Engine Shock Heating During Takeoff

Conversations often center around "shock cooling." So what is shock heating?

Shock heating is the situation that exists when a pilot almost instantly applies full power to the engines as he begins his takeoff. It comes as quite a shock to the engines. Remember, the majority of engine failures take place during power changes - takeoff and landing. The pilot uses gear, flaps, speed brakes, gradual power reductions, and 1200°F to 1400°F EGT mixture settings to control shock cooling during rapid descents. RAM suggests the same degree of attention when applying takeoff power.

A rapid advance to takeoff power can be as hard or harder on the engines as shock cooling. Even at fast idle while the aircraft is taxied to the runway, the internal cylinder temperatures are only warm. Numerous engine components are not yet up to the heat and pressures of full power. The oil may be warm, but it's still cool enough to be at a higher than normal pressure. This situation sends misleading feedback pressures to the internal engine control systems. It takes time for the engine systems to perform their function and to adjust for the heat.

Bursting into full takeoff power can be compared to spilling an entire pot of hot coffee on your legs vs. one small cup. Although both have the same temperature, the full pot of coffee contains a tremendous quantity of heat. Damage results anytime anything is forced to absorb a large quantity of heat quickly - rather than gradually. RAM acceptance and test pilots use the following takeoff technique to help smooth their transition to higher cylinder temperatures and system pressures.

Always Assert Your Pilot In Command Authority To Ensure The Safe Operation Of Your Aircraft And Passengers.

- When lined up on the runway centerline for takeoff, hold the brakes and smoothly advance the throttles to 27-30 inches of manifold pressure. Allow the MP to stabilize 3-5 seconds. During that time, scan the engine instruments. Verify that they are normal.
- Release the brakes and smoothly advance the throttles to takeoff power manifold pressure. Remember, oil pressures and feedback signals to the controllers are adjusting as the temperatures rise. Pilots should allow engine systems time to function.
- Again, scan the instruments and make any necessary final throttle adjustments.
- Should an immediate takeoff be required upon arrival at the run way, the same procedures can be followed during the takeoff roll instead of holding the brakes - if runway length is suitable: partial power, stabilize, then full power.
- As you takeoff, cross checking fuel flow, RPM, MP and EGT is essential. It enables you to recognize and react to critical or premature instrument readings in a timely manner. Plus, it helps you remember the exact numbers when later communicating with your aircraft mechanic. Your aircraft mechanic needs to know specifics in order to effectively troubleshoot.

- Of further benefit, there should be no more surging and overboosting when using the above technique for smoother throttle advancement.
- Most importantly, smooth power increases will allow the cylinder combustion chambers to experience a more constant and orderly transition to the high temperature range of their design limits.

From the RAM Engine website