

V-9000 Series Rotary Motion Rack and Pinion Pneumatic Actuators for Butterfly Valves

Product Bulletin

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The V-9000 Series Pneumatic Rack and Pinion Actuators are designed for direct mounting on Johnson Controls® VF Series Butterfly Valves. The actuators are available in eight sizes with torque output capacities capable of automating VF Series Butterfly Valves up to 20 inches in size.

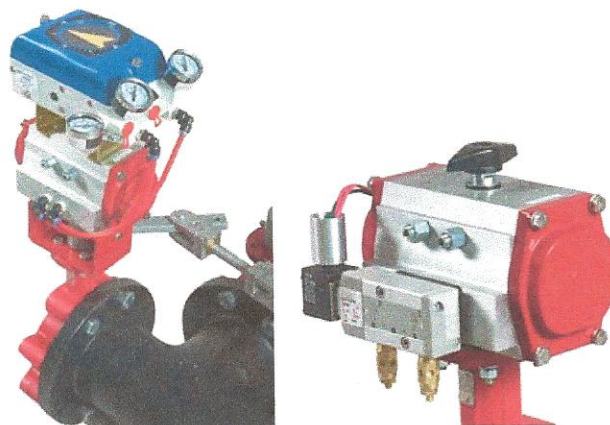


Figure 1: V-9000 Series Pneumatic Actuators Installed on VF Series Butterfly Valves

Table 1: Features and Benefits

Features	Benefits
Compact Modular Design	Provides direct mounting to VF Series Butterfly Valves.
Low Friction Piston Guides and Rings	Provide maximum efficiency and long life.
Built-in Shaft Position Indicator and Travel Stops	Mean that no add-on visual indicators or travel stops are required.
Full Range of Modular Add-on Control Accessories	Allows versatility in meeting system design requirements.

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Applications

The V-909x Series Actuators are double-acting (air-to-open/air-to-close), whereas the V-919x Series Actuators incorporate spring-return action. The unique modular design allows the same basic actuator body to be used for both spring-return or double-acting service requirements.

For two-position operation, either style of actuator is furnished with the appropriate factory-mounted 120 VAC solenoid air valve. For modulating control applications, the solenoid air valve is replaced with a V-9000-500 Positioner.

Clean (filtered), dry air at 40 to 120 psig (280 to 840 kPa) is recommended. Pressures well below and slightly higher than this range may be allowed under certain conditions. Consult a Johnson Controls representative for application recommendations.

The recommended operating temperature range is -13 to 200°F (-25 to 95°C). Below 32°F (0°C), take care to protect the supply air lines from freezing should condensed moisture collect in them.

Features

The V-9000 Series Pneumatic Actuator is a space-saving modular product line that is completely enclosed and self-contained (see Figure 2).

The acetal guide ring and bearing pad have a very low coefficient of friction and absorb the side thrusts of the pistons. In addition, the piston cylinder walls in the body are honed to a very fine finish thus reducing the overall coefficient of friction.

The output shaft bearings on the top and bottom of the pinion are made of low-friction acetal. The output shaft and pinion gear are one piece, manufactured from hardened alloy steel, and zinc-plated for corrosion protection.

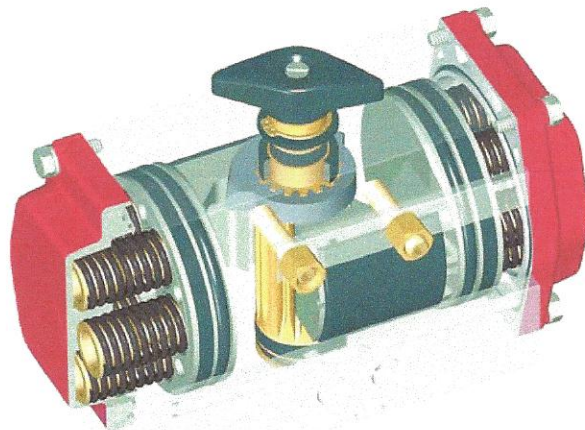


Figure 2: V-9000 Cutaway View

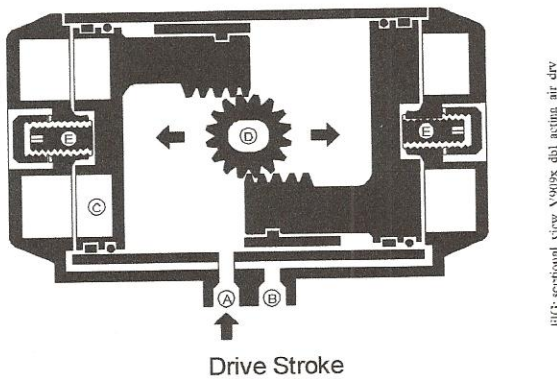
The shaft position indicator clearly shows the open or closed position and can easily be removed when field mounting a positioner or travel switch.

The body is extruded aluminum with an anodized corrosion protective surface. The end caps have a thermoplastic epoxy coat for chemical resistance.

The travel stop adjusting screws limit the travel of the actuator to specific degrees of rotation. The pistons are die cast aluminum.

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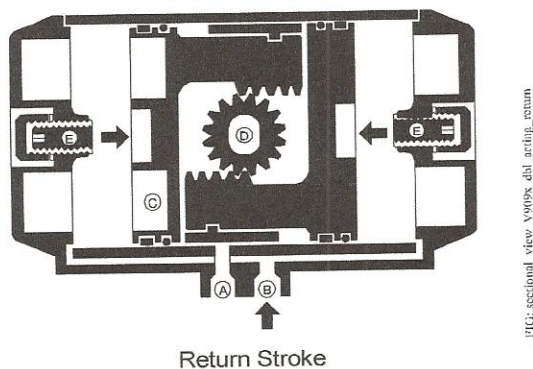
Operation.



**Figure 3: Sectional View from Top
V-909x Series Double Acting Actuators**

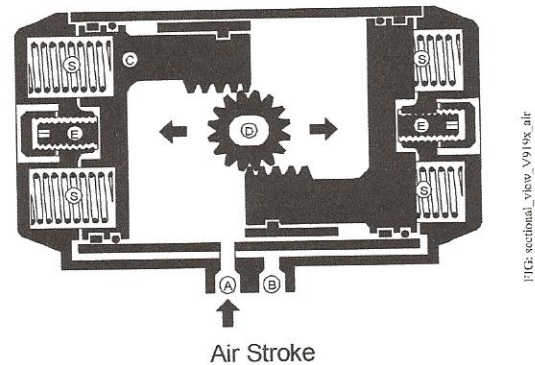
As illustrated in Figure 3, the air pressure is applied to the inner chamber through Port A and exhausted from the outer chamber through the exhaust Port B. The outward generated force causes the pistons (C) to move outward, which in turn causes the output shaft (D) to rotate counterclockwise (when viewed from the top).

This movement continues until the pistons come into contact with the mechanical end stroke adjustment screws (E), which are factory set for 90° rotation. The screws can be adjusted to precisely regulate the rotation of the pistons and output shaft to the correct amount of travel.



**Figure 4: Sectional View from Top
V-909x Series Double Acting Actuators**

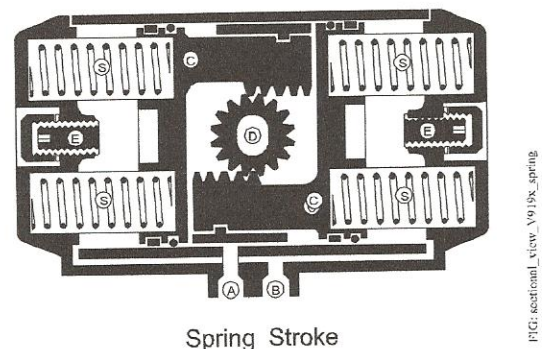
As illustrated in Figure 4, with air pressure applied to the outer chamber from the supply through Port B and exhausted from the inner chamber through Port A, the inward generated force causes the pistons (C) to move inward, which in turn causes the output shaft (D) to rotate clockwise (when viewed from the top).



**Figure 5: Sectional View from Top
V-919x Series Spring Return Actuators**

As illustrated in Figure 5, the air pressure is applied to the inner chamber through Port A and exhausted from the outer chamber through the exhaust Port B. The outward generated force causes the pistons (C) to move outward, which in turn causes the output shaft (D) to rotate counterclockwise (when viewed from the top) and the return springs (S) to compress.

This movement continues until the pistons come into contact with the mechanical end stroke adjustment screws (E), which are factory set for 90° rotation. The screws can be adjusted to precisely regulate the rotation of the pistons and output shaft to the correct amount of travel.



**Figure 6: Sectional View from Top
V-919x Series Spring Return Actuators**

As illustrated in Figure 6, with air pressure exhausted through Port A, the inward force generated by the return springs (S) causes the pistons (C) to move inward, which in turn causes the output shaft (D) to rotate clockwise (when viewed from the top).

Actuator Sizing

The V-9000 Series Rack and Pinion Actuators are presized for all styles of Johnson Controls VF Series Butterfly Valves; refer to the ordering data templates in *VF Series Standard-Pressure, Standard-Temperature Butterfly Valves Product Bulletin (LIT-977205P)* and *VF Series High-Pressure, High-Temperature Butterfly Valves Product Bulletin (LIT-977208)* for full code numbers for sizing recommendations. The actuators are sized for the maximum expected seating/unseating torque requirements of the valve at the minimum available air supply pressure to the actuator. Actuator sizing recommendations on VF Series Butterfly Valves are based on a 25% safety factor on 2 through 12 in. valves and a 10% safety factor on 14 through 20 in. valves.

See Table 2 for torque and ordering data for V-909x Series Actuators. Example 1 and Example 2 use information provided in Table 2.

- **Example 1:** A valve with 80 psig available air pressure requires 695 lb-in of torque. Use a V-9093-1 with 721 lb-in torque available.
- **Example 2:** A valve with 60 psig available air pressure requires 1,235 lb-in of torque. Use a V-9094-2 with 1,615 lb-in torque available.

Sizing for the V-919x Series Spring Return Actuators is dependent on the return to normal position of the valve.

See Table 2 for sizing information for normally open, normally closed, and three-way valves. Example 3, Example 4, and Example 5 use information provided in Table 2.

- **Example 3:** A normally closed valve with 80 psig available air pressure requires 465 lb-in of torque. Use a V-9194-14 with 522 lb-in spring start and 491 lb-in air end torque.
- **Example 4:** A normally closed valve with 60 psig available air pressure requires 705 lb-in of torque. Use a V-9194-24 with 732 lb-in spring end and 883 lb-in air start torque.
- **Example 5:** A three-way valve with 80 psig available air pressure requires 846 lb-in of torque. Use a V-9196-12 with 1,679 lb-in spring start; 978 lb-in spring end; 4,764 lb-in and air start; and 4,063 lb-in air end torque.

Note: One valve in the three-way assembly is normally open and one valve is normally closed; therefore, all four values must exceed the torque requirements for the valve assembly.

Table 2: V-909x Series Actuator Torque Data (lb-in)¹ and Ordering Data (Double Acting)

Code Number	Supply Pressure psig (kPa)					VF Series Code Number ²	Actuator Air Volume (in ³)	Shipping Weight lb ³
	40 (280)	60 (420)	80 (560)	100 (700)	120 (840)			
V-9092-1	145	221	297	373	449	-020	9.35	3.4
V-9093-1	351	536	721	906	1,091	-030	20.5	6.3
V-9094-1	493	753	1,013	1,272	1,532	-040	28.9	8.5
V-9094-2	1,058	1,615	2,171	2,728	3,285	-042	62.0	16.9
V-9096-1	2,797	4,270	5,742	7,214	8,687	-060	140.6	38.8
V-9097-1	5,783	8,826	11,870	14,914	17,957	-070	309.5	77.8
V-9098-1	14,211	21,691	29,171	36,650	44,130	-080	734.1	167.0

1. lb-in x 113 = N-m

2. Refer to the ordering data templates in *VF Series Standard-Pressure, Standard-Temperature Butterfly Valves Product Bulletin (LIT-977205P)* and *VF Series High-Pressure, High-Temperature Butterfly Valves Product Bulletin (LIT-977208)*.

3. lb x 0.454 = kg

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Table 3: V-919x Series Actuator Torque Data (in-lb)¹ and Ordering Data (Spring Return)

Code Number	Suffix	Air Stroke Supply Pressure psig (kPa)										Spring Stroke		Weight (lb) ²
		40 (280)		60 (420)		80 (560)		100 (700)		120 (840)				
		NC ³ Start	NO ³ End	NC Start	NO End	NC Start	NO End	NC Start	NO End	NC Start	NO End	NC Start	NO End	
V-9193	-12	210	167	395	352	580	537	765	722	950	907	184	141	6.0
	-13	156	76	341	261	526	446	711	631	896	816	275	195	6.3
	-14	--	--	281	176	466	361	651	546	836	731	360	255	6.6
	-15	--	--	220	97	405	282	590	467	775	652	439	316	6.8
	-16	--	--	--	--	369	185	554	370	739	555	536	352	7.1
V-9194	-12	310	232	570	492	830	752	1089	1011	1349	1271	261	183	8.0
	-13	218	101	478	361	738	621	997	880	1257	1140	392	275	8.4
	-14	--	--	386	231	646	491	905	750	1165	1010	522	367	8.8
	-15	--	--	294	94	554	354	813	613	1073	873	659	459	9.1
	-16	--	--	--	--	462	229	721	488	981	748	784	551	9.5
V-9194	-22	692	469	1249	1026	1805	1582	2362	2139	2919	2696	589	366	18.1
	-23	509	174	1066	731	1622	1287	2179	1844	2736	2401	884	549	18.8
	-24	--	--	883	437	1439	993	1996	1550	2553	2107	1178	732	19.5
	-25	--	--	700	142	1256	698	1813	1255	2370	1812	1473	915	20.3
	-26	--	--	--	--	1073	404	1630	961	2187	1518	1767	1098	21.0
V-9195	-13	--	--	1357	733	2099	1475	2841	2217	3583	2959	1419	795	22.1
	-15	--	--	--	--	1568	529	2310	1271	3052	2013	2365	1326	24.2
V-9196	-12	1819	1118	3292	2591	4764	4063	6236	5535	7709	7008	1679	978	39.7
	-13	1399	349	2872	1822	4344	3294	5816	4766	7289	6239	2448	1398	42.1
	-14	--	--	2452	1123	3924	2595	5396	4067	6869	5540	3147	1818	44.5
	-15	--	--	2030	353	3502	1825	4974	3297	6447	4770	3917	2240	46.8
	-16	--	--	--	--	3154	1196	4626	2668	6099	4141	4546	2588	49.2
V-9197	-12	3833	2508	6876	5551	9920	8595	12964	11639	16007	14682	3275	1950	75.1
	-13	2859	868	5902	3911	8946	6955	11990	9999	15033	13042	4915	2924	80.2
	-14	--	--	4930	2275	7974	5319	11018	8363	14061	11406	6551	3896	85.2
	-15	--	--	3949	638	6993	3682	10037	6726	13080	9769	8188	4877	90.3
	-16	--	--	--	--	6022	2031	9066	5075	12109	8118	9839	5848	95.3
V-9198	-12	9487	6747	16967	14227	24447	21707	31926	29186	39406	36666	7464	4724	160.2
	-13	7125	3015	14605	10495	22085	17975	29564	25454	37044	32934	11196	7086	168.3
	-14	--	--	12243	6762	19723	14242	27202	21721	34682	29201	14929	9448	176.4
	-15	--	--	9880	3030	17360	10510	24839	17989	32319	25469	18661	11811	184.5
	-16	--	--	--	--	14998	6778	22477	14257	29957	21737	22393	14173	192.6

1. in-lb x 113 = N·m

2. lb x 0.454 = kg

3. N.C. is the abbreviation for Normally Closed; N.O. is the abbreviation for Normally Open.

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Table 4: V-919x Series Ordering Data

Code Number	Suffix	VF Series Code Number ¹	Total Actuator Air Volume Required for 90° Rotation (cubic inches)	Total Number of Springs in Actuator ²
V-9193	-12	-320	32.6	4
	-13	-330		6
	-14	-340		8
	-16	-360		12
V-9194	-12	-420	45.9	4
	-13	-430		6
	-14	-440		8
	-15	-450		10
	-16	-460		12
V-9194	-22	-422	95.5	4
	-23	-432		6
	-24	-442		8
V-9195	-13	-530	130.8	6
	-15	-550		10
V-9196	-12	-620	259.6	4
	-13	-630		6
	-14	-640		8
	-15	-650		10
	-16	-660		12
V-9197	-12	-720	450	4
	-13	-730		6
	-14	-740		8
	-15	-750		10
	-16	-760		12
V-9198	-12	-820	900	4
	-13	-830		6
	-14	-840		8
	-15	-850		10
	-16	-860		12

1. Refer to the ordering data templates in *VF Series Standard-Pressure, Standard-Temperature Butterfly Valves Product Bulletin (LIT-977205P)* and *VF Series High-Pressure, High-Temperature Butterfly Valves Product Bulletin (LIT-977208)*.
2. The numbers listed are the total number of springs in the actuator; the last digit of the code number suffix indicates the number of springs per piston. There are two pistons per actuator.

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Dimensions

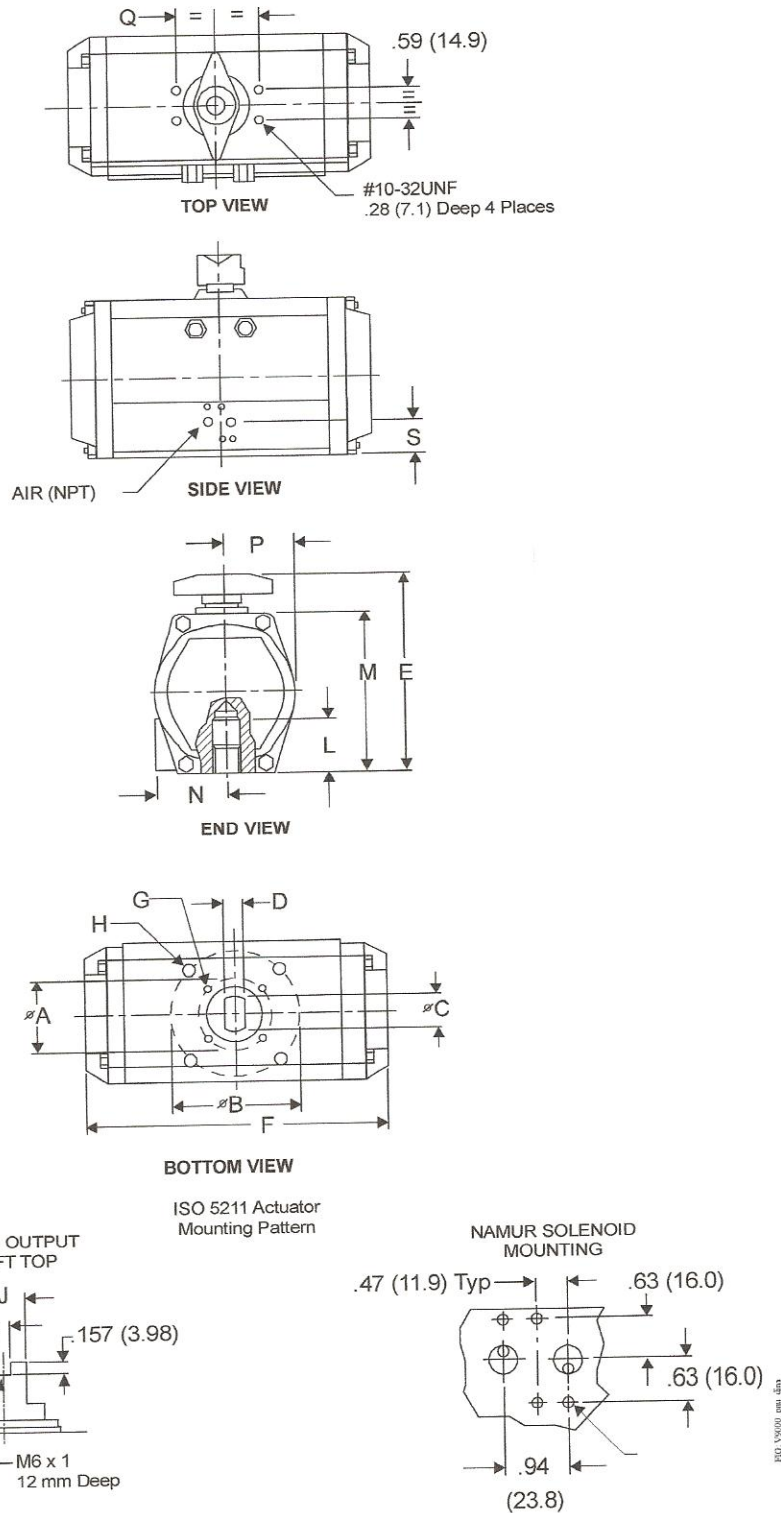


Figure 7: V-9000 Series Pneumatic Actuator Dimensions in. (mm)
(See Table 5 for Dimensions Matrix)

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Table 5: V-9000 Series Actuator Dimensions Matrix in. (mm)

Dimension	V-9x92	V-9x93	V-9x94-1x	V-9x94-2x	V-9x95	V-9x96	V-9x97	V-9x98
Air (NPT)	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4
A	1.97 F05	1.97 F05	1.97 F05	4.92 F12	4.92 F12	--	4.92 F12	6.50 F16
B	2.76 F07	2.76 F07	2.76 F07	4.92 F12	4.92 F12	4.92 F12	6.50 F16	7.87 x4.72 Rect.
C	.55 (14.0)	.75 (19.1)	.75 (19.1)	1.18 (30.0)	1.18 (30.0)	1.18 (30.0)	1.97 (50.0)	2.50 (63.5)
D	.40 (10.2)	.51 (13.0)	.51 (13.0)	.87 (22.1)	.87 (22.1)	.87 (22.1)	.47 (11.9)	.62 (15.7)
E	4.53 (115)	5.43 (138)	5.78 (147)	7.28 (185)	8.09 (206)	9.36 (238)	11.62 (295)	13.49 (343)
F	5.58 (142)	7.40 (188)	8.59 (218)	11.90 (302)	12.31 (313)	15.54 (395)	19.57 (497)	28.78 (731)
G (UNC)	1/4-20 x .32	1/4-20 x .32	1/4-20 x .32	5/16-18 x .46	5/16-18 x .46	--	1/2-13 x .78	M16x2 x 28 mm
H (UNC)	5/16-18 x .40	5/16-18 x .40	5/16-18 x .40	1/2-13 x .60	1/2-13 x .60	1/2-13 x .60	5/8-11 x 1.11	M16x2 x 28 mm
J	.38 (9.7)	.50 (12.7)	.50 (12.7)	1.12 (28.4)	1.12 (28.4)	1.12 (28.4)	1.12 (28.4)	1.12 (28.4)
L	1.38 (35.1)	1.46 (37.1)	1.46 (37.1)	2.20 (55.9)	2.20 (55.9)	2.20 (55.9)	4.72 (120)	6.50 (165)
M	3.46 (87.9)	4.27 (109)	4.61 (117)	5.52 (140)	6.32 (161)	7.80 (198)	10.16 (258)	12.06 (306)
N	1.72 (43.7)	2.28 (57.9)	2.47 (62.7)	2.78 (70.6)	2.88 (73.2)	3.78 (96.0)	4.56 (116)	5.40 (137)
P	1.38 (35.1)	1.79 (45.5)	1.97 (50.0)	2.37 (60.2)	2.70 (68.6)	3.39 (86.1)	4.41 (112)	5.39 (137)
Q	1.58 (40.1)	1.58 (40.1)	1.58 (40.1)	1.58 (40.1)	1.58 (40.1)	2.56 (65.0)	2.56 (65.0)	2.56 (65.0)
S	.89 (22.6)	1.26 (32.0)	1.32 (33.5)	1.64 (41.7)	1.64 (41.7)	2.26 (57.4)	2.45 (62.2)	2.48 (63.0)
T	.79 (20.1)	.79 (20.1)	.79 (20.1)	.79 (20.1)	.79 (20.1)	1.18 (30.0)	1.18 (30.0)	1.18 (30.0)
U	.47 (11.9)	.47 (11.9)	.47 (11.9)	.47 (11.9)	.47 (11.9)	.75 (19.1)	.75 (19.1)	.75 (19.1)

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