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901 Series Porsche Transmission

Introduction

The 901 series Porsche transmissions was a four or five speed longitudinal transaxle designed and manufactured by Porsche between 1964 and 1976. The transmission was used primarily in the 911 but variations were also used in the 904, 906, 912 and 914 production road and race cars. Transaxle is the correct definition instead of transmission due to the differential being part of the overall design. However for simplicity purposes this article will use the term transmission.

History

As part of the creation of the type 911 (901) car, Porsche created an all new transmission which became the 901 transmission. The initial version utilized a cast aluminum housing with later models having a cast magnesium housing. The basic design consists of a main segment that houses the gears, differential and bell-housing. However the two shafts and gear sets themselves are attached to an intermediate plate that is sandwiched between the larger casting and the end plate (sometimes referred to as the "nose cone" or "tail cone".) The transmission was designed as a 5-speed however 4-speed versions were offered. The shift pattern is considered to be odd with reverse at the top left and first on the bottom left. This makes for a more difficult 1st to 2nd up-shift. The Porsche designed synchronizer system (aka "Balk Ring" design) was used on all 901 series transmissions. It is possible to convert from the Porsche synchronizer system to a dog gear racing style system.

The transmission was used frequently in Porsche racing cars partially due to the wide selection of gears that were available. Variations include the type 901 used in early 911 cars, type 902 used in the 912 car, type 911 used in later 911 cars and the type 914 used in the 914 car. While not technically part of the 901 series, the type 905 is a Sportomatic version that uses many of the design specifications (such as distance between the input and output shaft, gears, etc.) of the 901 series. Specific models are given an official Porsche "type" designation and this typically designates a specific configuration (gearing, intended use in a specific car, etc.) An example would be the "Type 914/12" which was used in the 1973-76 Porsche 914 car. A feature of the mainshaft on a 901 series transmission was that 2nd gear is part of the shaft. A special main shaft that was used on the 904 car (commonly known as the 904 mainshaft) does not include 2nd gear on the mainshaft. This allows for easier ratios changes for 2nd gear. Real 904 mainshafts are relatively rare and reproductions are available.

Typically these transmissions were provided with a standard "open" differential. However some examples were provided from the factory with a ZF clutch type Limited Slip Differential (LSD). The 901 series transmission was eventually replaced by the 915 series transmissions.

Production Changes

The basic design changed somewhat over the production life. Main transmission case material changed from aluminum to magnesium. The intermediate plate that carries the main gear stack changed from a thinner to a thicker design. The differential experienced a number of evolutionary improvements. A number of other various internal items changed during production. As you would expect with the transmission being used in various cars there are design features specific

to those cars. Those used for mid-engine placement have the differential “flipped”. There are casting differences based upon shift linkage configuration, transmission mounting methods, clutch activation methods and other reasons. The number of differences are to many to list here. While there are a number of differences there remains a number of things that changed very little. The basic gear design was unchanged during the life of production (you will find small manufacturing variations however). This makes it easy to re-gear these transmissions due to the wealth of different gears that have been manufactured over time.

Known Issues

When used within it’s design parameters the 901 series transmissions are well built and tough. However those that are pushed beyond these design limits, have high mileage and/or are poorly maintained can expose the weak spots in the design.

Magnesium Corrosion. Even the newest example of a 901 series transmission is now 35 years old. The thin chromate conversion applied to the bare magnesium and Cosmoline like Tectyl waxy protection wears off within a few years. Over time the magnesium case can experience internal and external corrosion.

Use with high torque engines. It is believed that Porsche set 138 lb/ft (sand cast aluminum) and 148.5 lb/ft (die cast aluminum) maximum torque values for the 901. However this value most likely represents a torque level that maximized longevity and that while the 901 can handle higher torque values, the use with engines that produce higher amounts of torque will reduce the overall longevity of the transmission.

Weak first gear. The location on the input shaft that holds first gear is the weak point on the input shaft. Combining high torque, grip levels from modern tires and hard launches, you can twist first gear off the input shaft.

"Simplified" Differential. The design for the differential used roughly between 1968 and 1970 can lead to catastrophic failure of the transmission when the “teats” on the end of the output flange stretch bolts wear off.

Ovaling of intermediate place bearing carriers. Over time the holes machined into the intermediate plate that hold the input and output shaft bearings can experience an oval wear pattern. This allows the bears to loose support and eventually cause failure of the bearings.

Versions

Listed below is a chart of the various versions that Porsche produced

Manual

Version	Gears	R&P	1st	2nd	3rd	4th	5th	Serial Number	Note
901/0	5	7:31	AA	GA	O	U	Y		1964-65 911
901/02	5	7:31	A	F	M	S	Z		1966-67 911S
901/03	5	7:31 S	A	F	M	S	Z		1968 911T
901/06	4	7:31 S	A	HB	S	Z		7090001 - 7090223	1969-70 911
901/07	5	7:31 S	A	F	M	S	Z	7190001 - 7192529	

901/10	4	7:31 S	A	HB	S	Z			1968-69 911S, 911T
901/12	4	7:31 S	A	HB	S	Z		7091001 - 7091469	
901/13	5	7:31 S	A	F	M	S	Z	7193001 - 7198787	
901/50	5	7:31	B	GA	M	T	Y		1967 911 Special ratio option
901/51	5	7:31	AA	E	I	M	O		1967 911 Hillclimb ratio option
901/52	5	7:31	AA	F	J	O	S		1967 911 Airport ratio option
901/53	5	7:31	C	HA	O	T	Y		1967 911 Speed ratio option
901/54	5	7:31	B	HA	M	R	V		1967 911 Nurburgring ratio option
901/75	5	7:31 S	B	GA	M	T	Y	7390001 - 7390002	1968 911 Special ratio option
901/76	5	7:31 S	AA	E	I	M	O	7391001 - 7391001	1968 911 Hillclimb ratio option
901/77	5	7:31 S	AA	F	J	O	S	7392002 - 7392010	1968 911 Airport ratio option
901/78	5	7:31 S	C	HA	O	T	Y	7393001 - 7393003	1968 911 Speed ratio option
901/79	5	7:31 S	B	HA	M	R	V	7394001 - 7394008	1968 911 Nurburgring ratio option
901/80	5	7:31 S	B	GA	M	T	Y	7390101 - 7390109	1969 911 Special ratio option
901/81	5	7:31 S	AA	E	I	M	O	7391101 - 7391102	1969 911 Hillclimb ratio option
901/82	5	7:31 S	AA	F	J	O	S	7392101 - 7392118	1969 911 Airport ratio option
901/83	5	7:31 S	C	HA	O	T	Y	7393101 - 7393106	1969 911 Speed ratio option
901/84	5	7:31 S	B	HA	M	R	V	7394101 - 7394109	1969 911 Nurburgring ratio option
902/0	4	7:31 S	A	H	Q	X		160001 - 162462 (up to 7/26/1965), 163001 - 165214 (4 cyl engine) 200000 - 200402 (6 cyl engine)	1965-66 911, 912

902/1	5	7:31 S	A	F	M	S	X	220001 - 221721 (up to 7/26/1965) 234001 - 238942 (4 cyl engine) 130001 - 131571 (6 cyl engine)	1965-67 911, 912
902/01	4	7:31 S	A	H	Q	X		1080001 - 1089999	1968 912 US
902/02	5	7:31 S	A	F	M	S	X	1280001 - 1289999	1968 912 ROW
902/04 902.04 902.300/14	4	7:31 S	A	H	Q	X		109xxxx - ????????	1969 912
902/05	5	7:31 S	A	F	M	S	X	129xxxx - ????????	1969 912
902/06	5	6:29	A	GA	O	U	Z	5195001 - ????????	1969 late 912 US
902/16 902.300/16	5	6:29	A	GA	O	U	Z	129xxxx - ????????	1969 912
902/50	5	7:31 S	A	E	I	O	U	9285001 - 9285999	1969 close ratio option #1
902/55	5	6:29	A	E	I	O	U		1969 close ratio option #2
902/60	5	7:31 S	A	E	I	O	U		1969 close ratio option #3
911/00	4	7:31 S	A	HB	S	ZA		7000001 - 7000691 (MY 1970), 7010001 - 7019999 (MY 1971)	1970-71 911T
911/01	5	7:31 S	A	GA	O	V	ZA	7100001 - 7109999 (MY 1970), 7700001 - 7702730 (MY 1970), 7110001 - 7119999 (MY 1971), 7710001 - 7719000 (MY 1971)	1970-71 911E, 911S
911/80	5	7:31 S	B	GA	M	T	Y	7319101 - 7319200	1970 911 Special ratio option

911/81	5	7:31 S	AA	E	I	M	O	7319201 - 7319300	1970 911 Hillclimb ratio option
911/82	5	7:31 S	AA	F	J	O	S	7319301 - 7319400	1970 911 Airport ratio option
911/83	5	7:31 S	C	HA	O	T	Y	7319401 - 7319500	1970 911 Speed ratio option
911/84	5	7:31 S	B	HA	M	R	V	7319501 - 7319600	1970 911 Nurburgring ratio option
914/01	5	7:31	A	GA	O	V	ZA	7500001 - 750???? (MY 1970), 7510001 - 751???? (MY 1971), 7520001 - 752???? (MY 1972)	1970-72 914/6
914/11	5	7:31	A	F	N	V	ZD	HA 0000001 - HA 0014826 (MY 1970), HA 0014827 - HA 0030093 (MY 1971), HA 0030094 - HA 0053072 (MY 1972)	1970-72 914/4
914/12	5	7:31	A	F	N	V	ZD	HA 0053072 - HA 0056362 (MY 1973), HA 01102 - HA 31122 (MY 1973), HA 01013 - HA 31073 (MY 1973), HA 01083 - HA 31074 (MY 1974), HA 05084 - ? (MY 1975), HA 05085 - ? (MY 1976)	1973-76 914/4

Sportomatic

Version	Gears	R&P	1st	2nd	3rd	4th	5th	Serial Number	Note
905/00	4	7:31 S							1967-68
905/01	4	7:31 S							1967-68

905/13	4	7:27 S	C	HB	O	V		7290001 - 7291044	1968-69
905/20	4	7:27 S	C	I	Q	X		7200001 - 7201023 (MY 1970), 7210001 - 7219999 (MY 1971)	1970-71 911T, 911E
905/21	4							7220001 - 742???? (MY 1972), 7230001 - 743???? (MY 1973)	1972-73 911T, 911E
914/??	4	7:27	C	J	S	Z		?	914/4 Sportomatic Prototype
914/05	4	7:27	C	I	Q4	X		7800001 - 780???? (MY 1970), 7610001 - 7610027 (MY 1971)	1970-71 914/6

Those transmission that came with what is known as the "Simplified" differential are listed with an "S" after the final drive ratio in the charts above.

Gearing and Differential

Differential

901 transmissions were either delivered with a standard open differential, or an optional ZF clutch type limited slip unit. Over the life of the transmission there were design changes to the standard open differential. The type 901, 902 and 905 transmissions used a smaller differential carrier while the type 911 and 914 used a larger and strong design.

"Simplified" Differential

Along with the differential carrier basic size changes, there were also differences in how the differential carrier pin (part of the spider gear assembly) is held in place. Roughly between 1968 and 1970 a design (known as the "simplified" differential as it was simpler and used fewer parts) utilized special pin like extensions (commonly known as the "teats") on the end of the stretch bolts that attach the output flanges to the differential. When in place, these teats hold the carrier pin in place. However the teats wear off the ends of the bolts over time and once they fail, they no longer hold the carrier pin in place. Centrifugal and other forces allow the pin to slide out of position then impacting the interior of the case leading to a catastrophic failure of the transmission. Campaigns by Porsche at that time tried to address the issue via modifications. So some transmissions from the affected era have been fixed. Earlier and later differentials have a different design and do not have this problem.

Final Drive

The final drive consists of a pinion and ring gear. As this is a transaxle design, the pinion gear is on the end of (part of) the output shaft. The ring gear is bolted to the differential. The final drive

ratio is the ratio of the teeth count between the pinion and ring gears. For example a typical 901 final drive has a ratio of 7:31 (4.429). This translates to 7 pinion teeth and 31 ring teeth.

Ratio	Gear
6:29 (4.833)	Pinion and Ring
7:31 (4.429)	Pinion and Ring
7:27 (3.857)	Pinion and Ring

Main Gears

Each gear set generally consists of two gears. One for the input shaft and one for the output shaft. There are some slight exceptions. As reverse is part of first gear, it has a matching “reverse idler” gear. So 1st gear consists of the input, output and reverse idler gear. On most 901 series transmissions the input shaft includes 2nd gear. So in these a 2nd gear set would include the input shaft. The gear ratio for a gear set is the ratio of the teeth count between the input and output shaft gears. For example an 901 “A” 1st gear has a ratio of 11:34 (3.091). This translates to 11 teeth on the input gear and 34 teeth on the output gear. While all 901 series gears can be described via their teeth count (and associated ratio), to make it easier to identify specific ratios, Porsche used an A through Z based naming system. With “A” being a low 11:34 1st gear and “ZD” being a high 31:22 5th gear.

In a perfect world, any of these gear sets could be used in any location to provide ultimate flexibility with respect to gearing. However due to the basic design of the transmission (internal case space, shift fork locations, input/output shaft design, etc.), specific gears can typically only be used in specific locations. For example in general a gear designed for 5th gear may also be placed in the 4th gear location (and vice versa) . The same goes for 2nd and 3rd gear (assuming you have a 904 mainshaft). 1st gear is not designed to be relocated into other gear slots. In addition to using gears in their intended locations, there is a concept known as “flipping” which can for example use a 5th gear in place of 3rd gear. This is accomplished by switching or flipping the gears from the input to output shaft to reverse the ratio.

Code	Ratio	Gear
A	11:34 (3.091)	1
AA	12:34 (2.833)	1
B	14:37 (2.643)	1
C-	12:29 (2.417)	1
C	15:36 (2.4)	1
CA	13:29 (2.231)	1
D	16:35 (2.188)	1
E	17:34 (2)	2
F	18:34 (1.889)	2
G	18:33 (1.833)	2
GA	18:32 (1.778)	2
GB	17:30 (1.765)	2
H	19:32 (1.684)	2,3
HB	19:31 (1.632)	2,3
HA	20:32 (1.6)	2
I	20:31 (1.55)	2,3

J	21:31 (1.476)	3
K	21:30 (1.429)	3
KA	22:31 (1.409)	3
L	22:30 (1.364)	3
M	22:29 (1.318)	3,4,5
N	23:29 (1.261)	3,4,5
O	23:28 (1.217)	3,4,5
P	23:27 (1.174)	3,4,5
Q	24:27 (1.125)	3,4,5
R	25:27 (1.08)	4,5
S	25:26 (1.04)	4,5
T	26:26 (1)	4,5
U	26:25 (0.9615)	4,5
V	27:25 (0.9259)	4,5
W	27:24 (0.8889)	4,5
X	28:24 (0.8571)	4,5
Y	28:23 (0.8214)	4,5
Z	29:23 (0.7931)	4,5
ZA	29:22 (0.7586)	4,5
ZD	31:22 (0.7097)	4,5

Serial Numbers

Model and/or serial number/build date are stamped on the bottom of the case. The location and style/decoding scheme of the stamping are depending upon the type of transmission and year of manufacture. Some stampings includes the type designations, while others do not. Some indicate details such as differential type, while others do not. Some list a unique serial number, while others may only list a build date (implying that multiple transmissions will have the same stamping)

901, 902, 905 and 911 types

AAA/AA BB CDE NNNN

A = Type (i.e. 06 = 901/06)

B = Differential Designation, 12 = ZF LSD, missing = no LSD

C = Application, 5 = 4 cylinder engine, 7 = 6 cylinder engine

D = ?

E = ?

N = Sequential Serial Number (i.e. 0001, 0002, etc.). Some models did not start with serial number "1"

914/01 and 914/05 types

The 914/01 transmission that was only used in the 914/6 car generally have the stamping in a square raised section of the casting directly under the differential, however some early production examples have the stamping on the "keel" instead. This raised section only appears on the 914/01 transmissions. The 914/05 transmission does not have this raised area and has its stamping on the keel. It should be noted the actual transmission type "914/01" or "914/05" is part of the stamping

914/AA B CDENNNN

A = Type (01 = standard 5 speed, 05 = 4 speed Sportomatic)

B = Differential, 10 = 80% LSD, blank = standard open differential

C = Application, 7 = 6-cyl engine

D = Type, 5 = 5 speed, 6 = 4 speed Sportomatic

E = Model Year, 0 = 1970, 1 = 1971, 2 = 1972

N = Sequential Serial Number (i.e. 0001, 0002, etc.)

914/11 and early 914/12 (up to and including some early 1973 model year 914/4)

All of the 914/11 and some of the early 914/12 transmissions used a different style of stamping as well as a different location for the stamping. The stamping is located directly on the front to rear reinforcement webbing or "keel" that is part of the casting. This keel runs the length of the transmission, but as with the 914/01 and 915/05 transmission, the stamping is located generally under the differential. It should be noted the actual transmission type "914/11" (and maybe even 914/12" is part of the stamping.

914/AA B CDNNNNNNN

A = Type (01 = standard 5 speed, 05 = 4 speed Sportomatic)

B = Differential, 10 = 80% LSD, blank = standard open differential

C = Type, H = Manual

D = Gear/Differential, A = 5 speed, B = 5 speed with LSD

N = Sequential Serial Number (i.e. 0000001, 0000002, etc.)

Late 914/12 (most 1973 and beyond)

Other than the very early 914/12 transmissions mentioned above, the bulk of the 914/12 transmissions used a third style of stamping. It used the same location as the 914/11 and early 914/12, but is decoded differently and there is no transmission type indicated on the transmission. Additionally the new numbering scheme is based upon date of manufacture and not individual transmissions. This means that if multiple transmissions are manufactured on the same day, they should have the same stamping.

ABCCDDE (No "type" indicator on these, however all of these are type 914/12)

A = Type, H = Manual

B = Gear/Differential, A = 5 speed, B = 5 speed with LSD

C = Day of manufacture

D = Month of manufacture

E = Year of manufacture

Links

http://en.wikipedia.org/wiki/Manual_transmission

<http://www.bigporsche.com/history914w.htm>

<http://forums.pelicanparts.com/porsche-912-technical-forum/933215-902-1-transmission-identification.html>

http://www.912registry.org/content.aspx?page_id=22&club_id=22055&module_id=185540

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