

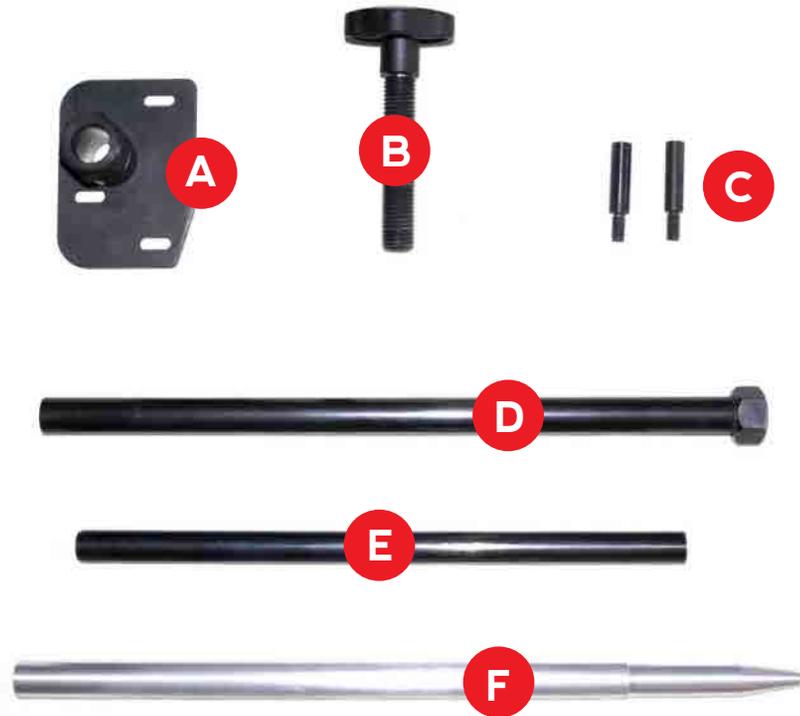
**FAULTLESS
TOOLS**

**INSTRUCTION
MANUAL**



106-28

M96 Wrist Pin Clip Installation Tool



- A** Front Console
- B** Threaded Handle / Knob
- C** Piston Pin Guides
- D** Delivery Tool
- E** Driven Rod
- F** Alignment Tool

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ABOUT THIS FAULTLESS TOOL:

The Faultless Piston pin and clip insertion tool was developed to lessen the chances of improper piston pin and clip installation when assembling the Porsche M96/ M97 engine. This tool was Invented and developed at Flat 6 Innovations by Jake Raby and Charles Navarro following an engine rebuild school where all attendees seemed to have the same challenges when assembling an engine with the current tools on the market. All of those tools were similar, and were based from the factory installation tool, which isn't intuitive, and has zero instructions to accompany it.

It was clear that a new tool was necessary that would allow for the piston pin and clip to be inserted using less force, and the perfect tool would also allow the installer to hear the audible "click" of the piston pin clip being seated into the piston. Being able to simply load a piston pin and clip into the tool, align the piston and connecting rod, and then delivering the piston pin and clip together, or just the clip by simply turning a handle is something that only the Faultless Piston pin & clip tool can offer. This Patent Pending design & process is unique while also being effective, and is used to assemble Flat 6 Innovations engines.

THOUGHTS FROM THE INVENTOR OF THE FAULTLESS PISTON PIN/ CLIP TOOL

The following step-by-step instructions will walk the user through the steps of tool use and engine assembly in the order that is best for instructional purposes. The individual user may loosely follow these, or alter them to best fit their method of application.

Before attempting to use this tool on an engine that is being assembled, it is imperative that the assembler uses the bank 2 crankcase half on the workbench to fit, and use the tool for the first time. By inserting piston #6 with its rings in place, into cylinder #6 while the crankcase half is on the workbench the Faultless Piston Pin/ clip tool can be used to align the piston with the tool bore in the crankcase, then deliver a piston pin and clip into the piston in the same manner that will be experienced when doing this job on the "real" project engine.

This is done on the workbench without any risks involved, and without the pressure of the technician knowing that a failed attempt of pin/ clip delivery will result in failure of the process, and loss of the piston pin retention clip inside the engine.

Despite the assembler's experience level with the M96/ M97 or ANY other engine, its imperative that this "trial run" of the tool be carried out before attempting the work on the assembled engine.

Once the assembler has attained full proficiency with the tool, delivering a pin and clip into the inserted piston, and understands the dynamics of the process, engine assembly may move forward. Do not attempt to move forward with the process until success has been reached on the workbench! By carrying out this process with the crankcase half on the workbench, the assembler can see how the tool fits into the piston counter bore, and exactly how the tool must fit into the piston to allow for delivery of the piston pin, and or clip to be installed without fault.

After becoming proficient with the tool and process on the workbench the assembler may move forward by installing the bank 2 crankcase half onto the engine and picking up with the following step-by-step instructions at step #1.

SUMMARY OF TOOL USE:

The Faultless Piston pin/ Clip tool requires lubrication of its components using light machine oil, to offer the smoothest operation. This unit is made from high quality materials that resist wear and can be used year after year if the surfaces are lubricated.

The assembler will install a piston and then position that piston in the bore, where the piston pin bore aligns with the tool access path that's machined into the crankcase at the factory. The access path is plugged with a plug that has a 14mm broached hex in the center. This access plug must be removed prior to the process being attempted. At this time, the engine should be rotated so the bank #2 cylinder deck faces the floor, allowing the connecting rods to hang much like pendulums within the engine. This alone greatly reduces the issues related to this process.

With the piston inserted and roughly aligned in the bore, the crankshaft is rotated to position the small end of the connecting rod near Bottom Dead Center (BDC) to allow for the alignment rod to pass through the piston and connecting rod, mechanically forcing their centerlines to be aligned for piston pin insertion.

Now that the components are aligned, a piston pin clip, and piston pin are loaded into the Faultless Tool and the tool is passed through the front console and through the access pathway. With the tool properly inserted into the piston counter bore; the handle on the Faultless Tool is rotated where it will force the piston pin through the piston and through the small end of the connecting rod. Following the piston pin is its clip, which is being simultaneously delivered into the piston, where it will be forced into the seating groove, delivering an audible "click" when seated.

With the clip **assumed** to be correctly in place, the assembler will then utilize a bore scope to survey the situation, ensuring that the clip is seated into the groove and not mistakenly delivered into the tool counter bore. With positive visual verification (bore scope aided only!) that the clip is correctly seated in the proper groove, the assembler can move to the next cylinder of the engine and repeat the process of piston installation.

TECHNICAL NOTE:

The Faultless Tool can be used to install a piston pin & clip combination, or simply to install the piston pin clip. These instructions illustrate the step-by-step method that would be utilized to deliver the pin and clip assembly into an engine together, however the assembler may wish to install the piston pin conventionally and only deliver the clip using the Faultless Tool. If this is the case, skip the portion of the instructions regarding the piston pin, and once the piston pin clip is inserted into the tool and squared into the tool's bore using a piston pin, the pin could be removed and the clip delivered individually

THE USE OF A BORE SCOPE DURING THE PISTON INSTALLATION PROCESS IS HIGHLY RECOMMENDED.



When working within the confines of the M96/ M97 engine the installer will be carrying out piston pin, and clip installation several inches inside the engine. This means that conventional flashlights, mirrors, and other devices will not provide the installer with enough positive indication that the piston pin and clip has been seated correctly throughout the processes.

The Snap On BK8000 is one of the best devices for this, as it has a long, thin optical lead that features both straight and 90 degree cameras built in. This allows the installer to toggle between views by simply touching the screen. This means the use of 90 degree mirrors and etc do not come into play, which will be welcomed to those who understand the nightmares that can occur when a mirror clipped to the end of an optical lead falls into an engine. The BK8000 also features adjustable brightness and contrast, which are great benefits when assessing shiny components with oil on their surfaces that will tend to reflect. Any high quality bore scope can be used for this verification; the BK8000 is just an example that I have chosen as it is my personal favorite of all the tools I have utilized to carry out this job. Please don't think that you'll be effective enough at verification of proper pin & clip insertion if you only use a flashlight and mirror. While the faultless piston pin & clip tool offers ease of installation, and more positive verification that the clip is installed with it's audible "click" the system, and tool are only as effective as their user.

Like engine assembly, a lot of common sense, situational awareness and focus are required.

Remember: If the piston pin clip is not fully inserted into the piston pin bore and locked in place, the clip will be ejected by the piston pin, which will then proceed to destroy the cylinder and entire crankcase in a matter of seconds. You do not have a second chance at getting this portion of the engine assembly right, and the margin of error is zero.



TAPERED SLEEVE RING COMPRESSOR

Another optional tool that is highly recommended to simplify the piston installation task is the tapered sleeve ring compressor. We recommend sleeve ring compressors sold by LN Engineering (www.lnengineering.com) that fit all M96/M97 engines from 2.5 to 3.8 liter. Performance sizes are also available for custom bore sizes. This tapered sleeve unit progressively compresses the piston rings as the piston travels through the tool and into the bore. The key to the effectiveness of this unit over ALL others is the way the tool sits perfectly flat atop the bore, removing the transitional gap that is the piston installers worst nightmare. The M96/ M97 engine uses small, fragile oiling rings, which are very easy to break. With the M96/ M97, even the most experienced engine builders may have issues with this, and the chances of the issues are greatly increased if other conventional ring compressors are used. The reason for this lies in the method of ring compression, and that the tapered sleeve type compressor seats best against the top of the cylinder deck, where others may partially slide into the cylinder. Please listen to these recommendations and purchase the best ring compressor that will lead to the least chance of complication and failure.

Remember: broken rings lead to scored cylinders immediately.

 Lubrication is your friend. Use liberal amounts of light oil on all tool surfaces and assembly lube, or engine oil on all components that will be installed into the engine.

 Make sure the tools and components are perfectly clean, contamination from debris on a workbench can be a disaster

 Before starting any work, ensure the piston pins glide effortlessly through the delivery tool, as well as the piston bore and the small end of the connecting rod. No resistance is acceptable. Some “rebuilt” connecting rods may have bushings that are not properly sized and may bind or gall during assembly. Some pistons may have burrs within their piston pin bore, these must be removed, as they will increase effort and create complexities during the entire procedure.

 Ensure that the piston counter bore allows for the Faultless Tool’s delivery tube to be fitted completely and has no binding or tight spots. This is super important, as issues here will result in the piston pin clip being delivered into the counter bore, rather than the clip groove where the clip should seat.

 Only assemble engine components in a room with a temperature of at least 72 degrees. Assembling the engine in a cold environment will make components feel too tight only because they are colder than optimum, and a few degrees makes a difference. In some instances components may feel so tight that honing is considered to increase clearance, when only having a warmer environment could solve the issue. This is especially true with pistons as they are very susceptible to temperature changes.

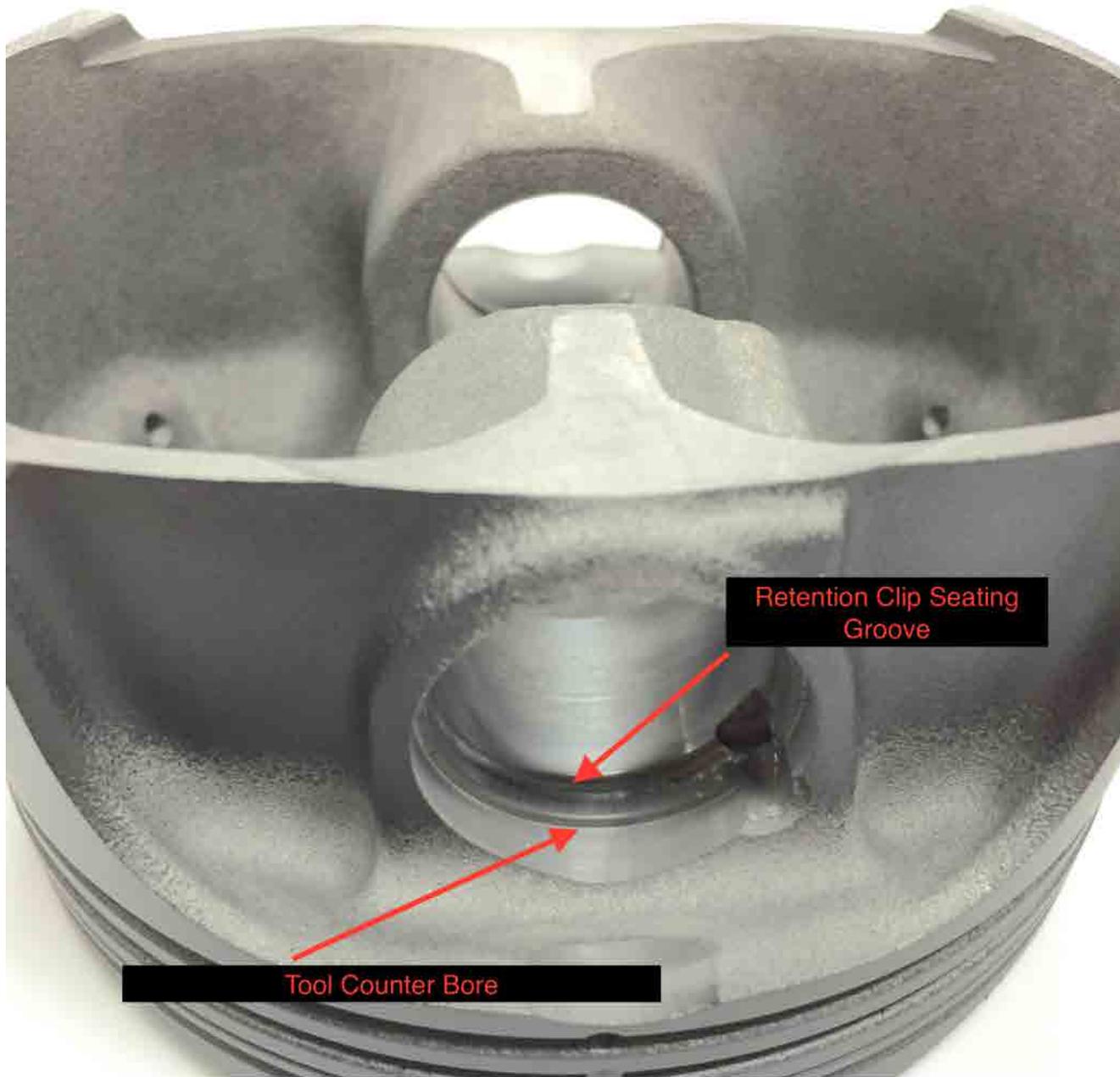
 If the Faultless Tool delivery tube attempts to back out of the compression nut housing while the handle is being turned, an alignment issue exists between the tool and the piston, or between the piston and the connecting rod. This must be corrected before moving forward. The tool has been designed in a manner that will not allow excess force to be exerted on the components through mechanical advantage, hence the delivery tube being pushed out of the compression console. Once the alignment issue is corrected, the components will then allow for the process to be completed properly.

 Use an engine stand that does not shake! If the engine stand is not rigid enough, after alignment of the connecting rod with the piston, the shakiness may allow the connecting rod to shift in it’s position, creating misalignment.

 Use a heavier assembly lube, like Joe Gibbs Assembly Grease, on the Bank #2 connecting rod bearings. This will help to stabilize the connecting rods during the processes of piston pin and clip insertion.

 Before beginning assembly, install the piston pin clips into the opposite side of each piston. The “opposite side” is the side that does not have the tool counter bore on the stock piston. Failure to install this clip now, on the work bench will create big challenges later, as the piston pin will pass completely through the piston, and contact the bore on the other side, resulting in damage and complexities.

 The biggest mistake that can be made is to falsely deliver the piston pin clip into the piston, installing it into the counter bore, rather than the clip groove within the piston. If this is not noted, or corrected this will result in immediate engine failure, with collateral damages that destroys the crankcase, connecting rod, piston and other internal components.



Retention Clip Seating Groove

Tool Counter Bore

Note in this photo that the piston is fitted into the compressor with the rear most piston pin clip in place. This is required! Failure to insert this clip prior to the rest of the procedure being carried out will result in less than favorable circumstances.



After verifying piston to cylinder clearance, piston ring end gap, and fitting the piston rings, the piston and rings can be lubricated with liberal amounts of engine oil. Carefully insert the piston into the tapered sleeve piston ring compressor, ensuring that the rings maintain their position. Do not force the piston into the compressor, as no force should be necessary to carry out this operation. If excess force is required, disassemble the unit and find the source of the issue.

Firmly hold the ring compressor to the cylinder deck and tap the piston into the bore. If the compressor is not seated against the cylinder deck for the duration of the insertion procedure, piston rings will be broken!



Piston shown properly inserted into the bore. Piston appearance will vary through M96/97 displacements and production dates.





Locate the guide console from the tool kit. This is a heavy steel unit that will bolt to the front of the engine as pictured. This unit plays a multi- role effort in the piston pin and clip insertion process as it locates and indexes the alignment and clip/ pin delivery tools. It also has a compression nut assembly that will firmly hold the clip/ pin delivery tool during the insertion process. Bolt the unit to the engine as shown. The elongated bolt holes allow for use of the Faultless Tool on all years, models and displacements of M96/ M97 engine with ease.

With the piston inserted into the bore, rotate the engine 180* from the position shown in this photo. Doing this will greatly simplify the remainder of the processes related to piston pin/ clip insertion, using gravity as a friend, rather than a foe.



This is the position that all work will be carried out from this point forward. With the engine rotated in this position, each connecting rod will hang very near the center of their respective bores. This greatly aids in the piston pin/ clip installation processes, as engine or crankshaft rotation has a result much like a pendulum, which can decrease alignment difficulty greatly. After each piston assembly is completed the assembler will need to rotate the engine back 180° to install the next piston into the bore, then rotate back to this position to complete the processes for that cylinder.



With the engine in this position, the piston can be driven deeper into the bore, where it will be observed through the inspection hole in the front console. A bore scope or flashlight can be used for this. When the piston pin bore of the piston roughly aligns with the center of the connecting rod, you can move to the next step.

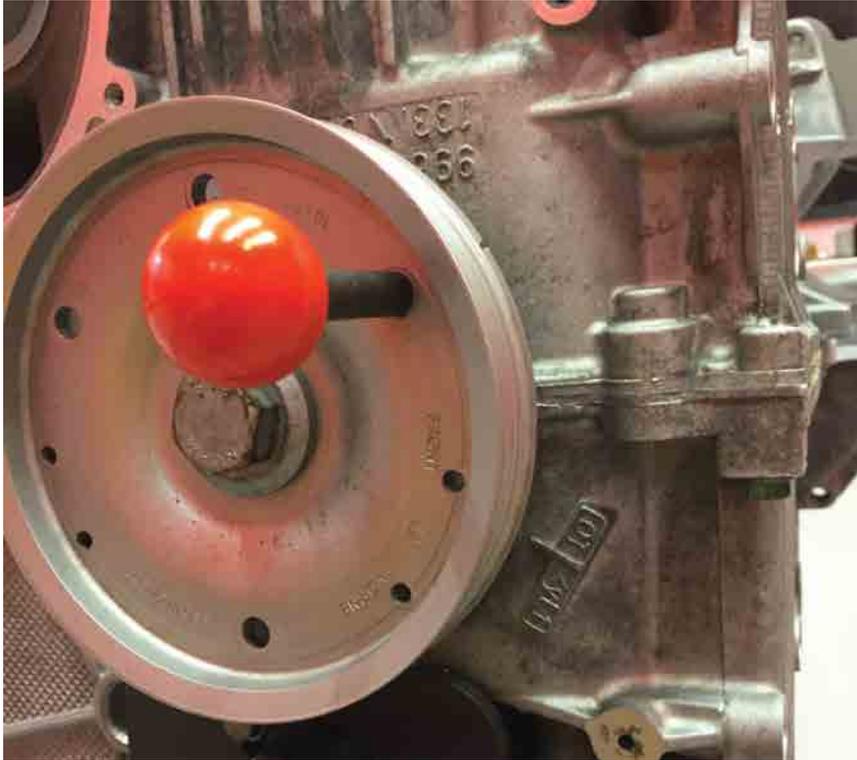
Remove the locking nut and compression ferrule from the front console. Removing these components will allow for easier use of the alignment tool, as it will reduce friction.



Observe the crankshaft pulley and find the position that's marked "U6". This will change with each respective cylinder that is being worked with. Piston installations always begin with cylinder 6. Locate this index hole in the crankshaft with the locking pin boss on bank 1 of the crankcase.



Using a cam timing locking tool, (optional, not included in this tool kit) or 8mm dowel, lock the crankshaft in the proper position, through the crankshaft pulley.

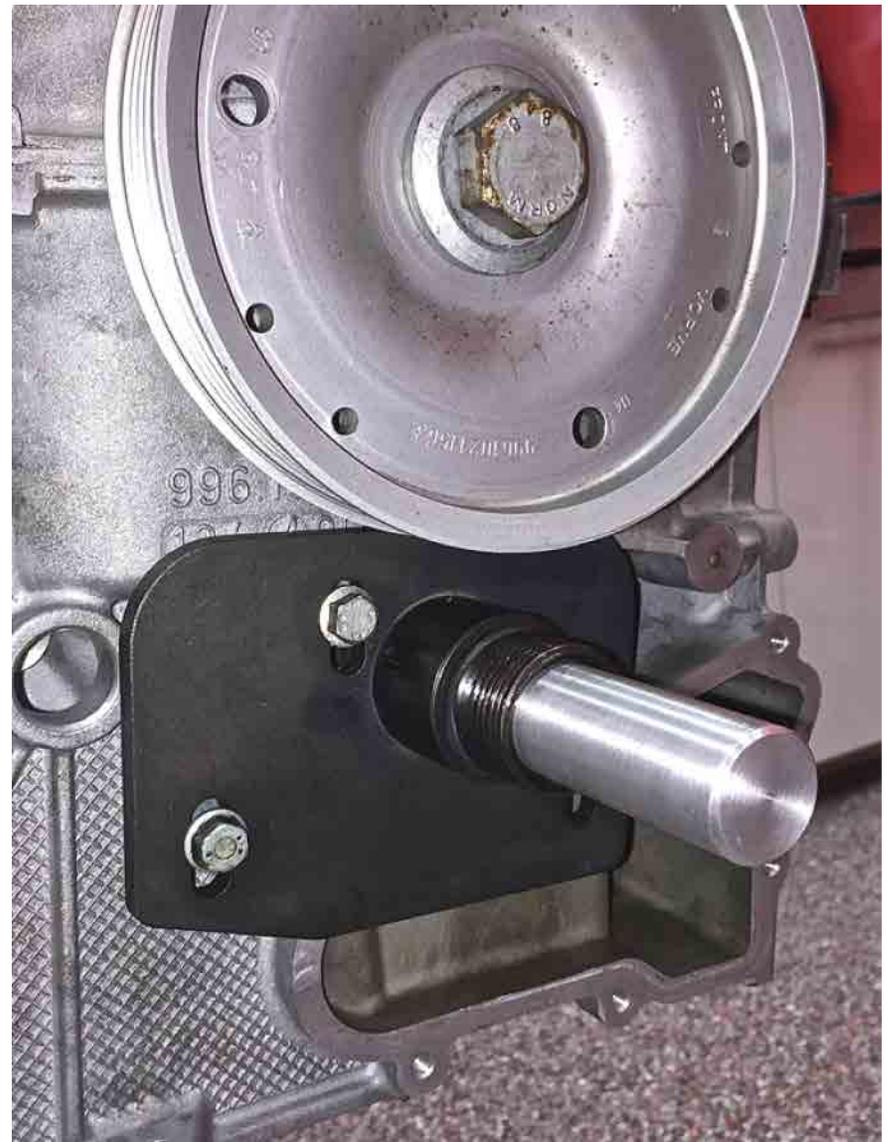


Using a cam timing locking tool, (optional, not included in this tool kit) or 8mm dowel, lock the crankshaft in the proper position, through the crankshaft pulley.

Insert the lubricated alignment tool into the front console and into the crankcase. During insertion, constant rotation of the tool will decrease difficulty. The tool will pass through stages of tightness/ looseness as it mechanically forces the piston and connecting rod to align. This is normal, and expected. Do not force the tool into place with a hammer or excess force!



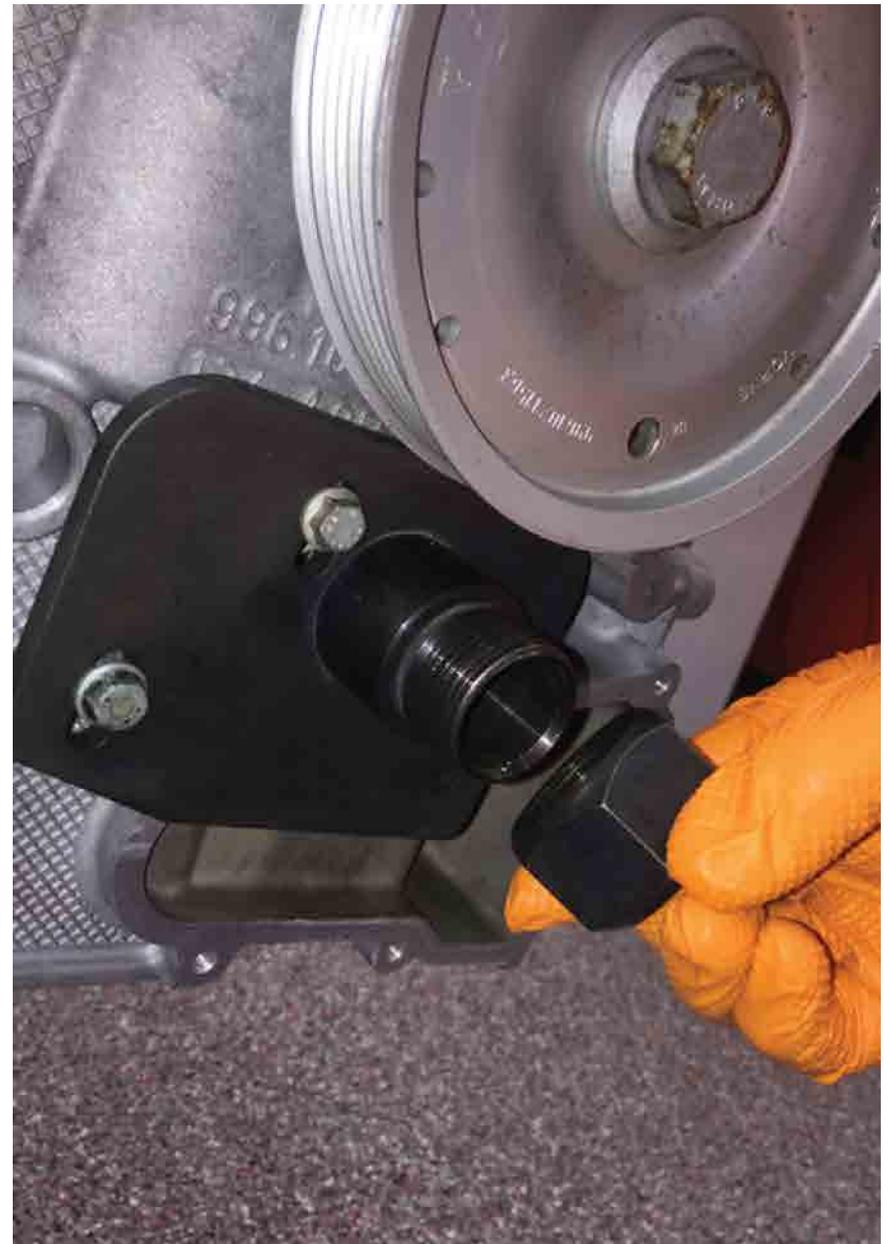
With the alignment tool bottomed into the crankcase, cylinder 6 is properly aligned, and we can move forward.



Here's a "Silver Bullet" for the installer! With the alignment tool inserted, loosen the front console bolts and then re-tighten them. This will perfectly align the tool console with the centerline of the piston/ connecting rod. Better alignment= less friction and effort during installation, which greatly decreases the chances of complications. With these bolts tightened, the tool can remain tight, and in place for the remainder of the installation processes on all cylinders.



After removing the alignment tool, re-fit the compression ferrule / nut assembly.



Locate these two piston pin guides from the tool kit. The smaller diameter of the two is used for stock Porsche pistons. The larger is used for aftermarket JE pistons. The diameter is optimized for common JE pistons, if using another brand, or a custom piston, a custom diameter piston pin guide may be necessary.



Fit the piston pin guide into one of the piston pins that will be utilized to assemble the engine you'll be working with. For proper tool operation its imperative that that the piston pin guide fit the piston pin with only a slight amount of operating clearance. If the piston pin must be forced onto the guide, this issue must be addressed before moving forward,. The guide and piston pin must slide freely!





The piston pin guide threads into one end of the driven rod.

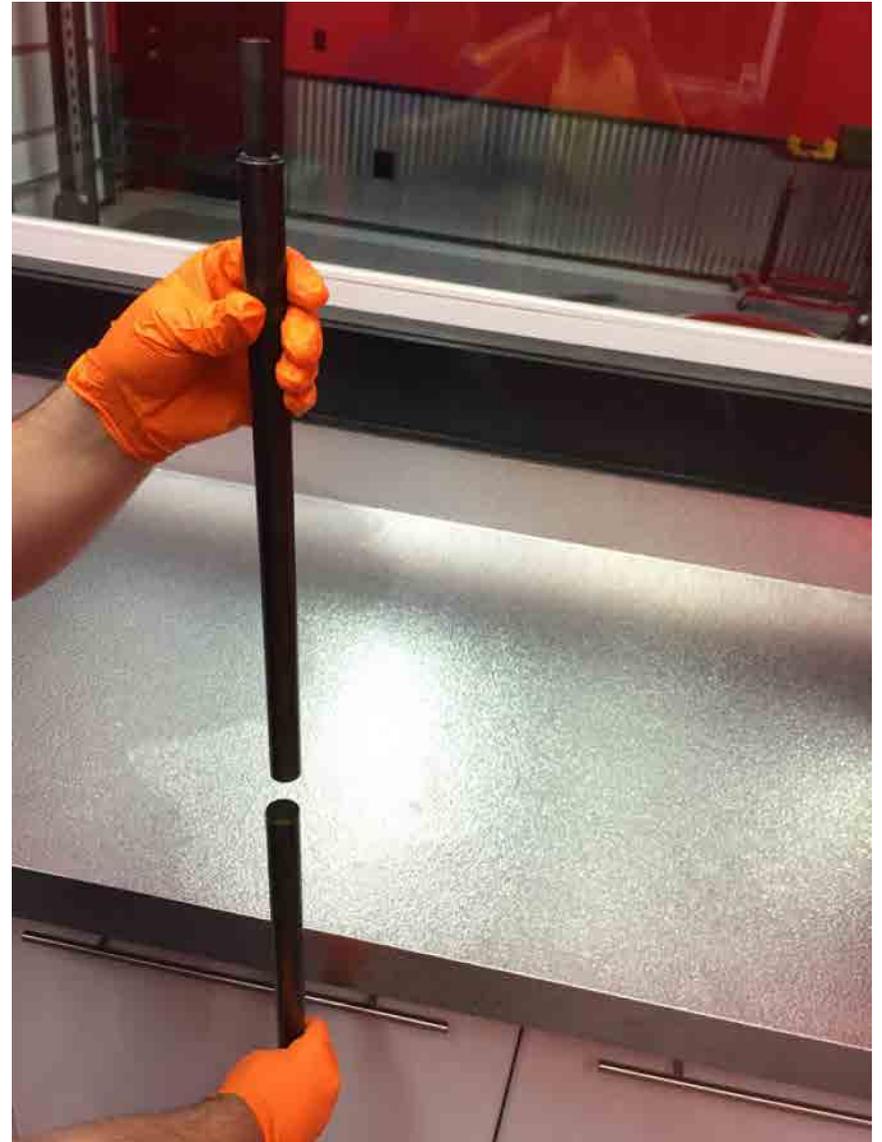
Only tighten this unit by hand, never use a thread locker!





Piston pin guide installed into the driven rod

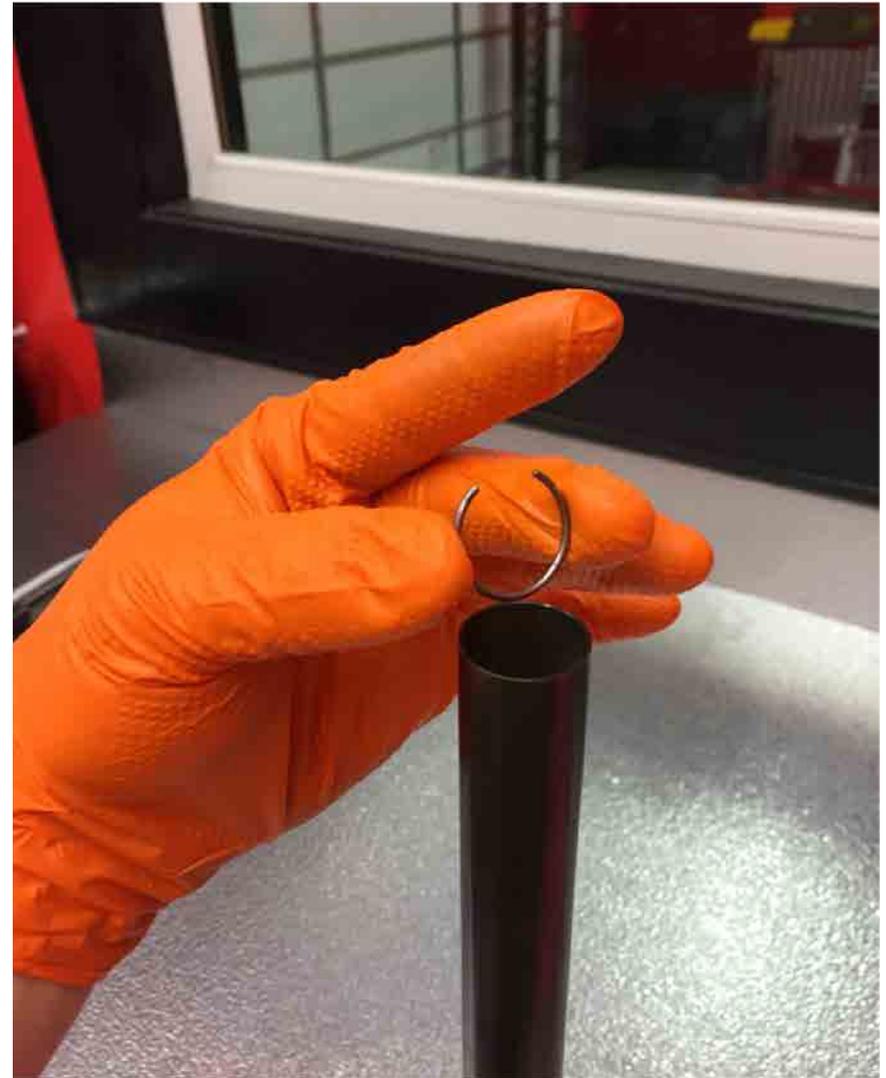
Insert the driven rod into the delivery tube. Light lubrication is recommended to increase tool life and decrease effort.



Driven rod shown inserted completely into the delivery tool



The use of safety glasses for the following procedures is highly recommended! Flying piston pin clips have no mercy on the eyes. Using a new OEM piston pin clip that has been modified, hold as shown. Never reuse piston pin clips, as they may have lost their tension and could result in difficulty using this tool, or premature engine failure.(note: In this photo the driven rod has been removed to better illustrate the processes.)



Compress gently and slide the clip into the mouth of the delivery tool.



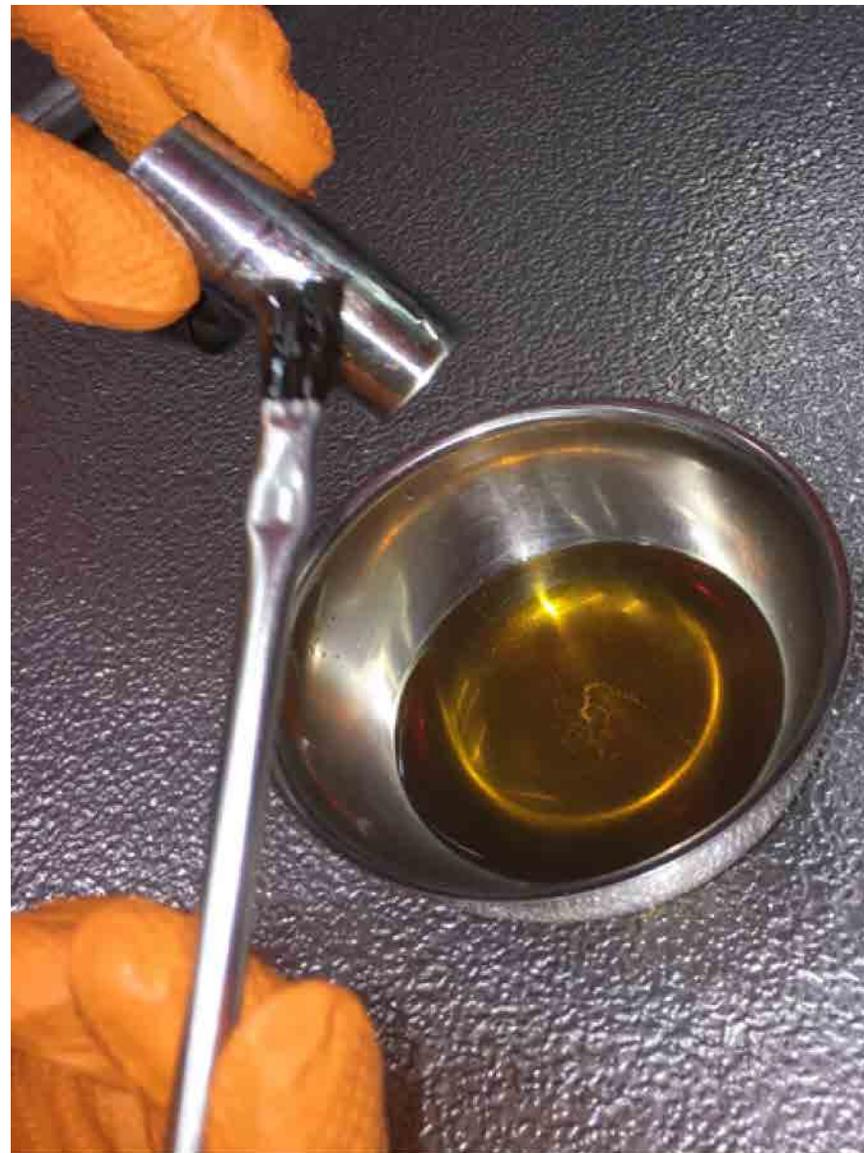
Push the clip into the mouth of the tool to ensure it is not prematurely ejected.



Push the piston pin clip to one side of the delivery tool as shown. This will allow for the following processes to occur more smoothly.



It's time to deliver a piston pin, and clip! Lubricate a piston pin heavily. Lubrication plays a key role in the successful use of the Faultless Tool.



Insert piston pin into the mouth of the delivery tool. The piston pin will encapsulate the previously loaded piston pin clip into place.



Squeeze the piston pin into the delivery tool. Its best if the pin is inserted so 2/3 of the pin is inside the delivery tool. This is done to ensure the following processes are simplified.



Insert the threaded installation knob into the delivery tool.



Turn the installation handle to create contact between the driven rod and the installation handle, as well as the piston pin clip, and piston pin. To ensure that all components are seated within the delivery tool, one hand can be used to hold the piston pin while turning the handle. (Note: The Faultless Tool is designed to accommodate different lengths of piston pins to allow for assembly of engines with extremely large bore sizes, so what may appear to be excess travel in the tool, is actually a built in feature.)





CRITICAL!

Before moving forward it is imperative that the installation handle be ran in far enough that the piston pin has $\frac{1}{2}$ of it's length protruding from the delivery tool! This will allow the initial insertion of the tool to pass the piston pin through 1 side of the piston, and into the connecting rod. This keeps the connecting rod from possibly being shifted to one side, allowing for a situation where the piston pin may not engage into the connecting rod!

With the piston pin inserted into the delivery tool, along with its retention clip, the Faultless Tool can be inserted through the front console and into the piston that's being installed. The next challenge is ensuring the delivery tool is properly seated into the tool counter bore of the piston! This is all done by feel, and your practice that was carried out on the bench will help you know how the proper seating feels.



Once the tool is seated into the counter bore of the piston, tighten the compression nut to lock the tool to the console.





After ensuring the delivery tool is properly seated into the piston counter bore, you can move forward with the installation process. Slowly rotate the installation handle while paying close attention to the delivery tool at the point where it enters the compression nut. If resistance is felt at the installation handle the alignment of one of more components may not be correct. This will force the delivery tool out of the compression nut assembly. This is a safety feature, to ensure the mechanical advantage of the installation tool will not force components to assemble that are not properly aligned. If the tool is properly aligned only slight resistance will be felt in the installation handle and the piston pin and clip will properly deliver with an audible “click!” when in place. Work with the radio off, in a quiet environment to hear this “sound of success”. If no click is heard, remove the delivery tool with care and check your work with the bore scope to ensure the clip is properly installed. Even if the audible “Click!” is heard, you must still ensure the clip was delivered into the seating groove, and not the counter bore.

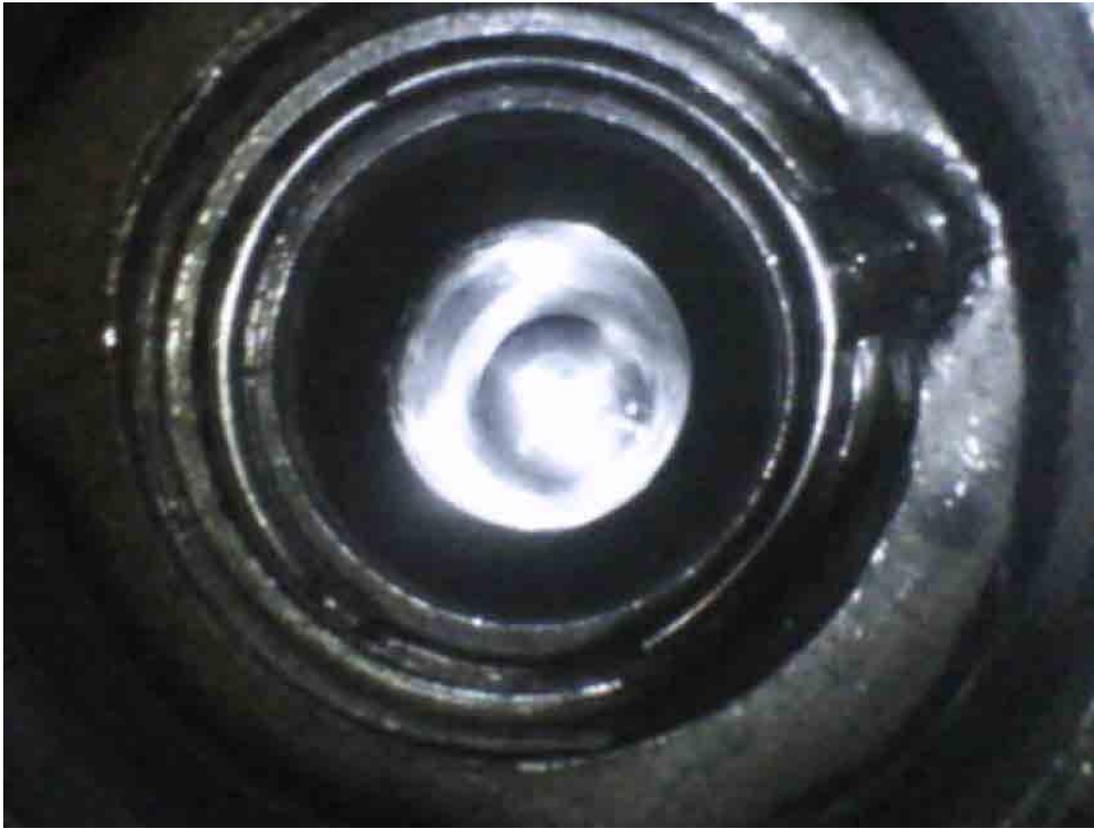
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**This is NOT
the picture that
you want to see!**



This clip has been improperly installed. This photo shows the clip inserted into the tool counter bore, not the clip retention groove! If the clip is inserted in this manner and the mistake is not caught, immediate engine failure is expected only seconds or minutes after the initial firing of the engine. The engine will fail as a result of the piston pin moving out of the bore and contacting the cylinder/ crankcase. This leads to massive amounts of collateral damage.



This photo taken from a BK8000 bore scope during a piston installation depicts a correctly installed piston pin clip. Note that the tool counter bore is clearly shown and is free from any portion of the clip contacting it. Also note that the entire clip is clearly locked into the seating groove of the piston, and that it is seated consistently against the end of the piston pin. A bore scope with a 90-degree camera, or mirror can also be used to further verify piston pin clip installation.

With this completed, on all three cylinders of bank #2, the process is now complete and engine assembly can continue.



We hope that these instructions have been effective with your piston pin and clip installation.

With the proper use, the Faultless piston pin & clip installation tool will greatly decrease the difficulty associated with M96/ M97 engine assembly.

Jake Raby
Inventor/ Developer
Faultless Tool Product Line

