New Cylinder/Engine Break-in Procedure

- Use Mineral Oil, or normal non-synthetic operating oil (ie Shell 100 or Mobil XC 20-50) with no additives. Do not use mineral oil in turbo-charged engines, to avoid coking.
- Follow manufacturer/supplier directions for break-in. If not available, the following general guidelines may be used.

1. **Run for 1 minute at 1000 rpm**.
    a. Check for oil pressure and other normal indications.
    b. Do mag check. (Do not cycle prop.)
    c. Check minimum idle speed.
    d. Shut down, note idle mixture by slight (50 rpm) rise.
    e. Check for leaks.
    f. Make adjustments as needed.
    g. Let engine cool down completely.

2. **Run for 2 minutes at 1000 rpm**.
    a. Check for oil pressure and other normal indications.
    b. Do mag check. (Do not cycle prop.)
    c. Do low and high boost pump pressure check.
    d. Check minimum idle speed.
    e. Shut down, note idle mixture by slight (50 rpm) rise.
    f. Check for leaks.
    g. Make adjustments as needed.
    h. Let engine cool down completely.

3. **Run at 1000 rpm until oil temp is stable or at 140°F (60 °C) then 1500 rpm for 5 minutes.**
    a. Check for oil pressure and other normal indications.
    b. Keep oil temp below 200°F and cylinder head temps below 400°F.
    c. Do minimum prop cycle (100 rpm drop) just to get oil in governor and check for functionality.
    d. Check minimum idle speed.
    e. Shut down, note idle mixture by slight (50 rpm) rise.
    f. Check for leaks.
    g. Make adjustments as needed.
    h. Let engine cool down completely.

4. **Run at 1000 rpm until oil temp is stable or at 140°F (60 °C) then 1500 rpm for 15 minutes, then higher rpm as noted below for 10 seconds.**
    a. Check for oil pressure and other normal indications.
    b. Keep oil temp below 200°F and cylinder head temps below 400°F.
    c. After 15 minutes, increase throttle to 1800 rpm and do mag check.
    d. Do minimum prop cycle (100 rpm drop) to check for functionality.
    e. If temps are OK, increase to full power (non-turbo) or 30 inches manifold pressure (turbo) for 10 seconds. Slowly decrease rpm to idle and let engine stabilize.
    f. Check minimum idle speed.
    g. Shut down, note idle mixture by slight (50 rpm) rise.
    h. Check for leaks.
    i. Make adjustments as needed.
    j. Let engine cool down completely.

5. **Full power high-speed taxi test.**
    a. Start and warm up engine using normal technique.
    b. Do mag check using normal technique.
    c. Do minimum (100 rpm drop) prop check at normal rpm.
    d. Slowly advance power to full throttle (but not above red-line) for a few seconds, long enough to check max rpm, fuel pressure/fuel flow, manifold pressure.
    e. Cool/stabilize engine at normal low rpm.
    f. Shut down.
    g. Make adjustments as needed.
    h. Let engine cool down completely.

6. **Repeat full-power high-speed taxi tests until adjustments are correct.**

7. **Flight test #1 (30 minutes).**
    a. Start and warm up engine per POH, but do minimum (100 rpm) prop cycle checks.
    b. Minimize ground/taxi time to minimize heating, but allow engine to warm up sufficiently.
    c. Take off with full power in accordance with POH.
    d. ASAP decrease engine speed to climb power per POH. Keep mixture richer than normal.
    e. Do shallow climb (300 fpm, to maximize cooling air flow) to suitable altitude above/near airport (3-5000 ft max.). Watch, control temps.
    f. Level-off, reduce throttle to 75% power (65% for turbo). Keep prop rpm higher than normal, but within green limit. Keep cowl flaps open.
    g. Set mixture to 100-125 ^{o}F rich of peak (or richer depending on other indicators).
    h. Maintain flight near or circle airport, cycle rpm every 5 minutes in increments of 100 rpm within recommended cruise rpm range.
    i. Close cowl flaps for descent, unless temps are high.
    j. Descend at normal/high cruise descent power at 300-500 fpm, keeping manifold pressure as high as possible (18”-23”) to prevent piston flutter.
    k. Land, open cowl flaps, avoid over-heating on ground.
    l. Shut down, inspect engine.

8. **Flight test #2 (2 hours).**
    a. Start and warm up engine per POH, but do minimum (100 rpm) prop cycle checks.
    b. Minimize ground/taxi time to minimize heating, but allow engine to warm up sufficiently.
    c. Take off with full power in accordance with POH.
    d. ASAP decrease engine speed to climb power per POH. Keep mixture richer than normal. Every 5 minutes during climb, slowly advance throttle to full power then return to cruise climb power. Watch, control temps.
    e. Do shallow climb (300 fpm, to maximize cooling air flow) to suitable cruise altitude (3-5000 ft max.).
    f. Level-off, reduce throttle to 75% power (also 75% for turbo). Keep prop rpm higher than normal, but within green limit. Keep cowl flaps open.
    g. Set mixture to 100-125 ^{o}F rich of peak (or richer depending on other indicators).
    h. For first hour, maintain 75% power, cycle rpm every 5 minutes in increments of 100 rpm within recommended cruise rpm range.

i. For second hour, set normal 50-100 °F rich of peak mixture, alternate between 65% and 75% power every 15 minutes and cycle rpm every 5 minutes in increments of 100 rpm within recommended cruise rpm range.
j. Close cowl flaps for descent, unless temps are high.
k. Descend at normal/high cruise descent power at 300-500 fpm, keeping manifold pressure as high as possible (18”-23”) to prevent piston flutter.
l. Land, open cowl flaps, avoid over-heating on ground.
m. Shut down, inspect engine.

9. **Further break-in.**
    a. Most break-in wear should now be complete, with reduced heat indications and reduced oil consumption observed.
    b. It may take 25-50 total hours to fully break in a new engine or cylinders. During this period, opt for lower altitude flights and higher-power settings, rather than high altitude flight and lower-power settings, to keep cylinder pressures high, ring seating pressures high, and to reduce piston flutter.
    c. Change the engine oil after 25 hours of break-in time.

References:

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