/DOHC/4 -valve/FI
	○		Honda	CRF250 Rally	Water-cooled/4 -stroke/single-cylinder/DOHC/4 -valve/FI

(4) Oceania

In contrast, motorcycle exports to Oceania in 2020 increased by 8.2% from the previous year to 23,000 units.

(5) The Middle-East and Africa

Motorcycle exports to the Middle-East and Africa in 2020 decreased by 16.5% from the previous year to 13,000 units.

(6) Central and South America

Finally, motorcycle exports to Central and South America in 2020 decreased by 39.3% from the previous year to 13,000 units, with a particularly large fall occurring in exports to South America.

3 Product and Technological Trends —

3.1. Product Trends

Table 1 lists some of the representative motorcycle models launched in Japan in 2020.

Although very few class 1 motor-driven cycles were launched in 2020, manufacturers introduced a higher number of class 2 motor-driven cycles. New models in this segment included the Honda Monkey 125, Super Cub 110, Hunter Cub 110, CT125 Cross Cub, and Grom, the Yamaha BW'S125 and Cygnus X125, as well as the Suzuki GSX-R125 and GSX-S125.

New models in the mini-sized motorcycle segment in-

cluded the Honda ADV150, CRF250L, Rebel 250, and CBR250RR, the Yamaha Serow 250, YZF-R25, and MT-25, the Suzuki Gixxer SF250 and Gixxer 150, as well as the Kawasaki ZX-25R and KLX230R S.

New models in the small-sized motorcycle segment included the Honda CB1000R, CBR1000RR-R, CRF1100L Africa Twin, Rebel 500, and CBR600RR, the Yamaha Tracer 900, MT-09, XSR900, MT-07, XSR700, TMAX560, and Ténéré 700, the Suzuki V-STROM 1050, as well as the Kawasaki Z H2, Ninja 1000SX, and ZX-10RR.

3.2. Technological Trends

As electronic control technologies continue to become more advanced, more and more models are being equipped with constant speed cruise control systems, riding modes with selectable engine power characteristics and traction control intervention levels, and the like. More models were also launched with multi-function meter clusters featuring thin-film-transistor (TFT) or liquid crystal displays. Some new models also have the capability to connect with mobile terminals, creating new possibilities for the future of motorcycles. 2020 also saw the release of updated versions of electric models such as the Honda Benly e: and Yamaha E-Vino. Electric bike lineups are likely to continue expanding in the future.

Table 1 Specifications of New Engines in 2020

Manufacturer	Name of model	Engine type	Displacement (cm ³)	Bore (mm)	Stroke (mm)	Max. power (kW/rpm)	Max. torque (N·m/rpm)
Honda	CBR1000 RR-R	Water-cooled/4 -stroke/parallel 4 -cylinder/DOHC/4 -valve	999	81.0	48.5	160/14,500	113/12,500
	CBR600 RR	Water-cooled/4 -stroke/parallel 4 -cylinder/DOHC/4 -valve	599	67.0	42.5	89/14,000	64/11,500
Yamaha	YZF-R1 M	Water-cooled/4 -stroke/parallel 4 -cylinder/DOHC/4 -valve	997	79.0	50.9	147/13,500	113/11,500
	TMAX560	Water-cooled/4 -stroke/parallel 2 -cylinder/DOHC/4 -valve	561	70.0	73.0	35/7,500	56/5,250
Suzuki	V-Strom 1050 XT	Water-cooled/4 -stroke/V2 /DOHC/4 -valve	1,036	100.0	66.0	78/8,500	99/6,000
	Gixxer SF250	Oil-cooled/4 -stroke/single-cylinder/SOHC/4 -valve	249	76.0	54.9	19/9,000	22/7,300
Kawasaki	Z H2	Water-cooled/4 -stroke/parallel 4 -cylinder/DOHC/4 -valve	998	76.0	55.0	147/11,000	137/8,500
	Ninja ZX-25 R	Water-cooled/4 -stroke/parallel 4 -cylinder/DOHC/4 -valve	249	50.0	31.8	33/15,500	21/13,000



Fig. 1 CBR1000RR-R Fireblade SP



Fig. 2 CBR600RR



Fig. 3 YZF-R1M



Fig. 4 TMAX560



Fig. 5 V-Strom 1050XT



Fig. 6 Gixxer SF250

torcycle.

(2) Gixxer SF250

This motorcycle is equipped with a 249 cm³, oil-cooled, 4-stroke, single overhead cam (SOHC), 4-valve, single-cylinder engine. The lubrication circuit around the combustion chamber is separated from the finely bored cooling oil circuit of the new Suzuki Oil Cooling System (SOCS), which expands the heat transfer area and ensures uniform cooling of the entire combustion chamber. This design enhances durability by maintaining the appropriate engine temperature. In addition, increasing the combustion efficiency and reducing friction by, for example, applying a textured coating to the piston skirts helped to realize excellent fuel efficiency in addition to higher engine speeds and power. Figure 6 shows the external appearance of this motorcycle.

(4) Kawasaki Motors Corporation

(a) Z H2

This motorcycle is equipped with a 998 cm³, water-cooled, 4-stroke, DOHC, 4-valve, parallel 4-cylinder engine. By adjusting the valve timing from the Ninja H2 SX and shortening the secondary reduction ratio, even greater torque was realized in medium to low speed regions to complement the overwhelmingly powerful supercharged engine, while also enhancing handling. In addition, optimizing the shape of the intake ducts enabled the operation noise and intake sound of the supercharger to be tuned, helping to realize a totally unique engine sound. Figure 7 shows the external appearance of this motorcycle.

(b) Ninja ZX-25R

This motorcycle is equipped with a 249 cm³, water-



Fig. 7 Z H2



Fig. 8 Ninja ZX-25R



Fig. 9 890 Duke R



Fig. 10 F 900 R



Fig. 11 Tiger 900 GT

cooled, 4-stroke, DOHC, 4-valve, parallel 4-cylinder engine. Since 2007, this model has adopted a 4-cylinder 250 cm³-class engine. By shortening the stroke and reducing the weight of reciprocating parts through lightweight pistons, and adopting larger diameter intake and exhaust valves as well as a narrower valve included angle, higher power and a smoother engine rotational sensation at and above 17,000 rpm were achieved. The result is a motorcycle that utilizes the inherent advantages of a 4-cylinder engine to deliver a fun-to-ride experience up to high engine speeds. Figure 8 shows the external appearance of this motorcycle.

2 Technological Trends outside Japan

2. 1. Trends of Each Manufacturer

(1) KTM 890 Duke R

This motorcycle is equipped with an 889 cm³, water-cooled, 4-stroke, DOHC, 4-valve, parallel 2-cylinder engine. In addition to increasing the displacement of the engine from 799 cm³ in the 790 Duke to 889 cm³ by expanding the bore and stroke, a higher compression ratio was adopted, the amount of valve lift was increased, piston weight was reduced, and the rotating mass of the crankshaft was increased by 20%. These measures helped to boost maximum power from 77 to 89 kW, resulting in highly responsive riding performance and seamless engine characteristics. Figure 9 shows the ex-

ternal appearance of this motorcycle.

(2) BMW F 900 R

This motorcycle is equipped with an 894 cm³, water-cooled, 4-stroke, DOHC, 4-valve, parallel 2-cylinder engine. The displacement of the engine was increased from 853 cm³ in the F 850 GS to 894 cm³ by expanding the bore by 2 mm and a higher compression ratio was adopted. These measures increased maximum power from 70 to 77 kW and enable 87 N · m of torque to be generated between 4,500 and 8,500 rpm, resulting in a powerfully enjoyable sensation of engine torque at all speed ranges. Figure 10 shows the external appearance of this motorcycle.

(3) Triumph Tiger 900 GT

This motorcycle is equipped with an 888 cm³, water-cooled, 4-stroke, DOHC, 4-valve, parallel 3-cylinder engine. In addition to increasing the displacement of the engine from 800 cm³ in the Tiger 800 to 888 cm³ by expanding the bore by 4 mm, the crankpin layout was changed from an equal 120-degree spacing from the cylinder on the left side of the bike that generates a firing interval of 240 degrees to a 90-degree interval from the left cylinder (creating a T-shaped crankpin layout when viewed from the side). The resulting change in the firing interval creates an uneven firing interval of 180, 270, and 270 degrees, boosting maximum power, creating riding characteristics with a greater feeling of togetherness between bike and rider, and generating a unique engine

sound. Figure 11 shows the external appearance of this motorcycle.

3 Research and Development Trends

In Europe, with the Euro 5 standards becoming applicable to new models in 2020, each manufacturer launched models that comply with these standards. Motorcycle manufacturers are continuing development work to respond to further major changes on the horizon, including

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1 Introduction

The novel coronavirus COVID-19 pandemic that has raged throughout the world and shows no sign of abating caused the cancelation of both the Internationale Motorrad-Messe (INTERMOT) trade show and the Esposizione Internazionale Ciclo Motociclo e Accessori (EICMA) motorcycle show, which were scheduled for the autumn of 2020. Similarly, the Tokyo and Osaka Motorcycle Shows that were scheduled for the spring of 2021 in Japan were also called off. With opportunities to show off new models taken away by the pandemic, manufacturers were forced to adopt new methods such as online launch shows and web-based motor shows. As a result, many motorcycle fans in 2020 were only able to see long-awaited new models on paper or screen. Despite this situation, the closing deadline for compliance with Euro 5 and other regulations resulted in both the Internet and magazines being full of new models, a somewhat ironic situation given the circumstances.

Despite predictions of a major slowdown in demand due to the coronavirus pandemic, customers' recognition of motorcycles as a leisure item capable of avoiding close contact with other people resulted in unexpectedly high demand in some markets. A global shortage of transportation containers also led to frequent supply shortages in some regions.

In addition, although to a lesser extent than with cars, the transformation of the motorcycle industry by connected, autonomous, shared, and electric technologies is also beginning to permeate slowly into motorcycle design. As well as the issue of how to apply these technologies in a limited space, future advances in the user-interface (UI) design field, which has been relatively neglected until recently, are being considered in combination with

even more stringent environmental regulations and electrification. However, the spread of the coronavirus pandemic across the world in 2020 spurred various changes in motorcycle use and demand in different countries. The industry is watching with interest to see how manufacturers will respond to these changes and what technologies will be developed to further enhance the appeal of their models.

the inevitable wave of electrification. The result is likely to be unprecedented changes to motorcycle design in the near future. With this year seeming like the eve of a major storm of change, the following sections look back over motorcycle design trends in 2020 through the lens of individual models.

2 Sports Motorcycles

In the broad lineup of models offered by manufacturers, sports motorcycles with full cowlings are often responsible for driving the brand image of the manufacturer. A major wave of change is starting to sweep across the designs of these models. The cause of this change is an aerodynamic device called the winglet, which has become indispensable to success in MotoGP races. These winglets are mainly located on the front cowling and function to prevent the front wheel lifting off the ground at high speeds. Although these devices are most effective on the racetrack, mass production race-based models equipped with winglets have started to be launched to create an even racier image.

The model that has most actively pushed winglets to the forefront of design is the Ducati Panigale Superleggera V4 (Fig. 1). The general incongruity of this design is



Fig. 1 Ducati Panigale V4R



Fig. 2 Honda CBR1000RR-R



Fig. 3 Kawasaki ZX-10R



Fig. 4 Suzuki Hayabusa

probably due to the way that the winglets appear to be attached at random with no thought given to affinity with the flowing lines of the cowling. However, the foremost characteristic of winglets is as functional parts. As successful race bikes incorporate winglets as a matter of course, most customers in the market look on them in a favorable light.

Standing in contrast to the Panigale is the Honda CBR1000RR-R, which has managed to successfully integrate the winglets into boxes as part of the cowling design (Fig. 2). This concept is specifically designed for racetrack performance. Care has been taken with every detail, resulting in a sophisticated design that does not compromise dynamic performance.

Similarly, although not completely redesigned for 2020, the newly released race-based Kawasaki ZX-10R, which is inspired by the model that has won the Superbike World Championship for six consecutive years, also features enclosed winglets (Fig. 3). The compact LED headlamps incorporated into the ram air intake are similar to



Fig. 5 Suzuki Gixxer SF250



Fig. 6 Kawasaki ZX-25R

those in the CBR1000RR-R mentioned above. However, the impactful and unique face of the ZX-10R indicates the direction for the next generation of Ninja bikes from Kawasaki.

Although not a model that was designed specifically for the racetrack, Suzuki launched the long-awaited new Hayabusa in 2020 (Fig. 4). While maintaining a powerful appearance instantly recognizable as a Hayabusa, the new model boasts simple and fresh design work. The cowling incorporates chrome-plated trim around the ducts, an almost unprecedented feature for a motorcycle in this category. The design is likely to give a strong boost to Suzuki's inspirational brand image.

Turning to the 250 cc class, manufacturers unveiled two models as part of the cutthroat competition in the sports segment. The first is the Suzuki Gixxer SF250 (Fig. 5). With an upright and rider-friendly riding position, the Gixxer features flowing and unique design themes with a low and compact stance. In combination with its distinctive LED headlamps and swing-arm mounted rear fender, the result is an expression of Suzuki's signature style. The other is the Kawasaki ZX-25R (Fig. 6). Featuring the only 4-cylinder engine in the 250 cc class, the ZX-25R shares headlamps with its sister Ninja 250 model. The result is a deliberate similarity in styling that gives the ZX-25R a powerful appeal as a member of the unmistakable Ninja family.



Fig. 7 Honda Rebel 1100



Fig. 10 Yamaha Tracer 9



Fig. 8 BMW R18



Fig. 11 Honda CT125



Fig. 9 Yamaha MT-09

3 Departure from Conventional Forms

As motorcycle customers become older, motorcycles with a strong appeal based on outward forms of style are beginning to lose their luster. One example is Harley Davidson, which has come to be known for its adherence to a set of seemingly consistent and universal values. In contrast, however, a growing number of models are being designed with newer sensibilities that appeal both to new generations with unique values and discerning veteran riders with experience of many different models.

For example, the Honda Rebel 1100 (Fig. 7), which is the older sibling to the popular Rebel 250 and 500 models, combines the same minimalistic styling as its other family members with a slimline and low-slung seating

position. With its accessible nature pushed to the forefront, the Rebel 1100 is introducing new values to the large cruiser segment. BMW launched the R18 (Fig. 18) featuring the trademark BMW flat-twin engine and combining the latest technologies with styling motifs taken from the 1936 R5. While unmistakably a BMW, the R18 looks like no other cruiser in its segment. Whereas BMW may have been influenced by any number of Japanese models when it designed the S1000RR, the R18 is a clear nod to BMW's historical brand image.

The modern motorcycle segment called SNK is not known for retro styling and has seen some new entrants with designs that go beyond existing conventions. The Yamaha MT-09 (Fig. 9) showcases a design that completely eschews showy expressions of power. By complementing functional dynamic parts with minimalistic styling elements with an individualistic face design, Yamaha is pushing a unique image for the MT world.

4 Diversification of Long-Legged Motorcycles

With long-legged motorcycles diversifying from dual-purpose to multi-purpose models, this style has come to be a part of the expanding range of adventure-based bikes. Manufacturers both inside and outside Japan are throwing their weight into developing models capable of meeting a wide range of needs from everyday use to

long touring. Harley Davidson has also joined this segment with the Pan America. Yamaha has released an updated Tracer 9 (Fig. 10) that adopts fresh and simple lights based on the new MT and a configuration of styling parts that defy current boundaries. This model has a novelty that appeals successfully over and above the details of the bike itself.

5 A Re-Examination of Motorcycles for Leisure

Motorcycles are being re-assessed by customers as a way to escape close contact with other people in the midst of the coronavirus pandemic. Following this trend, the Honda CT125 Hunter Cub (Fig. 11) has attracted particular attention both in Japan and in emerging markets. The history of the Hunter Cub goes back almost sixty years and it combines a titillating design that demonstrates an original and adventuring spirit with LED headlamps and other examples of the latest technologies into a strictly functional expression. Clearly distinguishable from its Cross Cub and Super Cub siblings, the Hunter Cub has brilliantly jumped onto a modern trend.

6 Highly Complex Electric Motorcycle Design

Even though the internal combustion engine will remain in use for the foreseeable future, electrification is an unavoidable trend. For motorcycles, one major issue is how to install a large square battery in a limited space,



Fig. 12 LiveWire

with the inevitable trade-off relationship this creates with cruising range. Among the various restrictions that electrification creates for motorcycles, the Harley Davidson LiveWire (Fig. 12) is one potential solution that combines the characteristics of an EV with a particular appeal to motorcycle enthusiasts. Electric drivetrains often appear to be unexciting and matter-of-fact, but the design of the LiveWire creates an excellent blend between electrification and a certain nostalgic spirit. The electric motorcycle market is one that Japanese manufacturers will have to enter in coming years, and is a hurdle that will not be easy to overcome. However, on the other extreme, an electric drivetrain consisting of a battery, motor, and control system also presents excellent opportunities for flexible layouts. With further breakthroughs waiting to be made, a succession of new designs may be just around the corner.