manually during climb, and the maximum m.p. is limited so the pilot does not have to worry about overboosting.

The density-reference system, used on some Lycoming engines, goes one step further. At full throttle, the wastegate is controlled by compressor discharge air. The pilot selects the desired m.p. and the density, or slope, controller tries to hold that density of air, regardless of changes in airspeed, ambient pressure, or temperature. This system actually can increase the m.p. by several inches during a climb, which has startled more than one unsuspecting pilot. Many pilots react to that situation by backing off on the throttle in the mistaken belief that the controller has failed and is putting out too much pressure. At less than full throttle, the turbocharger reverts to being a pressure-reference system, and things work pretty much as the pilot expects. The obvious advantage to such a system, when used correctly, is that it is automatically controlled and compensates for variation in density and airspeed. It almost totally eliminates bootstrapping.

HEAT PROBLEMS

For all the positive aspects of the turbocharger, it still has the nagging problem of hot, compressed air being pumped into the intake manifold. Not only does heat destroy engines, but it also robs them of power. A given turbocharged engine might produce the same m.p. and RPM at 13,000 feet as it does at sea level, but that doesn't mean it's producing the same horsepower. The hotter the air, the less dense it is, and while the turbocharger packs molecules of air together to overcome the increased density altitude that comes with altitude, it is not unusual for 15 to 20 percent of the engine's horsepower to be lost to heat, which means the turbocharger must work that much harder to make up the difference. This in turn creates more heat, causing a vicious circle.

To reduce the extent of the heat problem, some manufacturers put intercoolers between the compressor discharge and the intake manifold. The intercooler cools the hot, compressed air before it goes to the engine. Not only does that increase the critical altitude, but it also reduces the potential for detonation as a result of overheating. The disadvantages are increased weight, increased drag because the intercooler uses ram air, additional system complexity, and added expense.

With a turbocharger system, the manifold pressure gauge is controlled by the throttle and the tachometer is controlled by the propeller lever. The exhaust-gas temperature (EGT) gauge displays mixture control, and the cylinder head temperature (CHT) gauge is controlled by cowl flaps and airspeed. From an operational standpoint, the key to system longevity is heat control.

During takeoff and climb, EGT is controlled by throttle setting. If the EGT gets too high, power must be reduced. During cruise, EGT is a direct result of mixture manipulation; however, RPM also has an effect on EGT. If engine RPM is so fast that the exhaust valve opens before combustion is complete, EGT will be hotter because combustion will take place in the exhaust manifold.

Many pilots think takeoff and climb are the most critical periods of operation for an engine; actually, cruise can be far more critical. It is true that during takeoff, the engine is under full power, but it is also using a rich mixture, with the excess fuel acting as an

Lombardo, David A.(Author). Aircraft Systems.
Blacklick, OH, USA: McGraw-Hill Professional Book Group, 1998. p 147.
http://site.ebrary.com/lib/modarres/Doc?id=5001849&page=163