

LEFT — This is the basic home porting kit available from Joe Mondello, although you get many more disks and cartridges than shown here (see sidebar for complete list).



LEFT — This is the other equipment you'll need: a square, scribe, die grinder and stone shaper. All are also available from Mondello.

PORTING AT HOME

HEAD WIZARD JOE MONDELLO OFFERS TRICKS OF THE TRADE

BY MICHAEL LUTFY

Ask any engine builder where the key to engine performance lies, and most likely he'll tell you it's in the cylinder heads. The entire airflow system of an engine, (carburetor, manifold, headers and heads) is the most critical to engine performance. Remember, an internal combustion engine is basically a breathing machine. It inhales oxygen, ignites it, then exhales carbon monoxide. The efficiency of an engine to perform those three tasks determines its horsepower and torque output. It is admittedly an oversimplified explanation, but let's suffice it to say that cylinder heads, where all three of these functions take place, are the critical element in this system. It is there where all of the air fuel traffic is directed. It makes sense that the more efficient heads are at directing that flow, the better the overall performance output. That's where porting and polishing come into play.

Porting and polishing removes detonation-causing hot spots, casting flashes, and increases the air/fuel flow characteristics in all areas of the head.

If you were to check any engine handbook out on the market, most will advise that head porting is something you *don't* want to attempt at home. To a certain extent, this is true. If you're looking for a set of heads for a 600-plus horsepower competition engine, you might be better off having a professional shop prepare them for you, or purchasing a set of custom made heads. But if you're interested in increasing performance on a more limited scale, then porting heads yourself is the most cost-effective (and satisfying) way to go. The purpose of this story is to "clean up" the cylinder head by mildly porting and polishing the intake and exhaust ports, valve pockets and guides, intake runners and combustion chambers. What you'll need to do is

be patient, and above all, work slowly and carefully. Grinding heads is, at its very best, tedious work, and rushing through that last port can often be a big mistake.

The heads we selected are from a '72 350 small-block, with a cast number of 333882. They are "smogger" heads, meaning the combustion chamber is 76 cc's. Early small-block heads had a combustion chamber of 64 to 66 cc's. We called on Joe Mondello to demonstrate his method for mildly porting a set of small-block Chevy heads. Mondello is legendary in drag racing circles for his work on cylinder heads, particularly throughout the Fifties and Sixties. Every top drag racer today, from Muldowney to Garlits, has at one time or another run a Mondello-prepared cylinder head to stay competitive. Thirty years and countless hours stretched over a head bench have taken their toll, and today Joe no longer ports

heads himself. But he has designed a "master kit," to equip the do-it-yourselfer with the necessary items to port and polish cylinder heads themselves.

After selecting your heads and purchasing the kit (pn: PK-220-C), the first step is to have all machining work done to the head first, with the exception of decking. That includes installing replacement valve guides and seats. Have the heads hot-tanked, magna-fluxed, welded, etc. Decking is done last, because it's likely you'll be banging up the deck surface during the porting process. Before laying out the ports, you'll need to examine the manifold and headers, which should already have been selected. Conformity is the most important aspect to head porting. It is most critical to match all ports in size and shape. The size and shape of the manifold and header ports will determine much of the shape of your cylinder head ports.

If the headers are square, then grind the exhaust ports square. If they are round, then grind the exhaust ports round. With the exhaust, make sure that the headers remain slightly larger than the exhaust port.

If the intake manifold runners are smaller than the head ports, the head ports just need to be stoned and polished, and the intake manifold can be opened up slightly. But you don't want the intake manifold runners to be larger than the cylinder head ports. If that is the case, then the cylinder head intake ports need to be opened up to match the intake manifold runners. With larger manifold/smaller head ports, there will be a "reversion", where incoming air will bounce back into the intake manifold, and decrease air speed, resulting in a loss of power.

Now you're ready to begin. Joe suggests that you support the head with a variety of pieces of wood rather than

a head stand, because you get more versatility positioning the head. Also, it is important that you wear goggles, a dust mask and preferably ear plugs throughout the entire grinding process.

It doesn't matter where you begin, as long as the combustion chambers are done last. We started with the intake ports. Using the Dykem in the kit, we coated the mouth of the port. Using a set of dividers, measure the manifold ports, then compare them to the head ports. Select the largest port on the head to use as a guide. The idea is to find the largest cylinder head port and match all others to it in size. Mark both edges of the port mouth, then square them off with a scribe.

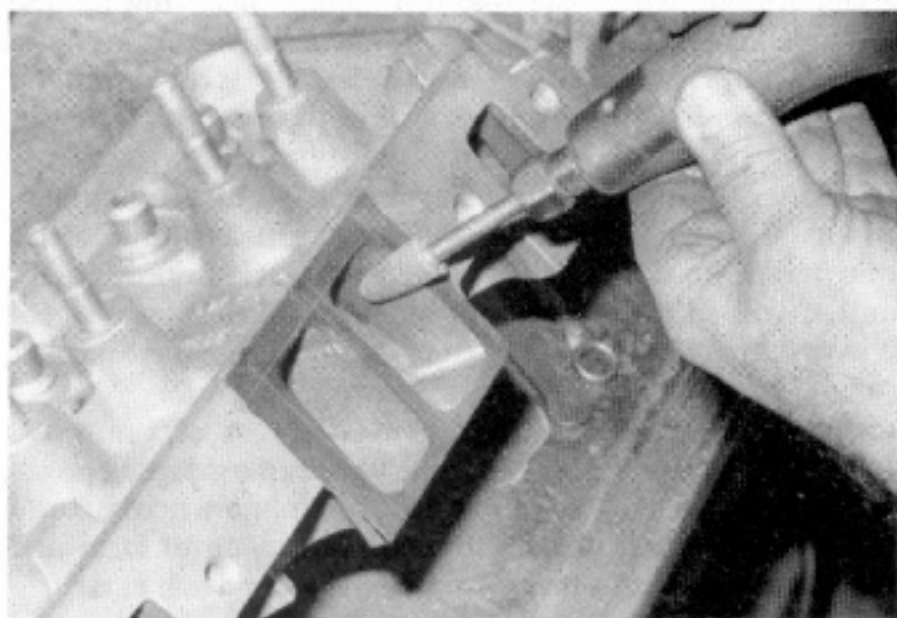
To "rough out" or remove any heavy metal, such as casting flash, use the carbide bit. Then you use a stone to form and blend, and a cartridge roll to polish. This is true in all areas of the head except the combustion cham-



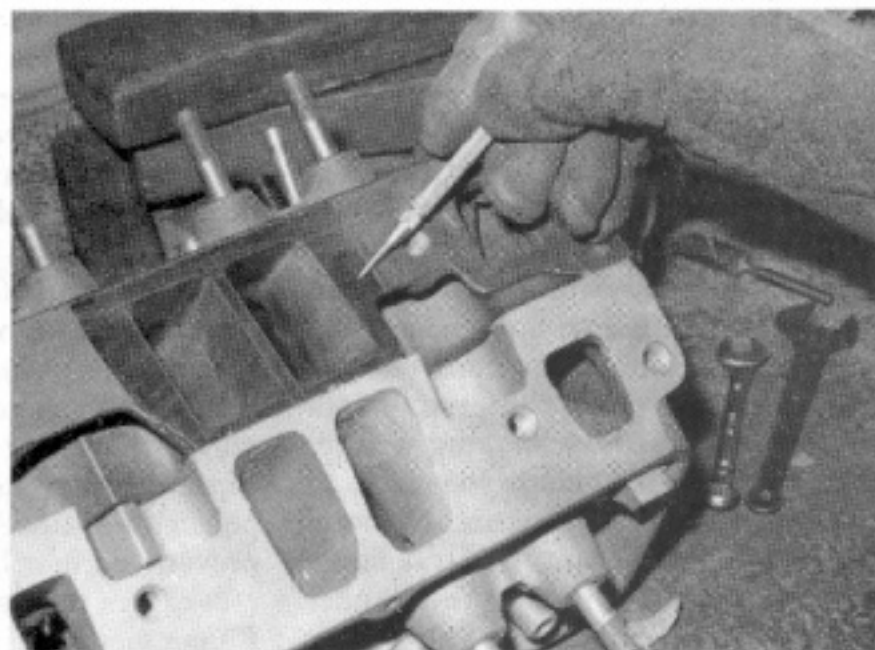
ABOVE — Dykem is brushed around ports. Match porting is exceptionally critical. Joe suggests finding the largest port with dividers, then porting all others out to same size. Use square and scribe to mark ports. Also consider manifold and header configuration before laying out (see text.)



ABOVE — After supporting head firmly, use a carbide bit to remove heavy metal and casting flash. Work downward, straightening out walls first, then work the bottom, work outward. Be careful of pushrod holes!

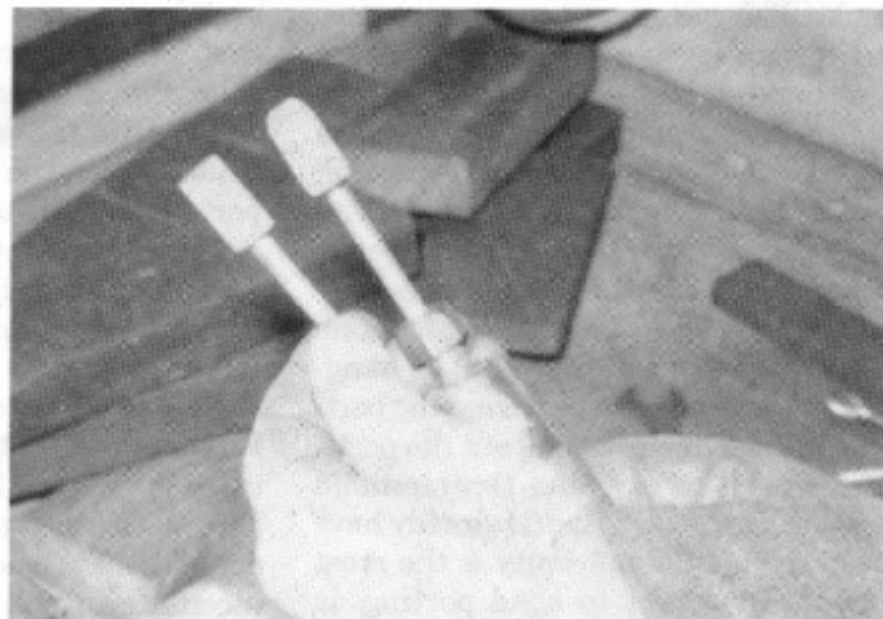
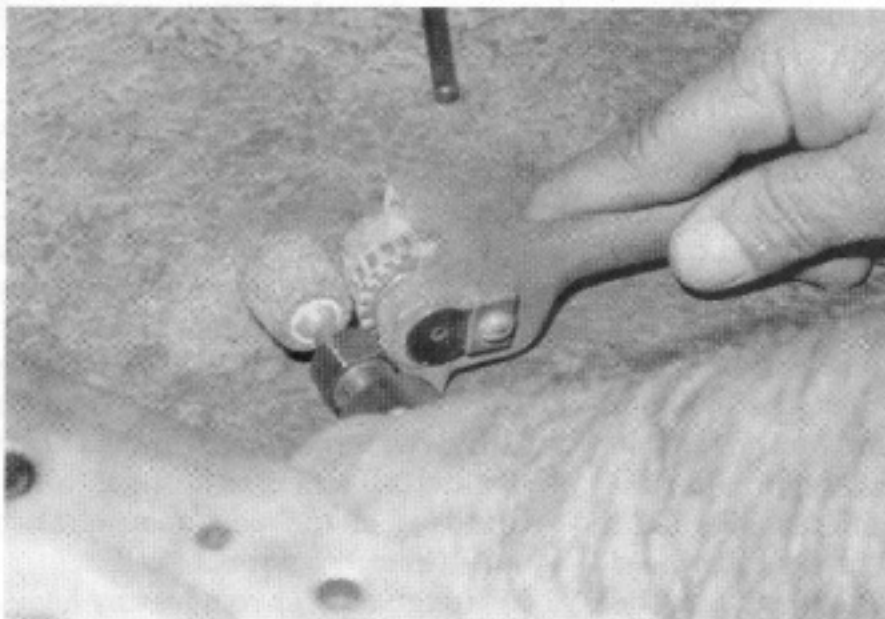


ABOVE — Stoning is next to blend and form the port. Use same motions and pattern as with carbide bit.



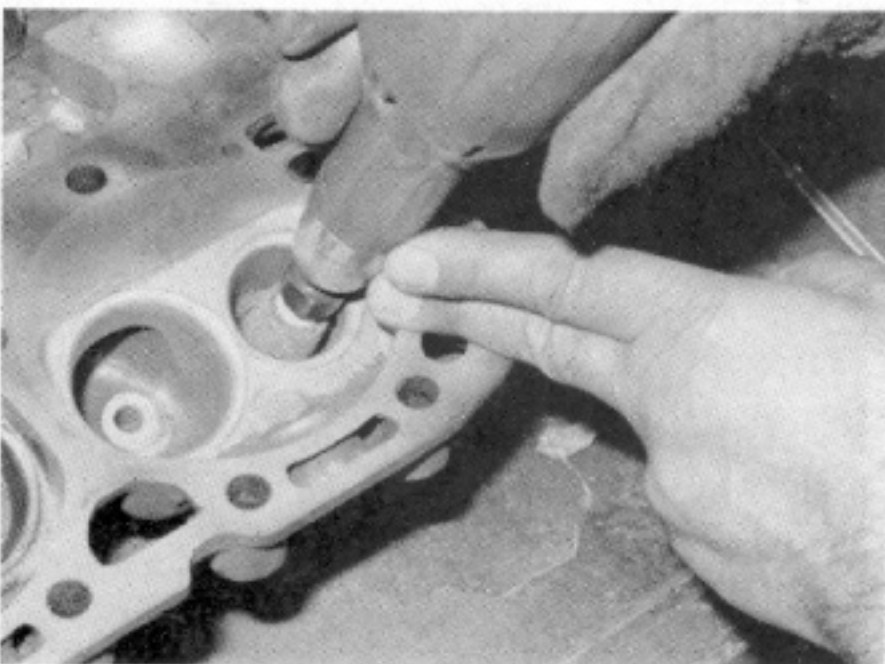
ABOVE — On the bottom is a stock head, on top is one ported. Note how bottom of head toward valve cover has been opened up. Also you can see that Joe has left center of port just roughed out, which he says is best for engines running up to 6,000 rpm only. On stock ports, note small "lumps" on top. That is casting flash that should be removed with carbide bit. Exhaust ports follow the same procedure as intakes.

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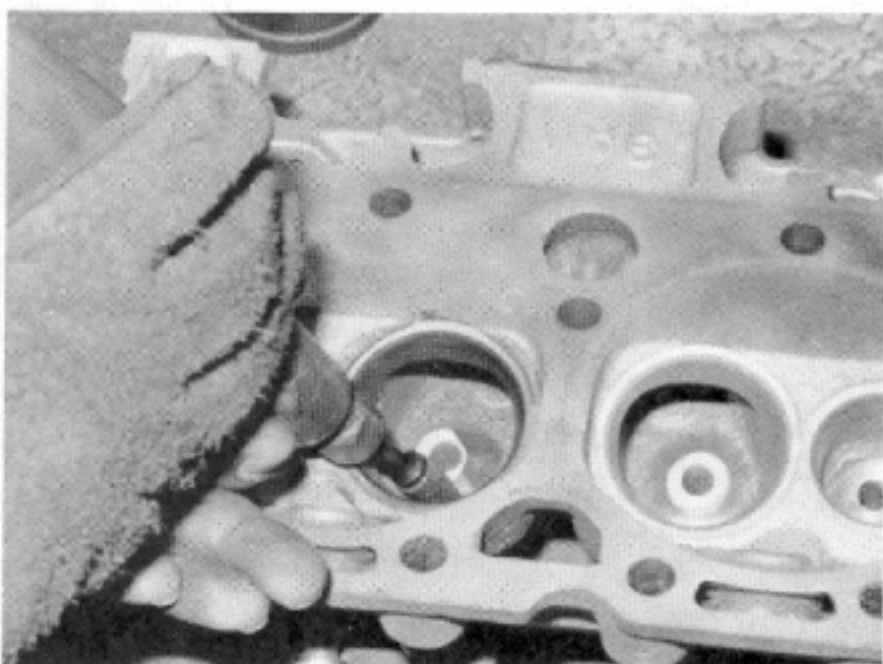


ABOVE & RIGHT — Stones are formed with shaper in a variety of ways to help reach bends and corners of port.

BELOW — Exhaust valve pocket is topped off with cupped stone.



BELOW — With intake valve pockets, Joe cuts the valve guide into a tear-drop shape with carbide bit.



bers, where the carbide bit should never be used.

According to Joe, all small-block intake mouths are not perpendicular to the walls. They all come in at a V-shape. The bottom part of the port towards the valve cover surface is always the narrowest part of the port. To start, work downward and straighten out the walls first, on both sides, then work the bottom of the port, coming into the actual V-shaped area, grinding outward, always keeping control and watching how close you come to the pushrod holes. Be careful there! Don't get it too thin or you'll be in serious trouble! On the other hand, you'll usually run into the valve cover holes, exposing them, but that problem is solved by putting valve cover studs in with Lock n' Seal, so don't worry about that.

What you want to do in the port is remove all lumps of casting flash metal,

and smooth out and open up the mouth. For street use and engines running up to 6,000 rpm, Joe recommends that you leave the center of the intake port rough, just remove all lumps. Stone and polish the mouth and walls, but it isn't necessary to completely polish the center of the port.

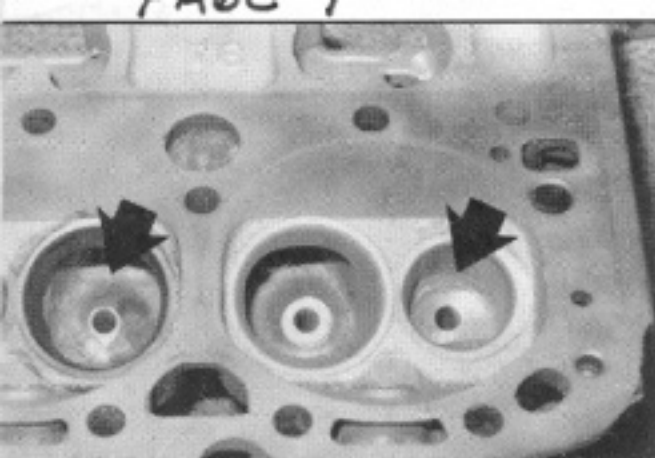
Exhaust ports follow the same procedure as intake ports. Just remember to port their shape according to the header size. Also, unlike the intake ports where Joe advises leaving the center of the port rough, completely polish the entire exhaust port. This will prevent carbon buildup.

Next we tackled the valve pockets. Remember that if you're going with replacement guides and seats, they should be installed already. The exhaust valve guide can be topped off with a stone, leveled off. The intake valve guide is shaped into a "tear-drop" shape. The exhaust guide can't be formed this

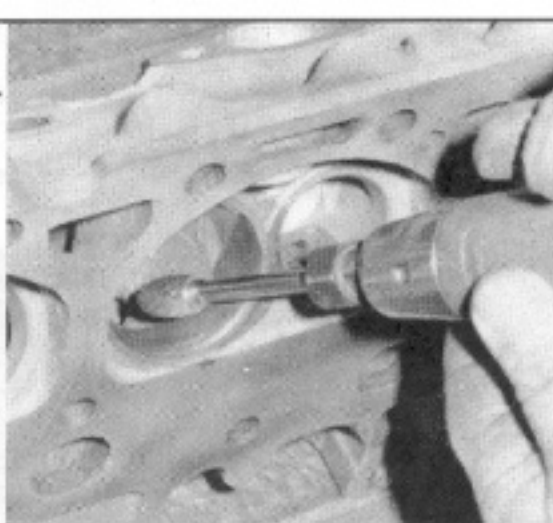
way because of the manner it enters the valve pocket, so all you can do is top it off. On the intake guide, work the tear-drop shape back toward the spark plug. Then, as the flow comes in through the runner, it comes around the back side of the wall, up the back side of the valve pocket, swirls across the spark plug and out the exhaust. This shaping of the intake guide alone will result in a drastic improvement, but both of these steps however, give much more area in the valve pocket and help redirect the flow.

Throughout the rest of the valve pockets, follow the same grinding procedure: carbide bit to remove heavy metal and shape guides; stone to form and blend, remove rough edges; cartridge roll to polish. It should be mentioned here that the stones can be formed with a special "stone shaper" to change their shape to reach into difficult areas.

The short side radius in the valve



ABOVE — Arrows indicate tear-dropped intake valve guide and topped exhaust port

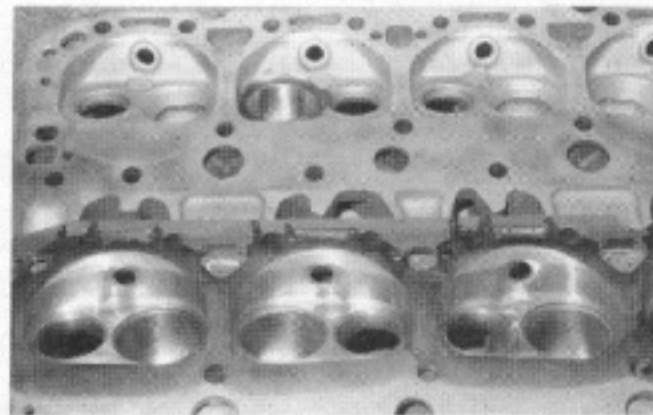


ABOVE — Here, Joe uses a carbide bit to smooth out the sharp-edged short side radius of the intake valve pocket. A critical area.



ABOVE — After stoning, move on to a cartridge roll of sandpaper. The sequence is carbide bit, stone, cartridge roll (40 grit) cartridge roll (100 grit) for most areas of the port.

RIGHT — Insert old valves to protect valve seats. Never use carbide bit on combustion chamber, just stones and cartridge rolls. Joe says there isn't much to do with chamber shape. Idea is to remove all potential hot spots.



LEFT — Chambers on top are stock, while those on the bottom have been worked over with a little Mondello magic.

pockets is another critical area. On small-block Chevy heads, the radius is a sharp edge, or lip. The idea is to smooth-out or round out this edge. Use a carbide bit carefully at first, then you'll need to "back shape" a stone by forming it so it gets narrower back toward the drill. It should look kind of like an upside-down tear-drop. Carefully work the short side radius lip into a soft roll.

To do the combustion chambers, find a couple of used valves to protect the valve seats. You don't want to grind the seats. Don't use any carbide bits, just stones and cartridges. Start with a large, round stone, then progress to smaller flame-shaped stones to blend the floor and walls. Then polish them up with the cartridge mandrels. The idea is to remove all rough surfaces and casting flashes completely. Such objects in the combustion chamber are potential "hot spots" which will heat faster than the rest of the chamber and could cause detonation.

All of this may seem oversimplified, and for a true competition head job, it is. But remember, we only wanted to provide you with enough information to "clean up" the cylinder heads to improve performance. If you're looking for more powerful results, you can perform what we've discussed here, then take it to a professional head porter to finish. It could save you a lot of money.

Joe Mondello strongly advises that you remember a few "golden rules." First, don't try to make a port as large as possible. That is not the objective. Conformity, or matching port size to manifolds and headers, and have them all the same size, is more important. Power is made in small-blocks according to how well all ports match. The short side radius is a critical area, so is tear-dropping around the valve guides, smoothing the radius around the pushrod holes, blending the rolls and bends around the intake port mouth and getting to the back side of the intake port. The top floor of the port where it comes into the short side radius is also important. Make sure all those sharp edges are gone. When the head is on the engine, the top floor on the short side radius is up toward the valve cover. If fuel comes in and hits any sharp edge or obstruction, it's going to be misdirected into the valve pocket. You want the fuel to flow smoothly into the floor of the port and around the short side radius. Tear-dropping the guide gives you more CC' content, volumetric fill, and increases the flow characteristics tremendously.

Head porting and polishing is an art form that can take years of trial-and-error to perfect. If you're a novice engine builder, then we suggest that you pick up a set of heads from a salvage yard to practice on, getting a feel for the die grinder and areas of the

head. Don't make your learning mistakes on the expensive heads you intend to put on your car. The last word is, be patient, go slowly and don't get discouraged. Head porting is extremely hard work, but we can guarantee that the results will make it all worthwhile.

Mondello's Home Porting Kit can be obtained by contacting: **Mondello Performance Products**, 8166 Orion Ave., Dept. AC, Van Nuys, CA 91406. (818) 994-6910. The part number for a small-block Chevy kit is (PK-22-C) and includes:

- (33) 60-grit (coarse) cartridge rolls
- (15) 100-grit (fine) cartridge rolls
- (25) 40-grit (coarse) flat discs
- (15) 100-grit (fine) flat discs
- (1) cartridge roll mandrel (2 3/4" x 1/4")
- (1) cartridge roll mandrel (4" long)
- (1) disc mandrel
- (1) carbide burr (1/2 x 1 1/4") 20 tooth (flame-shaped)
- (1) carbide burr egg shaped with 4" shank
- (1) carbo dressing stick for truing stones
- (2) 3M dust masks
- (1) Flexible clear goggles
- (1) bottle of Dykem with brush
- (2) Long Shank grey stones
- (1) short shank grey stone
- (1) short shank red stone
- (1) short shank brown cupped stone
- (2) short shank flame-shaped stone

OPTIONAL

Makita Grinder, Stone shaper, scribe, a 3/8" Carbide egg bit, a 3/8" flame-shaped carbide bit.