PRECISION GOVERNORS, INC.

2322 SEVENTH AVENUE ROCKFORD, IL 61104 815-229-5300 FAX: 815-229-5342

ELECTRIC GOVERNOR
MODEL SKA & SKB
INSTALLATION MANUAL

GENERAL

The following information is intended as an aid to properly applying a Precision Governors Model SKA and SKB Electric Governor. Since these governors are used on a wide range of engines in many applications, much of the information is somewhat general in nature. If you need assistance concerning a specific detail on your application, please consult Precision Governors, Inc., Application Engineering at 815/229-5300.

These instructions presume no electrical test equipment other than a multimeter for making the checks called for on the following pages. If no suitable meter is available, an inexpensive but adequate meter, part number 22-203, is available from your local Radio Shack store.

Many governor problems turn out to be installation troubles, particularly in first-time applications. Careful attention to the directions provided will go far toward a successful installation made in the least amount of time.

MOUNTING

BRACKET

The governor may be mounted in any attitude—there is no preferred orientation. Construct a simple, **rigid** bracket to mount the unit to the engine. 1/4" steel plate is recommended for bracket material. Try to get a short, straight shot from the governor arm to the carburetor or fuel rack.

Avoid "dog leg" linkages.

Avoid mounting the governor adjacent to exhaust system parts and other hot components. Large temperature variations can cause speed changes.

Remember that the governor must be adjusted while installed—don't mount so that adjustments are hidden or inaccessible, or in dangerous locations (such as near the fan or hot exhaust parts).

Adjustment will be greatly simplified if you can see and reach the adjusting pots without difficulty.

LINKAGE

1/4" -28 threaded rod and low friction rod-end bearings are recommended for linkage materials.

Keep the linkage as **short and straight** as possible.

Linkage must not rub engine, brackets, hoses, etc.

Friction and lost motion must be avoided if good governing is to be achieved.

With no power applied, the governor is spring-loaded into its minimum fuel position. The governor output shaft rotates approximately 32 degrees against the internal governor spring to max. fuel. This rotation is CW (clockwise) on one side of the governor and CCW (counterclockwise) on the other. If necessary, reverse the governor on its mounting plate so that the desired direction of rotation (CW or CCW to max. fuel) is on the desired side to match the fuel system direction of travel.

Attach the linkage to the governor arm by drilling a hole or slot in the arm for the rod-end bearing. This attachment point should be at a distance out the arm which is just sufficient to provide the needed travel* of the carburetor or fuel rack.

***NOTE:** This connection may need to be disconnected later during check-out, so make it accessible.

After connecting the governor linkage, check it out again to ensure that:

1. There is no binding, friction, interference or lost motion between the governor and the fuel system.
2. Motion is smooth and free from sudden force changes or unexplained forces. If not, investigate.
3. The full travel of the governor between its internal stops is moving the fuel system through its required travel and no further.

WIRING

See wiring diagrams for details of hook-up.

Use #18 wire minimum, #16 preferred.

Keep power wires to the governor as short as practical.

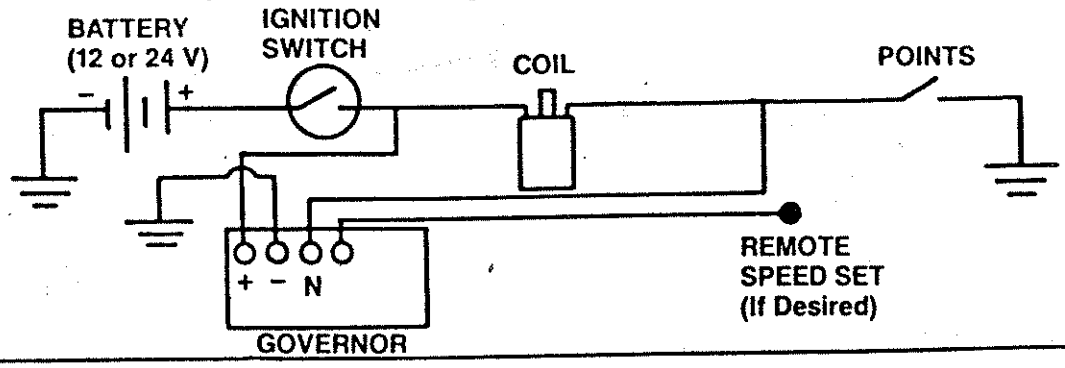
In each case, the governor is to be supplied with + 12 VDC to terminal (+), battery ground to terminal (−), and an AC signal whose frequency is proportional to engine speed at terminal (N).

Where possible, go directly to the battery (as for governor (+) and (−) connections.)

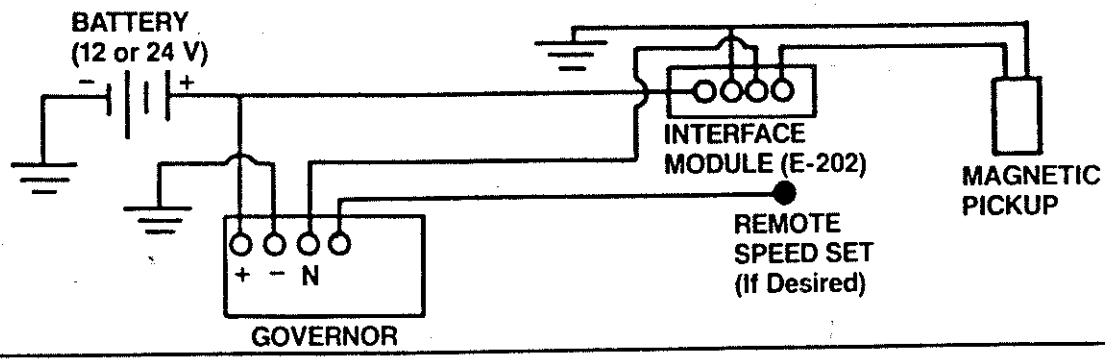
If governor is to be switched through the ignition switch, run directly from the proper switch terminal to the governor, and check that the wiring from the switch to the battery is at least #16 gage.

CUSTOMER NOTES:

WIRING DIAGRAM – Spark Ignited Engines



WIRING DIAGRAM – Diesel Engine



A properly functioning engine electrical system will run 13.5-14.5 VDC when the engine is running. Lower voltages can reduce governor output force and crispness of operation.

If an external source of DC power is used, check for 13.5-14.5 VDC during governor operation. (See Troubleshooting section.)

Guard against accidental shorting of wiring and against possible shorting at the governor terminals.

Before applying power to the governor, check for proper polarity of the power (see Start-up procedures). **Improper hook-up can damage electronics.**

CHECK-OUT & INITIAL START-UP PROCEDURES

Assuming the governor is now mounted, wiring is run, and linkage is installed, proceed as follows:

1. Disconnect (+) lead from governor. Turn engine switch on and check with meter for 11-15 VDC from the (+) lead to the (–) terminal on governor.
2. Controlling engine speed by hand, start engine (with (+) lead still disconnected), and (+) lead voltage should dip to 9-12 VDC during crank, then rise to 12-15 VDC. Stop engine.
3. Reconnect (+) lead to governor. Governor will try to control speed. Override manually during steps 4 and 5.
4. Connect meter to (+) and (–) terminals on governor.
5. Repeat steps 1 and 2. Voltage readings should be the same as before. Shut down engine.

If proper voltage is obtained in steps 1-5, then power supply wiring to governor is O.K. If not, determine why and correct before proceeding.

The next 3 steps are to check frequency signal input to the governor **on spark-ignited engines only.** If using an E-202 mag. pick-up module or an E-203 gen-set module, skip these steps and refer to tests for these modules on page 4 and 5.

6. Remove (N) lead from governor and use meter to determine voltage from (N) lead to governor (–) terminal.

CAUTION: High voltage spikes of several hundred volts may be present at (N) lead. **Do not touch (N) lead while engine is running.**

Also start measuring voltage on (N) lead using highest DC voltage scale and decrease until reading is obtained.

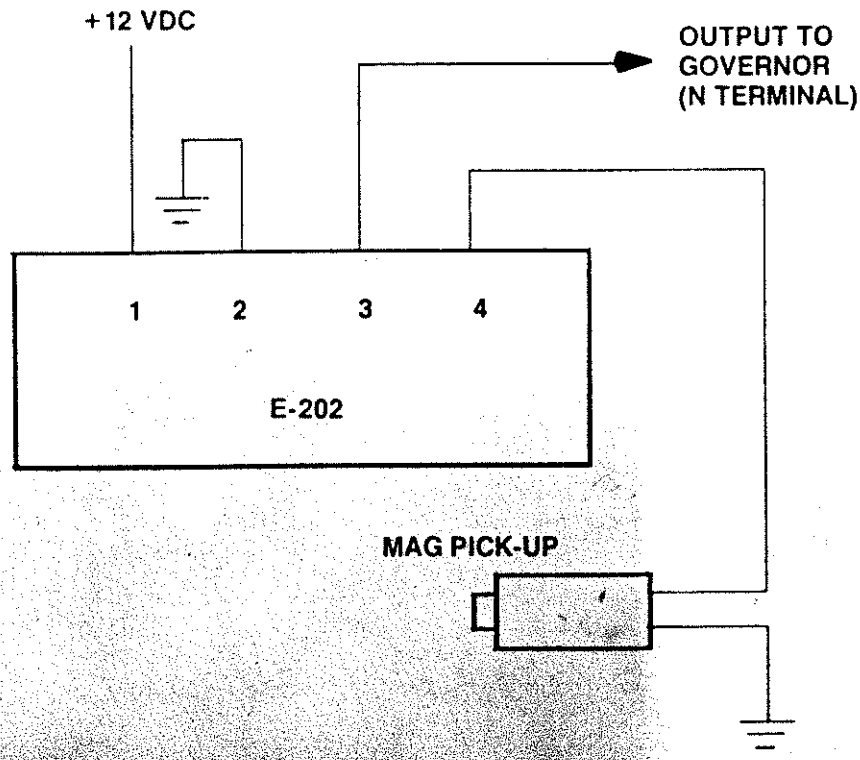
7. Start engine. Note meter reading indicating voltage from ignition system. (5-30 VDC) Then touch (N) lead to ground. Engine should die.
8. Reconnect (N) lead to governor. Start engine and re-check voltage from (N) to (−) governor terminals. Reading should be the same as before. If so, speed signal to governor is O.K., and governor wiring is O.K.
9. Disconnect linkage from governor arm. Turn power to governor from off to on. Arm should kick once toward max., then immediately return to off.
10. Reconnect linkage and repeat step 9. Again, the arm should kick toward max. If not, re-check for binding or external forces.
11. Hold linkage and start engine. Gradually release linkage while watching engine speed. Governor will try to push to max. speed until engine is at governor set point. If set point is too fast, turn speedset screw (N) down (CCW). If too slow, turn CW. This is a 25-turn adjustment, so several revolutions of the screw may be required.

Now proceed to "Governor adjustments." (Page 6)

E-202 MAG PICK-UP MODULE CHECK-OUT

Follow the wiring diagram for the E-202 mag pick-up module (below), then with engine running, check for:

1. Terminal (1) to terminal (2) voltage should be 12-15 VDC.
2. Terminal (4) to terminal (2) voltage should be 10-75 VAC. If not, check for faulty mag pick-up.
3. Terminal (3) to terminal (2) voltage should be 4-8 VDC. If not, E-202 module is probably faulty. Return to Factory.

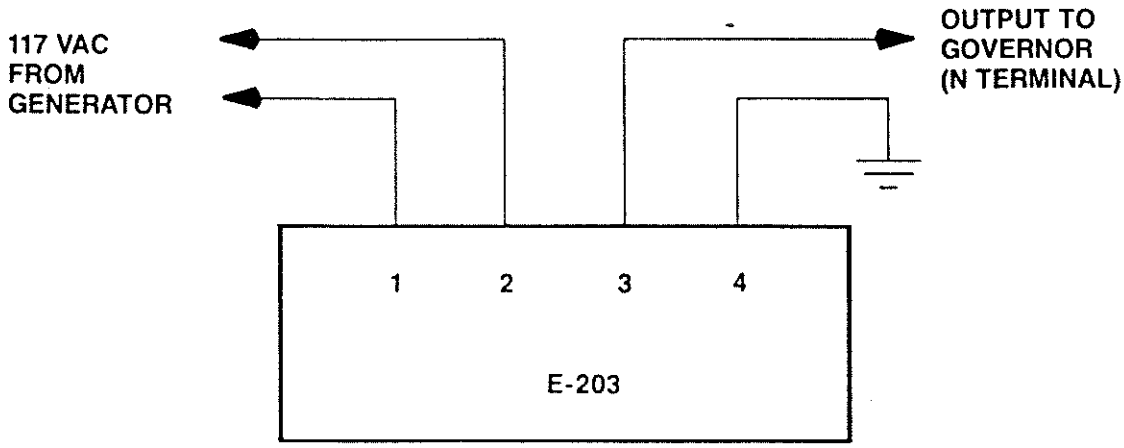


E-203 GEN-SET MODULE CHECK-OUT

Follow the wiring diagram for the E-203 gen-set module (below), then with engine running, check for:

1. Terminal (1) to terminal (2) voltage should be 100-135 VAC. If not, check wiring to generator.
2. Terminal (3) to terminal (4) voltage should be 15-35 VDC. If not, E-203 module is probably faulty. Return to factory.

NOTE: Governor will not open throttle until it gets a signal of about 8 VDC from the E-203 module. If your installation does not provide this signal due to insufficient residual magnetism in the generator, a mag pick-up or other frequency source should be used.



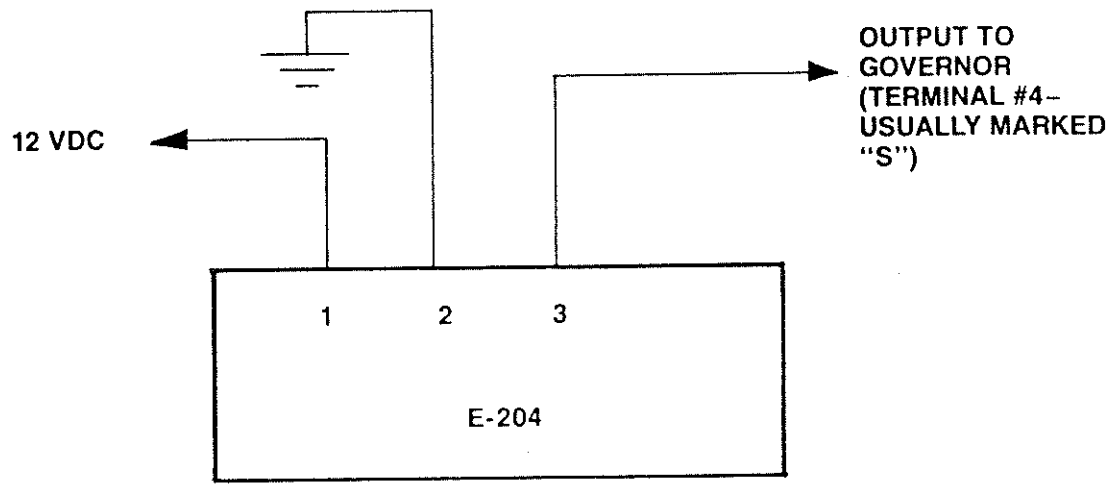
CUSTOMER NOTES:

E-204 REMOTE SPEED SET MODULE CHECK-OUT

Follow the wiring diagram for E-204 module (below), then with power on but engine not running, check as follows:

1. Disconnect E-204 terminal (3) from governor (S) terminal.
2. Check DC voltage from terminal (1) to terminal (2). Voltage should be same as battery voltage, 11.5 VDC min. If not, check wiring and repair.
3. Set dial in mid-travel (50%) and check voltage from terminal (3) to terminal (2). Voltage should read 3 to 4 VDC. Voltage should increase when dial setting is increased and decrease when dial setting is decreased. If not, unit is probably defective. Return to Factory.
4. Reconnect E-204 terminal (3) to governor terminal (S)(#4).

NOTE: Connecting E-204 terminal (1) to governor terminal (1) and E-204 terminal (2) to governor terminal (2) will provide the + 12 (or 24) VDC and the ground required.



GOVERNOR ADJUSTMENTS

Field Adjustments	Internal Adjustments
N = Speedset–25 turns	I = Integral–1 turn
G = Gain–1 turn	D = Derivative–1 turn

MULTI-TURN ADJUSTMENT (SPEEDSET)

This adjustment is made by turning the small (1/8" diameter) brass screw clockwise (CW) to increase speed, and counterclockwise (CCW) to decrease speed. The adjustment range of the pot is 25 full turns, and one full turn will change speed 100-200 RPM. This pot is protected by a slip clutch at either end, and so will not be harmed by over-adjustment. However, the governor will not function when this pot is at full travel past either end.

If you suspect you may have over-adjusted the speedset pot, turn it 25-30 turns CCW, then back 10 turns to get back into the normal range of adjustment.

SINGLE-TURN ADJUSTMENTS

These pots are 3/8" square and have a 1/8" white plastic adjustment containing a small screwdriver slot. Consider this slot as the hand on a clock.

When it's vertical, call that 12 o'clock. It can be turned CCW 140 degrees to 7 o'clock where it hits a stop. It can be turned CW 140 degrees to a stop at 5 o'clock.

Turning these adjustments CW increases their effect, i.e., increases sensitivity. Attempts to turn these pots past the stops will break them and disable the governor.

These pots are very sensitive adjustments. Make small (10 degree) changes at a time.

SETTING FIELD ADJUSTMENTS

Observe the same precautions as during the initial start-up procedures:

1. Start engine. Be prepared for over or underspeed set point unless previously set during initial start-up procedures. Adjust (N) pot to obtain desired speed. (CW adjustment increases speed.)
2. If engine surges rapidly, turn (G) CCW to stop surging. Allow engine to warm up.
3. Turn (G) CW in small (10 degree) increments and repeatedly upset linkage by manually pulling it toward idle and releasing it. Repeat until engine fails to stabilize promptly when upset, then back (G) CCW 10-15 degrees.
4. Now apply load. After a momentary dip, the engine should recover to the same speed as it was running no-load.
5. Dump load. Engine should recover after a brief rise in speed and return to the same base speed.
6. To increase sensitivity (make governor quicker), turn (G) CW. To improve stability, turn (G) CCW. The best compromise between high performance and good stability is what you are after.

NO-LOAD SURGE SPRING

In some installations, the engine tends to surge at no-load and then steadies out under load. This is usually found in carbureted engines with very high carburetor sensitivity at no-load.

De-tuning the governor to get stable no-load performance may result in sluggish performance when the engine is loaded.

For these installations, a governor incorporating a "No-load surge spring" is recommended. This additional light spring acts as a "bumper" at low fuel and increases system stability there.

Governors incorporating this spring have an additional adjusting screw and jam-nut located on top of the governor near the (G) pot and adjustment window. It is marked (B).

NO-LOAD SURGE SPRING ADJUSTMENT

1. Set (G) adjustment for satisfactory operation under load (full CCW, then CW 1/3 turn is a good starting point).
2. At no-load, adjust screw (B) CW 1/2 turn at a time until no-load surging stops, **no further.** Tighten jam-nut.
3. Check by applying load and removing, that engine still returns promptly to set speed on load removal.
4. Touch up (G) adjustment as required.

CUSTOMER NOTES:

TROUBLESHOOTING

We will discuss Troubleshooting in two general categories:

A. Governor won't work
B. Governor works, but can't be set up to give satisfactory performance

There is, of course, some overlap between these categories. Read both sections and apply the fixes that seem appropriate.

During Troubleshooting, be prepared to control the engine manually to prevent overspeeds, etc.

A. **Governor won't work**
No reaction from governor. Governor output arm never moves, engine off or engine running. Can be caused by:

1. No power
2. Incorrect electrical hook-up
3. Incorrect linkage, preventing movement
4. No speed signal to governor
5. Internal governor fault

1. **No power**
Use a voltmeter to check for 12-16 VDC between (+) and (−) terminals at terminal block on governor. Check during engine off and engine running conditions. If voltage is absent or low, check for:
   a. Wiring error
   b. Hook-up on wrong side of ballast resistor (spark engines only)
   c. Low battery
   d. Small wire size
   e. Bad ground connection
   f. Corroded terminals

2. **Incorrect electrical hook-up**
   a. Reversed polarity
   b. With engine stopped, apply power to (+) terminal. Governor should kick from off position toward on part way and immediately return to off. If not, problem is wiring (check with voltmeter), incorrect linkage (see 3. below) or internal governor fault (see 5. below).

3. **Incorrect linkage**
   a. Disconnect linkage from governor arm. Repeat step 2b. above. If linkage kicks when it didn't with linkage connected, linkage is the problem.

4. **No speed signal to governor**
   a. If using **ignition signal,** check terminal (N) to (−) at governor for 5-30 VDC. Engine should die when (N) is shorted at (−).
   b. If using E-202 module, check terminal (N) to (−) at governor for 4-8 VDC. If not right, check out E-202 module.
   c. If using E-203 module, check terminal (N) to (−) at governor for 15-35 VDC. If not right, check out E-203 module.

5. **Internal governor fault**
If steps 1-4 above have not revealed the problem, assume a governor failure. Before returning the unit to the Factory, make one last test:
   a. Remove governor from engine, disconnect all wiring and linkage.
   b. Connect meter (+) to (+) terminal, meter (−) to (−) terminal. Apply plus to minus directly from a 12V battery to governor (+) and (−) terminals.
   c. If meter reads 11-16 VDC and governor did not kick **once,** governor has an internal problem. Return it to the Factory.

B. **Governor reacts, but can't be set up to give proper performance**
This kind of trouble usually falls into 3 main categories:
1. **Actual governor malfunction**
2. Governor installation problems and improper installation
3. Governor not tuned or adjusted for engine/application

1. **Actual governor malfunction**
   The governor was engine-tested for proper operation just prior to being shipped. Unless damaged in shipment or by improper handling, it should be serviceable, but let us check it out first.
   a. Once again, disconnect fuel system linkage from governor output arm and control engine manually.
   b. Start engine, hold at a low speed. Governor arm should move to full fuel position.
   c. Increase engine speed. At some engine speed, governor arm should move to no-fuel position.
   d. By carefully varying engine speed, you should be able to cause the governor arm to pause momentarily near the middle of its travel. This engine speed is the set speed for which the governor is adjusted. If grossly incorrect, reset (N).
   e. With the engine running at low speed, move the governor arm throughout its stroke by hand. You should feel a constant smooth force in the on direction. No binding or rubbing should be felt within the governor.

If steps 1a. through 1e. can be accomplished as described, the governor is probably O.K. It recognizes underspeed, overspeed, on speed, and is not binding internally.

If the above steps cannot be accomplished satisfactorily, there is an actual governor malfunction. Return it to the Factory.

2. **Installation and adjustment problems**
   a. Governor is unable to move fuel system freely (not enough governor force available).
      If governor doesn't move fuel system to on far enough to provide sufficient fuel, but governor arm moves far enough when disconnected, look for:
      1) Linkage binding or misadjustment
      2) Low voltage at governor during operation*
         *Connect voltmeter to terminals 1 and 2 and observe voltage during operation. If governor fails to move full on and voltage dips over 1 volt, check for undersize wire (should be #16 minimum) or other voltage drop, and correct.
      3) Excessive forces* at governor during running, particularly on carbureted engines.
         *Carburetor butterfly valves are overloaded by the engine vacuum during running, which can add considerable force not present when engine isn't running.
         *Springs in the system: carburetor return springs, acceleration pump springs, etc., are not usually needed and can cause governing problems.
      4) Governor may be too small for engine. Use Precision Governor Model SKB.
   b. Governor is unstable at light-load or no-load, O.K. under heavy-load. See "Linkage" for carbureted engines.
   c. Governor experiences sudden, momentary spikes toward max. or min. at random intervals, then recovers.
      1) Look for loose wiring or momentary shorts in wiring. Meter connected from (+) to (−) at governor terminals will confirm problem.
      2) Short or broken connection inside governor. Rap governor case lightly to confirm.
      3. Noise or occasionally missing signal on speed signal.
   d. Speed seems to slowly wander (5-15 second periods) around set speed, particularly at higher loads. See item 2a. 4 concerning excessive loads on governor.

3. **Governor not tuned or adjusted for engine/application**
   The basic adjustment to set sensitivity/stability is the (G) or Gain pot. A good starting point for many engines is full CCW, then CW 1/3 turn. (See "Governor adjustments" section.) To increase stability, turn CCW. If satisfactory governing cannot be achieved with this one adjustment, the two internal adjustments may be needed. Normal starting points for these adjustments are:

   (I) – fully CCW, then CW 1/4 turn to 1/3 turn

   (D) – fully CCW, then CW 1/3 turn

   The (I) pot affects the rate of return to on-speed. Too little of this and the governor is slow to return to speed. Too much and it overshoots and has a slow instability.

The (D) pot affects the sensitivity somewhat like the (G) pot. Too little of this will cause the governor to be slow responding to load changes. Too much will cause nervousness and jumpy motions of the governor—constant, small, jerky movements.

SPECIFICATIONS SKA

Construction: Rugged aluminum case and steel structure. Factory-sealed. Corrosion-resistant finishes. Only one moving part, supported on precision ball bearings.
Size: 4" x 4" x 8", including basic electronics.
Weight: Approximately 9 lbs.
Torque output: Max. 1 foot lb. available. 3/8" shaft. Rotation up to 32 degrees, either clockwise or counterclockwise.
Speed range: 4:1 standard.
Temperature stability: ± 1.5% over a range of −25 degrees to 200 degrees F.
Actuator time constant: .050 second.
Power requirement: 12 or 24 Volt DC. Typical operating power 20 watts.
Speed band: Approximately ± 0.3%.
Mounting attitude: Any.

SPECIFICATIONS SKB

Construction: Rugged aluminum case and steel structure. Factory-sealed. Corrosion-resistant finishes. Only one moving part, supported on precision ball bearings.
Size: 5" x 5" x 11", including basic electronics.
Weight: Approximately 18 lbs.
Torque output: Max. 2 foot lb. available. 3/8" shaft. Rotation up to 33 degrees, either clockwise or counterclockwise.
Speed range: 4:1 standard.
Temperature stability: ± 1.5% over a range of −25 degrees to 200 degrees F.
Actuator time constant: .050 second.
Power requirement: 12 or 24 Volt DC. Typical operating power 60 watts.
Speed band: Approximately ± 0.3%.
Mounting attitude: Any.

CUSTOMER NOTES: