

3161 Governor

for Control of Engines and Steam Turbines

Application

The 3161 governor is designed for speed control of diesel engines, gas engines, or steam turbines. The variety of standard features and available options makes the governor ideal for use in a wide variety of applications which require work capacity of up to 24 N·m (18 lb-ft). Applications include off-highway vehicles, industrial, marine, generator set, compressor, or pump drives.

3161 operation can be isochronous for accurate constant speed or frequency control, or droop for load sharing. The amount of droop may be changed internally or with an optional external lever.

The governor has its own sump for quick startup response. Direction of rotation of the governor drive is set at the factory, but can be changed in the field by turning the pump housing.

Torque Rise to limit high speed torque, and Low Idle Offset to provide increased low speed, no-load stability, and reduce undershoot and stalling are among the many governor options.

Description

The 3161 is a mechanical hydraulic governor capable of droop or isochronous operation. A variety of speed setting, fuel limiting, and shutdown options may be added to the cover of the governor, making it extremely versatile for a variety of installations.

The 3161 uses an integral Gerotor pump, driven by the governor drive shaft, to provide hydraulic oil pressure. Oil pressure within the governor is maintained by a relief valve accumulator. Governor drive is 5/8" 36 or 5/8" keyed (16 mm). The 3161 can be equipped with a standard UG8 base and standard UG8 terminal shafts.

A rotating ballhead and pilot valve plunger assembly controls the flow of hydraulic oil that operates the governor power piston and terminal shaft. A spring-driven, oil-damped ballhead is available to dampen high-frequency, low-amplitude torsional vibrations.

Pressure compensation provides governor stability. Compensation is adjustable with a needle valve to match governor response to the engine. Pilot valve bushing porting and special springs in the compensation system can be specified to vary governor response.



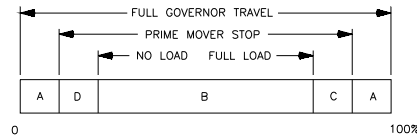
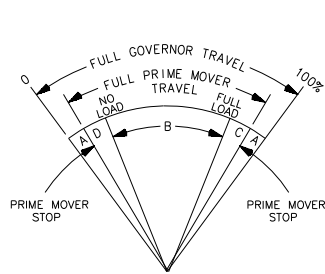
- Isochronous or droop control
- Manual, electric, pneumatic speed setting options
- Manual, electric, hydraulic shutdown options
- Fuel limiting options
- Torque rise, low idle offset options
- Terminal position indicator
- Operates with engine oil or self-contained sump
- Directly interchangeable with the UG8

Specifications

Control Characteristics

Steady State Speed Band
Output Travel

Less than $\pm 0.25\%$ of rated speed.
42° maximum. Woodward recommends use of 60% to 70% of the travel from no load to full load.



- A - OVERTRAVEL TO INSURE PRIME MOVER STOPS ARE REACHED.
B - NO LOAD TO FULL LOAD TRAVEL - NORMALLY 2/3 OF FULL GOVERNOR TRAVEL IS RECOMMENDED.
C - TRAVEL REQUIRED TO ACCELERATE THE PRIME MOVER.
D - TRAVEL REQUIRED TO DECELERATE OR SHUT DOWN PRIME MOVER.

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MAXIMUM WORK CAPACITY OVER FULL GOVERNOR TRAVEL OF 42° IS * . SEE ABOVE FOR RECOMMENDED GOVERNOR OUTPUT TRAVEL. IN SPECIAL APPLICATIONS MIN AND MAX PRIME MOVER STOPS MAY BE OUTSIDE THE GOVERNOR STOPS.

Work Capacity

Three work capacities are available:

- 10 N·m (7.5 lb-ft) maximum or 8 N·m (6 lb-ft) useful with 690 kPa (100 psi) internal operating pressure. Maximum stalled torque is 14 N·m (10 lb-ft).
- 20 N·m (15 lb-ft) maximum or 16 N·m (12 lb-ft) useful with 1379 kPa (200 psi) internal operating pressure. Maximum stalled torque is 27 N·m (20 lb-ft).
- 28 N·m (21 lb-ft) maximum or 24 N·m (18 lb-ft) useful with 1379 kPa (200 psi) internal operating pressure and larger servo. Maximum stalled torque is 38 N·m (28 lb-ft).

Droop

Two ranges are available:

- Adjustable for a 0 to 5 rpm decrease in speed setting per degree of terminal shaft travel to increase fuel.
- Adjustable for a 4 to 9 rpm decrease in speed setting per degree of terminal shaft travel to increase fuel.

Installation And Construction

Governor
Standard Governor Drive
Terminal Shaft (Output Shaft)
100 psi Governors
200 psi Governors
Case and Base

Designed for vertical operation, but can be tilted up to 45° from vertical.
5/8"-36 SAE serrations. 5/8" keyed drive shaft is also available.
May be either or both sides. The location is the same as the UG8.
Have either 0.500"-36 SAE serrated or 0.562" diameter flatted output-shaft design.
Have either a 0.625"-36 SAE serrated or 0.625" diameter flatted output-shaft design.
Cast aluminum. Internal parts are steel.

Governor Drive Characteristics

Drive Shaft Rotation Direction: Either clockwise or counterclockwise according to the orientation of the pump housing on the case.

Maximum Drive Speed Ranges: From a minimum of 400 rpm to a maximum of 1600 rpm. Constant speed operating range is from 1000 to 1500 rpm.

100 psi Governor: Requires 186 W (1/4 hp) maximum.

200 psi Governor: Requires 280 W (3/8 hp) maximum.

Oil Sump Capacity

Governor Sump: Holds 1.7 L. The governor can be self contained or connected to engine oil. SAE 10 to 50 weight oil is recommended for governor operation.

Viscosity: At operating temperature should be from 100 to 300 SUS. In most cases the oil used in the engine is satisfactory for use in the governor.

Vibration Resistance

Vibration Tested to tracked vehicle specifications.

Weight

About 18 kg (40 lb). Exact weight determined by option package.

Operating Temperature

-29 to +107 °C (-20 to +225 °F) (with proper viscosity oil).

Optional Features

Most governor options are installed on the cover of the 3161 governor. The options can extend the overall height of the governor, as measured from the base, to 478 mm (18.8 inches). The nominal height of the governor, without any options, is 364 mm (14.33 inches).

Speed Setting

Manual	0.500"-36 SAE serrated Speed Adjusting Shaft. Mechanical attachments typically use 15 to 20 degrees of the shaft's rotary travel for mechanical drive applications.
Electric	Uses a 24 Vdc permanent magnet motor. Polarity is reversed to raise and lower the speed setting. Separate voltage adapters are available to convert 115, 230 Vac and 32, 125, and 250 Vdc to the required 24 Vdc. Maximum life of speed setting motor is 250 000 raise/lower commands.
Rate of Speed	Setting change is typically 730 governor rpm/minute on a 24 V system.
Pneumatic	Standard pneumatic speed setting ranges are for 69/690 kPa (10/100 psi), 34/310 kPa (5/45 psi), and 69/413 kPa (10/60 psi). 21/105 kPa (3/15 psi) is also available. The bellows in the pneumatic speed setting option can operate at pressures up to 828 kPa (120 psi). The pneumatic speed setting option can be designed for any pressure under the maximum.

Ballhead Damping

Solid Ballhead Drive Standard. A spring-driven, oil-damped ballhead is available.

Governor Limiting

Manual Load Limiting and an extremely accurate Manifold Air Pressure fuel limiter (straight line schedule only) are available.

Torque Rise Limiters are available with precise dual or triple slopes. Torque Rise is used to limit high rpm torque, allowing the engine to develop a broad, flat torque curve.

Low Idle Offset increases engine stability at low idle, no load by increasing droop when these conditions are present. This feature also reduces engine speed undershoot during rapid speed-setting decreases.

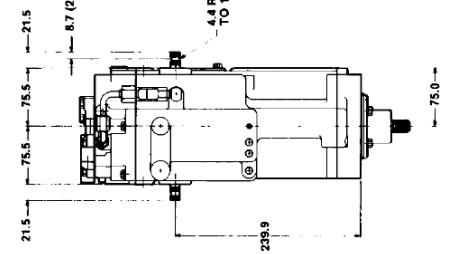
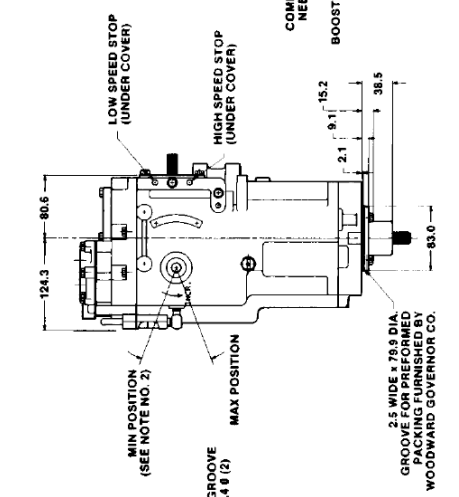
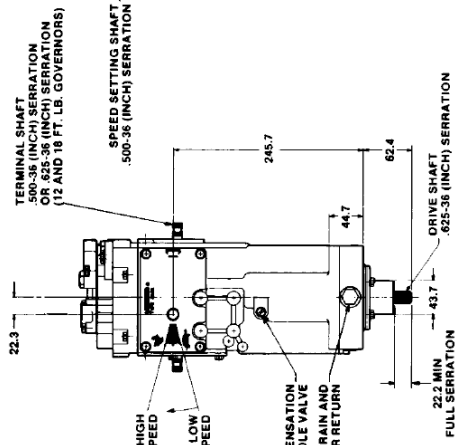
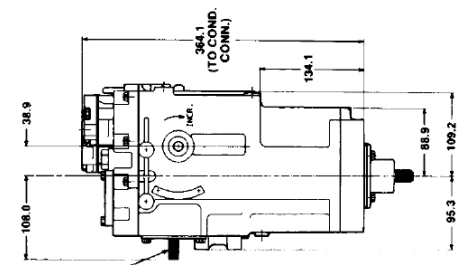
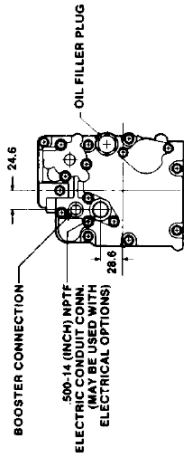
Governor Shutdown

Manual Shutdown.	To initiate a shutdown, the threaded handle can be pushed down or tilted in any direction. It can be used in conjunction with the electric or pressure shutdown.
Electric Shutdown	Uses a 24, 32, or 76 Vdc electric solenoid, either energize-to-run or energize-to-shutdown. The electric shutdown can be used in conjunction with the manual or pressure shutdowns.
Pressure Shutdown	276 kPa (40 psi) air or hydraulic pressure causes shutdown. The device resets when pressure drops below 138 kPa (20 psi). It can be used in conjunction with the manual or electric shutdowns.

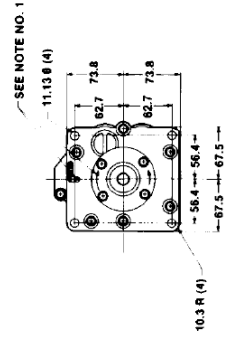
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METRIC

CONVERSION CHART			
mm = INCH	mm = INCH	mm = INCH	mm = INCH
.6	15.2	22.2	564.1
1.0	25.4	25.4	645.1
1.5	38.1	28.3	718.8
2.0	50.8	31.8	809.8
2.5	63.5	34.9	886.3
3.0	76.2	38.1	967.8
3.5	88.9	41.3	1049.3
4.0	101.6	44.5	1130.3
4.5	114.3	47.6	1211.3
5.0	127.0	50.8	1292.3
5.5	139.7	54.0	1373.3
6.0	152.4	57.1	1454.3
6.5	165.1	60.3	1535.3
7.0	177.8	63.5	1616.3
7.5	190.5	66.7	1697.3
8.0	203.2	69.9	1778.3
8.5	215.9	73.0	1859.3
9.0	228.6	76.2	1940.3
9.5	241.3	79.4	2021.3
10.0	254.0	82.5	2102.3
10.5	266.7	85.7	2183.3
11.0	279.4	88.9	2264.3
11.5	292.1	92.1	2345.3
12.0	304.8	95.3	2426.3
12.5	317.5	98.4	2507.3
13.0	330.2	101.6	2588.3
13.5	342.9	104.8	2669.3
14.0	355.6	107.9	2750.3
14.5	368.3	111.1	2831.3
15.0	381.0	114.3	2912.3
15.5	393.7	117.5	2993.3
16.0	406.4	120.6	3074.3
16.5	419.1	123.8	3155.3
17.0	431.8	127.0	3236.3
17.5	444.5	130.2	3317.3
18.0	457.2	133.4	3398.3
18.5	469.9	136.5	3479.3
19.0	482.6	139.7	3560.3
19.5	495.3	142.9	3641.3
20.0	508.0	146.0	3722.3
20.5	520.7	149.2	3803.3
21.0	533.4	152.4	3884.3
21.5	546.1	155.6	3965.3
22.0	558.8	158.8	4046.3
22.5	571.5	161.9	4127.3
23.0	584.2	165.1	4208.3
23.5	596.9	168.3	4289.3
24.0	609.6	171.4	4370.3
24.5	622.3	174.6	4451.3
25.0	635.0	177.8	4532.3
25.5	647.7	180.9	4613.3
26.0	660.4	184.1	4694.3
26.5	673.1	187.3	4775.3
27.0	685.8	190.5	4856.3
27.5	698.5	193.7	4937.3
28.0	711.2	196.8	5018.3
28.5	723.9	200.0	5099.3
29.0	736.6	203.2	5180.3
29.5	749.3	206.4	5261.3
30.0	762.0	209.6	5342.3
30.5	774.7	212.7	5423.3
31.0	787.4	215.9	5504.3
31.5	800.1	219.1	5585.3
32.0	812.8	222.3	5666.3
32.5	825.5	225.5	5747.3
33.0	838.2	228.6	5828.3
33.5	850.9	231.8	5909.3
34.0	863.6	235.0	5990.3
34.5	876.3	238.1	6071.3
35.0	889.0	241.3	6152.3
35.5	901.7	244.5	6233.3
36.0	914.4	247.6	6314.3
36.5	927.1	250.8	6395.3
37.0	939.8	254.0	6476.3
37.5	952.5	257.1	6557.3
38.0	965.2	260.3	6638.3
38.5	977.9	263.5	6719.3
39.0	990.6	266.7	6800.3
39.5	1003.3	269.9	6881.3
40.0	1016.0	273.0	6962.3
40.5	1028.7	276.2	7043.3
41.0	1041.4	279.4	7124.3
41.5	1054.1	282.6	7205.3
42.0	1066.8	285.8	7286.3
42.5	1079.5	289.0	7367.3
43.0	1092.2	292.1	7448.3
43.5	1104.9	295.3	7529.3
44.0	1117.6	298.5	7610.3
44.5	1130.3	301.7	7691.3
45.0	1143.0	304.9	7772.3
45.5	1155.7	308.1	7853.3
46.0	1168.4	311.3	7934.3
46.5	1181.1	314.5	8015.3
47.0	1193.8	317.7	8096.3
47.5	1206.5	320.9	8177.3
48.0	1219.2	324.1	8258.3
48.5	1231.9	327.3	8339.3
49.0	1244.6	330.5	8420.3
49.5	1257.3	333.7	8501.3
50.0	1270.0	336.9	8582.3
50.5	1282.7	340.1	8663.3
51.0	1295.4	343.3	8744.3
51.5	1308.1	346.5	8825.3
52.0	1320.8	349.7	8906.3
52.5	1333.5	352.9	8987.3
53.0	1346.2	356.1	9068.3
53.5	1358.9	359.3	9149.3
54.0	1371.6	362.5	9230.3
54.5	1384.3	365.7	9311.3
55.0	1397.0	368.9	9392.3
55.5	1409.7	372.1	9473.3
56.0	1422.4	375.3	9554.3
56.5	1435.1	378.5	9635.3
57.0	1447.8	381.7	9716.3
57.5	1460.5	384.9	9797.3
58.0	1473.2	388.1	9878.3
58.5	1485.9	391.3	9959.3
59.0	1498.6	394.5	10040.3
59.5	1511.3	397.7	10121.3
60.0	1524.0	400.9	10202.3
60.5	1536.7	404.1	10283.3
61.0	1549.4	407.3	10364.3
61.5	1562.1	410.5	10445.3
62.0	1574.8	413.7	10526.3
62.5	1587.5	416.9	10607.3
63.0	1600.2	420.1	10688.3
63.5	1612.9	423.3	10769.3
64.0	1625.6	426.5	10850.3
64.5	1638.3	429.7	10931.3
65.0	1651.0	432.9	11012.3
65.5	1663.7	436.1	11093.3
66.0	1676.4	439.3	11174.3
66.5	1689.1	442.5	11255.3
67.0	1701.8	445.7	11336.3
67.5	1714.5	448.9	11417.3
68.0	1727.2	452.1	11498.3
68.5	1739.9	455.3	11579.3
69.0	1752.6	458.5	11660.3
69.5	1765.3	461.7	11741.3
70.0	1778.0	464.9	11822.3
70.5	1790.7	468.1	11903.3
71.0	1803.4	471.3	11984.3
71.5	1816.1	474.5	12065.3
72.0	1828.8	477.7	12146.3
72.5	1841.5	480.9	12227.3
73.0	1854.2	484.1	12308.3
73.5	1866.9	487.3	12389.3
74.0	1879.6	490.5	12470.3
74.5	1892.3	493.7	12551.3
75.0	1905.0	496.9	12632.3
75.5	1917.7	500.1	12713.3
76.0	1930.4	503.3	12794.3
76.5	1943.1	506.5	12875.3
77.0	1955.8	509.7	12956.3
77.5	1968.5	512.9	13037.3
78.0	1981.2	516.1	13118.3
78.5	1993.9	519.3	13199.3
79.0	2006.6	522.5	13280.3
79.5	2019.3	525.7	13361.3
80.0	2032.0	528.9	13442.3
80.5	2044.7	532.1	13523.3
81.0	2057.4	535.3	13604.3
81.5	2070.1	538.5	13685.3
82.0	2082.8	541.7	13766.3
82.5	2095.5	544.9	13847.3
83.0	2108.2	548.1	13928.3
83.5	2120.9	551.3	14009.3
84.0	2133.6	554.5	14090.3
84.5	2146.3	557.7	14171.3
85.0	2159.0	560.9	14252.3
85.5	2171.7	564.1	14333.3
86.0	2184.4	567.3	14414.3
86.5	2197.1	570.5	14495.3
87.0	2209.8	573.7	14576.3
87.5	2222.5	576.9	14657.3
88.0	2235.2	580.1	14738.3
88.5	2247.9	583.3	14819.3
89.0	2260.6	586.5	14900.3
89.5	2273.3	589.7	14981.3
90.0	2286.0	592.9	15062.3
90.5	2298.7	596.1	15143.3
91.0	2311.4	599.3	15224.3
91.5	2324.1	602.5	15305.3
92.0	2336.8	605.7	15386.3
92.5	2349.5	608.9	15467.3
93.0	2362.2	612.1	15548.3
93.5	2374.9	615.3	15629.3
94.0	2387.6	618.5	15710.3
94.5	2400.3	621.7	15791.3
95.0	2413.0	624.9	15872.3
95.5	2425.7	628.1	15953.3
96.0	2438.4	631.3	16034.3
96.5	2451.1	634.5	16115.3
97.0	2463.8	637.7	16196.3
97.5	2476.5	640.9	16277.3
98.0	2489.2	644.1	16358.3
98.5	2501.9	647.3	16439.3
99.0	2514.6	650.5	16520.3
99.5	2527.3	653.7	16601.3
100.0	2540.0	656.9	16682.3



NOTE:
 1. DIRECTION OF PUMP ROTATION INDICATED BY ARROWS ON BASE AND PUMP HOUSING. ROTATE HOUSING 180° TO REVERSE DIRECTION OF ROTATION.
 2. 42° STROKE AVAILABLE. RECOMMENDED STROKE FOR NO LOAD TO FULL LOAD IS 28°.



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