

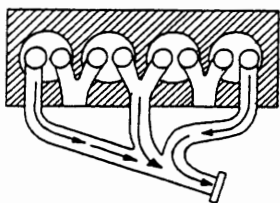
PASSING GAS

cylinders. As mentioned, the short branches of an exhaust manifold offer minimal scavenging. It may help to think of the scavenging principle like siphoning, having the inertial column create a low-pressure region that aids the companion cylinders during blowdown. When a system is designed as such, it is considered to be tuned. Headers create the desired effect by connecting cylinders with events in the firing order that allow a discharge pressure wave to enter the adjacent pipe. The pressure wave then divides, with one wave continuing downstream to the collector cone, while the other is reflected and returns to the original open exhaust port. If the lengths of the pipes are correct, the pulse will arrive toward the end of the exhaust period and will pull the residual exhaust gas from the bore. The size of the primary tubes, header, and collector length all determine the effectiveness of the system at a given engine speed.

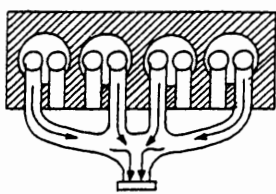
It is generally accepted that the size of the primary tubes should be based on the diameter of the exhaust valve seat area. However, the flange of the pipe is required

to meet with that of the exhaust port face in the cylinder head, so it's common for the exterior port to be larger than the area of the valve seat, and then it may be square or rectangular rather than circular. Some designers feel that the larger area of this junction effectively reduces pressure. An issue arises when the outside dimension of the primary tube compromises the internal pipe diameter. Space constraints, installation, clearance for the spark plugs, and a sufficient thickness for longevity all need to be addressed. Most body styles cause additional complications when trying to maintain equal length for each primary tube before being joined at the collector. Many off-the-shelf headers are marketed as being of equal length, but may actually have more than a 4-inch variation in the primary tubes. The cross-section of the pipe is also cause for concern: it must be large enough to evacuate the swept volume of the cylinder but be small enough to maintain high velocity.

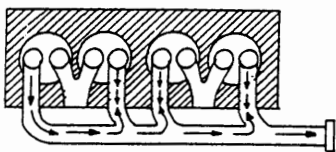
Given two engines of the same displacement and power, but operating at different rpm levels, the one with the higher engine speed will require the larger-diameter primary tube. This is a function of shorter



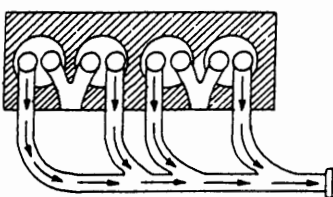
(a) Three-branch exhaust manifold with centre siamese exhaust valve ports



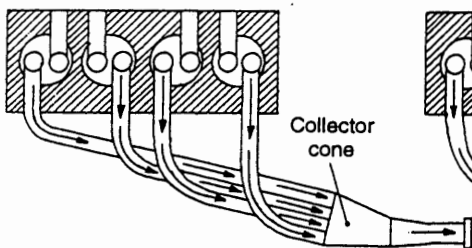
(b) Four-branch exhaust manifold with central downpipe



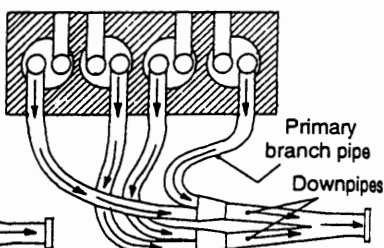
(c) Four short-branched exhaust manifold



(d) Four long-branched exhaust manifold



(e) Four-branch exhaust manifold arrangement for independence working



(f) Four-branch exhaust manifold with sub-divisions to obtain equal discharge interval at each junction