GENERAL INSTRUCTION SHEET

NRHS wants *every* customer's project to be a success. We provide what we believe to be the highest quality performance parts available. But to be successful, these parts *must* be installed correctly! Your factory service manual is an indispensable tool, however, high performance parts often require special attention in specific areas. We have listed these areas below. For all other procedures, please follow your factory service manual. If you have any questions, please call (303) 702-1600 and speak with a performance consultant. It's far better and cheaper to avoid a mistake than repair it!

1) Assemble your pistons and rings properly. First, it's *critical* that your rings are gapped properly. Square the ring in the bore and measure the gap with a feeler gauge. Adjust the gap with a ring gapping tool, or *very* carefully with a file (it helps to mount the file in a vise). Take off only a little at a time as you get close to the correct gap so that you don't overshoot and end up with a too-wide gap, this is a common mistake. Also make sure the gap is square, i.e. not "V"shaped or at an angle. Set the gap as follows:

- 3.498" to 3.563" bores: .018" top ring, .018" second ring
- 3.813" to 4.000" bores: .021" top ring, .021" second ring
- 4.125" to 4.250" bores: .023" top ring, .023" second ring
- Oil rings must have a gap of between .015" and .060"

Note that these gaps are for normally aspirated street motors on gasoline. If you need ring gap numbers for other applications, please call. Too tight of a gap will damage the cylinder wall or worse, so if in doubt, go a little bigger. Once the correct gap is achieved, *be sure to thoroughly deburr the filed area from all directions before installation onto the piston!* Burrs will cause the ring to hang up in the ring lands and burrs on the outside edge can actually score the cylinder wall. Nikasil cylinders are particularly sensitive to this! Finally, install the rings onto the pistons using a ring expander tool, taking care not to scratch the piston. It's *critical* that the correct ring (top or second) is placed in the correct ring land with the correct orientation! This is a common mistake that often results in excess oil consumption. The packaging will indicate the correct way to install the rings. If your rings are provided without packaging, the ring with the moly coating on the outside is the top ring and the uncoated ring is the second ring. If the ring is marked, the mark goes *up*. If the ring is unmarked, look for a bevel on the inside edge. That bevel goes up if it's a top ring, down if it's a second ring. If the ring has no mark and no bevel, it can be installed either way, but make sure it's in the correct ring land. If using a nik-a-sil cylinder, thoroughly lubricate the piston skirt, cylinder wall, *and the rings* before assembly. We recommend Red Line assembly lube, available from NRHS. The first few minutes of the Nikasil's life is critical and a lack of lubrication during this time will damage the plating. If using a cast iron lined cylinder, a thin coating of lubrication on the skirt and cylinder wall is all that's needed.

2) Check piston to piston clearance. With bolt-on engine kits (i.e. 1050/1250 XL/Buell kits, 98 inch Twin Cam kits, 85 inch Evolution Big Twin kits) this generally won't be a problem, although it doesn't hurt to give it a look. With big bore kits that require case boring and/or stroker kits, however, it is *extremely important* to check. Large bores and

longer strokes reduce the distance between the piston skirts at the bottom of the "V". NRHS big bore engine kits have shorter piston skirts to compensate, however, we try to maximize the skirt length for better piston stability and engine life, and on a specific combination on a specific engine, you may have to slightly clearance the piston skirt. To check piston to piston clearance with the cases split, put the flywheel assembly into the left crankcase half, put the pistons on the rods, and slide the cylinders on, over the two cylinder studs. Rotate the engine slowly and observe the clearance between the pistons as the flywheel turns through the point where the pistons come closest to each other. Clearance the skirts as necessary for a minimum of .060" gap. To check piston to piston clearance after the crankcase has been assembled, install one cylinder and piston assembly only. Rotate the engine until that piston is at bottom dead center. Looking through the other cylinder's hole in the case, observe the piston skirt's protrusion into the path of the other piston. Use a straight edge against the wall of the open case hole to determine if the piston needs to be clearanced. A flush fit here will be adequate as both pistons are not at bottom dead center at the same time (but they get close). If clearancing is necessary, it helps to mark the excess piston skirt with a magic marker while the piston is still at BDC. Clearancing can be accomplished with a simple sanding roll on a die grinder. Be sure to thoroughly clean all chips from the piston before reassembly.

3) Check cylinder to cylinder clearance. Axtell cylinders are made as big as possible for maximum structural integrity. Although rare, look for contact between the cylinders in the center of the V. If you torque down the heads with contact here, you *will* break the spigots in the cylinders! Grind on the cylinders as needed to get a minimum of .030" of clearance between them.

4) Install your wrist pin circlips correctly. This is an easy mistake to make and it has catastrophic results. We recommend installing one circlip while the piston is still on the bench. *Do not* us a pair of pliers to do this, as you can all too easily distort or nick the circlip and risk a failure. Start the circlip in its slot with the opening at 90 degrees to the rod. Work around in a circle, gently pushing it into place with your fingers. Once the entire clip is inside the wrist pin hole, *make absolutely sure* it's completely and correctly sitting in its slot. Repeat the procedure for the other circlip after installing the wrist pin through the rod (we recommend rags stuffed into the crankcase hole to prevent a dropped circlip from entering the crankcase). Again, it cannot be overstated how important is to get the circlip properly in its slot without damaging it. Triple check this! If you damage a circlip, call us and get a replacement rather than risk it.

5) Check your squish. The squish band is the area or areas where the piston comes very close to the head at top dead center. Optimizing the squish band clearance improves chamber turbulence, which helps power as well as minimizing detonation. NRHS engine kits come with special gaskets that will give a good squish clearance on the majority of engines. However, you should *always* check your squish clearance and adjust as needed. To check squish, place small pieces of .060" solder across the piston dome in several places around the squish band. The solder can be held in place with a small dab of wheel bearing grease or by taping it to the dome, placing the tape in an area outside the squish band so the tape won't alter the measurement. Torque the head into place and roll the engine through TDC once. Remove the head and measure the thickness of each solder strip. The ideal squish clearance for a street motor is anywhere between .030" and .035". Also take note of the distribution of the clearance around the squish band. Squish clearance can be adjusted with different head and base gasket thicknesses (some builders opt to eliminate
the base gasket altogether and use a sealer instead). If you have piston to head contact issues even with correct squish clearance, take a look at your wrist pin bushings. A

bushing that's too loose will allow the piston to rock side to side excessively and this will cause piston to head contact.
This is especially common after any type of a top end failure; even though the connecting rod may survive a top end failure without getting bent, it's very common for the wrist pin bushing to get elongated. This may be difficult to detect by feel, measure if you're unsure.

6) Install your cams correctly. High lift cams often require special attention in the gearcase and tappet area. Make absolutely sure the cam lobes swing clear of any obstructions in the gearcase with at least a .020" clearance. Mask the cam box and clearance material as needed. Sometimes it is necessary to chamfer the back side (closest to the crankcase) of the cam lobe itself, particularly to gain clearance for the pinion bearing race. If you have to do this, avoid encroaching on the lobe surface more than .100". Of equal importance is to make sure your tappets have adequate travel available *in both directions.* Install each cam and turn it such that the tappet is fully down. Make absolutely sure the tappet roller is still resting on the cam lobe and not hanging up on anything. This is a particularly common issue when using smaller than stock base circle cams in an XL, as the tappet's axle support will hang up on the cam bushing. Gain more clearance by slightly grinding on the bottom side of the tappet axle support. Also, with high lift cams you must check for adequate tappet anti-rotation pin clearance. The easiest way to do this is with a magnet. Turn the cam such that the tappet is at full lift and then stick a magnet onto the tappet from the top. Lift
the tappet up with the magnet until it stops against the tappet anti-rotation pin. You must have a minimum of .060" of clearance. To gain more clearance, the flat edge of the tappet must be extended down. A simpler method is to use a quality high performance tappet that already has a longer flat area, such as the JIMS performance tappets available from NRHS. Time your cams correctly. It's very simple to perform a spot-check of your cam timing, this is particularly valuable in cases where the alignment marks on the cams leave room for interpretation. With the cams installed but no pushrods in place, rotate the engine while watching the tappets on one cylinder. Position the engine approximately halfway between the point where the intake valve closes and the exhaust valve opens; this will ensure the lifters are on the base circle of the cams. Do not try to do this between the exhaust close and intake open event, that's the overlap period and there is no point where both valves are closed. Once the motor is positioned correctly, use a dial caliper positioned as a depth gauge and measure the distance between the top of the tappet block and the top of the tappet. Record these numbers. Now position that cylinder at TDC on overlap, i.e. where the exhaust is closing and the intake is opening, and repeat the measurements. For each tappet, subtract the overlap measurement from the base circle measurement and multiply the result by 1.625. You have just measured your TDC lift. Compare these measurements to the TDC lift specifications for your cams. They won't be exactly the same, but they should be pretty close. If there is a large discrepancy, open the gearcase back up and investigate the possibility that
your a tooth off in your cam installation. If your exhaust TDC lift is larger than the spec and your intake TDC lift is smaller than the spec, it indicates your cams are retarded, i.e. everything is happening later than designed. Likewise, if your exhaust TDC lift is smaller than the spec and your intake TDC lift is larger than the spec, it indicates your cams are advanced, i.e. everything is happening sooner than designed. Repeat the measurements for the other cylinder. If you are installing adjustable pushrods, be *sure* your adjustments are done with the tappets on the base circles of the cams. As with the above TDC lift measurements, you can only do one cylinder at a time because there is no point where all the valves are closed (unless you're working on a Blast). Position the motor about halfway in between the place where the intake valve closes and the exhaust valve opens. Do *not* try to do the adjustment between the exhaust close and intake open