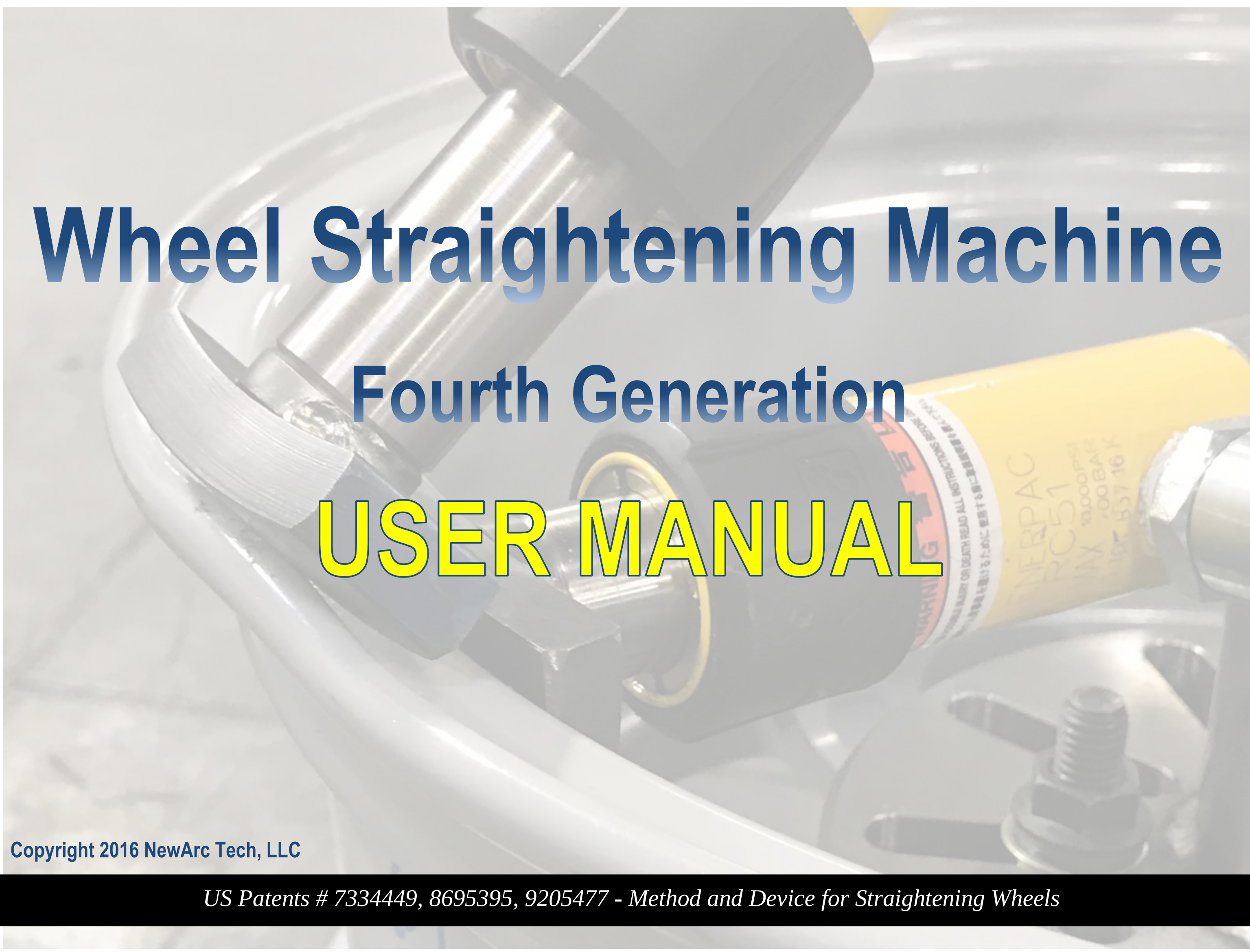
DUAL AXIS STRAIN RELIEF

WHEEL STRAIGHTENING TECHNOLOGY



Wheel Straightening Machine

Fourth Generation

USER MANUAL

US Patents # 7334449, 8695395, 9205477 - Method and Device for Straightening Wheels

NewArc™ Fourth Generation

The NewArc™ Generation Four, wheel straightener uses a patented process. The incomparable steel & aluminum frame version of our machine is designed as a dedicated straightener for precision repairs. It is light, portable and stores easily, which makes it ideal for use in car dealerships, tire stores, and other general auto repair facilities where floor space is at a premium.

The Gen III™ will ***Capture, Measure and Straighten*** wheels in single rigid and accurate setup. Here are the features of the new Gen III™ machine:

MOUNTING

- Wheel is secured rigidly on the machine platen like the way it mounts on a car.
- Wheel is located and mounted automatically around its true centerline.
- Universal platen allows for mounting of all types of wheels.
- Wheel can be inverted end to end without compromising accuracy of setup.
- Relationship of wheel to mounting surface remains rigid in either position.
- Accuracy of mounting remains constant in either position.
- Wheel can be precisely measured in either position.
- Wheel can be straightened in either position.
- All straightening and measuring operations are done in single setup.

MEASURING

- Because machine spins on precision bearings and the wheel is mounted around true center, the wheel turns accurately and spins in the same plane as it does when it is mounted on a car. As a result, precise measurements of critical surfaces can be made with a statically mounted dial indicator.

STRAIGHTENING

- Straightening pressure can be applied hydraulically or mechanically.
- Variable angles of adjustments are available for straightening positions.
- Straightening pressure originates from a rigid surface independent of wheel.
- Straightening pressure is applied only to the damaged area of the wheel.
- Supporting pressure can be applied either hydraulically or mechanically.
- Straightening can be done on either the inboard or outboard side of the wheel.
- Straightening and supporting pressure are deployed on separate axes..
- Multi-axis straightening and supporting pressure can be applied simultaneously.
- Straightening pressure applications can be independently staggered in separate planes.
- Both rigid and flexible straightening pressure applications are possible in a single setup.
- Heating and impact can be done, while wheel is mounted on the machine.
- Since the wheel can be inverted end to end without changing the setup, the accuracy of the runout measurements remains constant.

STORAGE AND PORTABILITY

- The machine is primarily intended to be used in a repair facility where storage and working space is of vital importance.
- Less than 2 square feet of storage space is consumed.
- It can be stored in a time saving “Ready” configuration for quick and easy setups.
- Since the machine frame is made of both steel and structural aluminum, it is light enough to be moved easily yet it remains strong enough to handle all wheel straightening forces.
- Everything needed for precision wheel straightening is either stowed in the toolbox or attached to the frame.
- Caster assemblies allow the unit to be moved quickly and smoothly.

GENERAL SAFETY

- The wheel is securely mounted to a rigid and precision platen.
- All hydraulic straightening applications are done at controllable angles.
- There are no pinch point issues associated with a typical rotating shaft.
- Safety procedures to protect both the operator and the machine have been incorporated.

MANUAL NUMBER REFERENCES

XXXPeriodically throughout this manual, numbers will sometimes appear in parenthesis. These numbers are part identification numbers. You can refer to those numbers on the parts list and drawings, which also have been included in the appendix of this manual. It is hoped that these numbers will assist you in understanding topics where explanations might be unclear.

TABLE OF CONTENTS

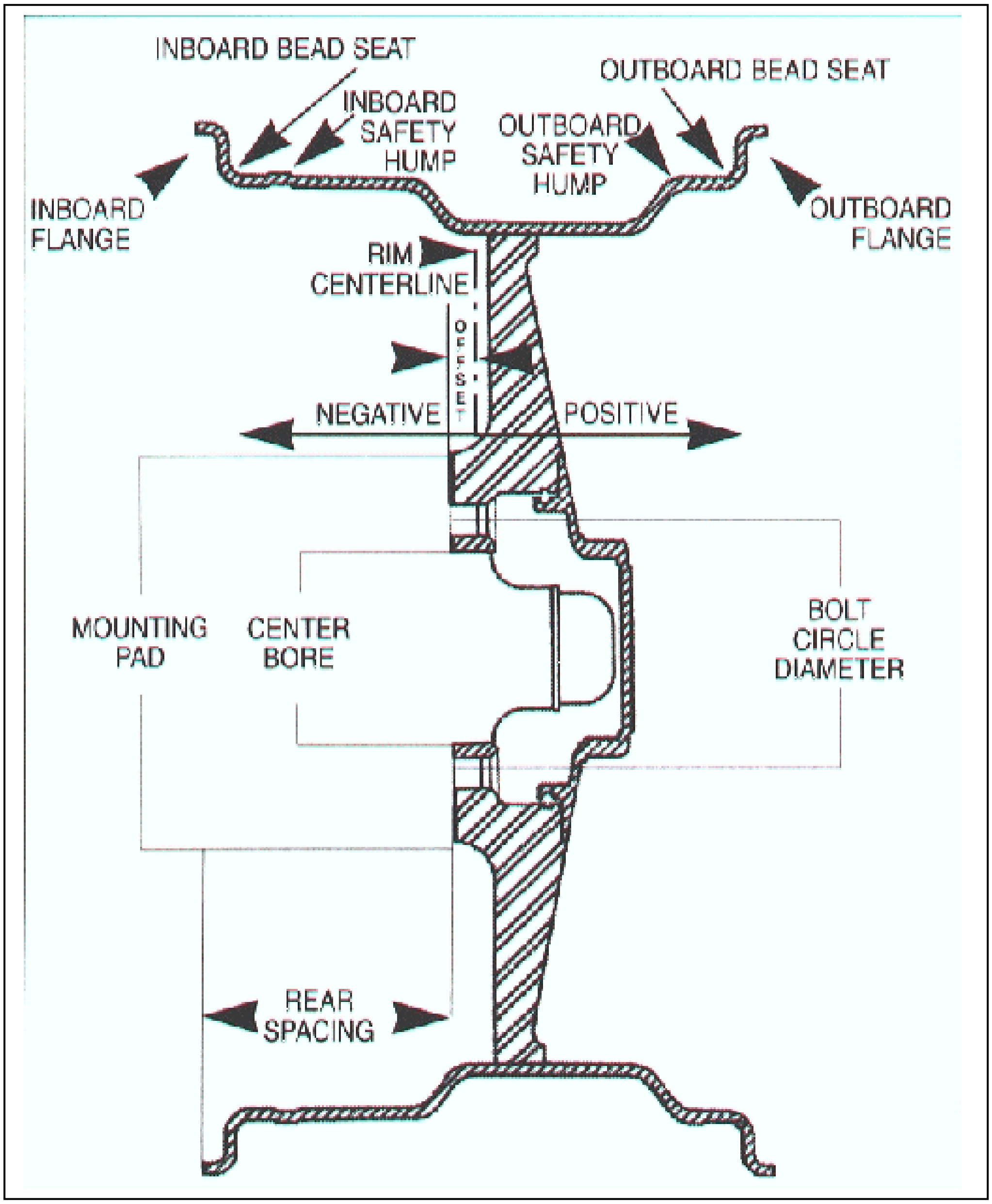
Page 38 of this manual will direct you to various locations by topic. Not all topics are listed. Only the most significant items are referenced. In some cases, the reference will be a photo rather than a written explanation. Use the search feature of the pdf file to search the entire manual for key words, such as “heat” or “indicator” etc.

Exploded view drawings, which identify every component of the machine by part number can be found in the appendix, beginning on page 40. Please use these numbers when ordering parts.

PHOTOGRAPH REFERENCES

Many of the photographs in this manual were taken, using older prototype machines. Although the photos are of actual straightening processes, the equipment and materials used in those photographs may not be the same as those provided with the latest machine. The photos were included to demonstrate patented techniques and to illustrate the incomparable performance capabilities of this machine. As you will see, it is possible to straighten a wheel effectively while the tire is still on the rim. However, for best results, we recommend that the tire be removed before mounting the rim on the machine.

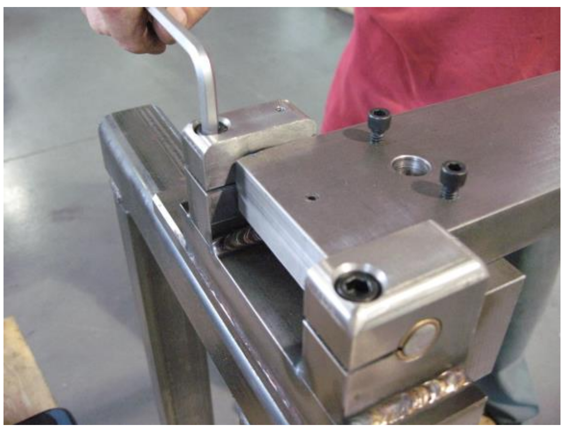
WHEEL TERMINOLOGY

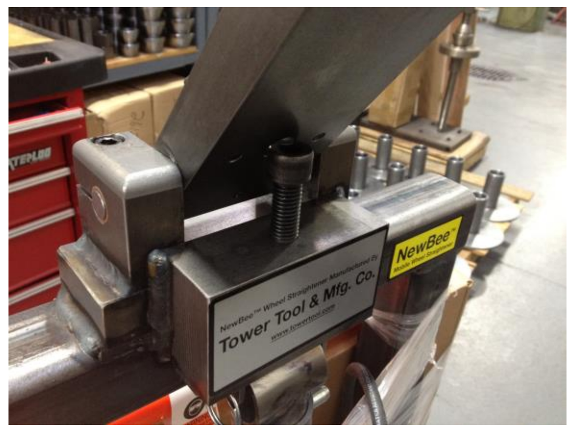


SPECIFIC SAFETY ISSUES

As with any machine tool, there are safety issues that must be addressed. Although safety is important at all times, when straightening a wheel there are specific issues that need to be addressed. The most important safety matters are as follows:

SWINGARM SAFETY BOLT (123)
Since the Swingarm is aluminum on the GenIV machine, the falling hazard has been greatly reduced. But the care and adjustment described here remains the same. On the older steel versions of the machine, as shown in the photos below, the Swingarm is heavy and presents a safety concern. Although the machine is equipped with friction hinges, they may need periodic readjustment. If the hinges are not adjusted properly and the Swingarm is left unsupported when in the upper position, even the aluminum Swingarm could free-fall and cause injury. The Safety Bolt is provided to ensure that the Swingarm cannot fall from the up position. When the Swingarm is raised, simply screw the Safety Bolt in a few turns. Even if the friction hinges are working correctly, the Safety Bolt should be installed whenever the Swingarm is raised.





Adjust the torque of the pinch bolts on the Swingarm hinge to regulate the Swingarm motion. The Swingarm should remain in position when parked at a 45 degree angle. If the Swingarm is opened for a long period of time, it is always a good idea to install the Safety Bolt.

MACHINE MAINSHAFT

When transporting the machine, make sure the Mainshaft is fully secured in the frame. Although the Mainshaft will stand unsupported outside the frame, as shown here, it is not totally stable. It can easily tip over if bumped. Not only could this be hazardous to anyone standing nearby, the journals and threads of the Mainshaft could become damaged. If stored outside the frame, always make sure the Mainshaft is secured.

SAFE OPERATIONS

During straightening procedures, there is always a danger that the straightening setups could become unstable, especially when applying hydraulic pressure. The more pressure the more risk of problems. There are other concerns as well that must be addressed. It is imperative that these concerns be addressed not only for safety reasons, but for success and efficiency in wheel straightening operations. Safety issues include securing, heating, ram alignment, flexing and the use of impact.

SECURING A WHEEL
A wheel must be properly secured on the machine platen to withstand high pressure straightening applications. An improperly mounted wheel will move under pressure and it can be damaged by the straightening processes. Whenever possible, use at least 3 mounting bolts.

The Mainshaft platen contains 6 slots. Five of the slots are 72 degrees apart and will line up with most 5-bolt PCD (pitch circle diameter) wheels. The 6th slot is milled out so that you can mount 4 and 6 bolt pattern wheels with at least two bolts. The two other clearance holes to allow the mounting of Smart Car three lug wheels. It is extremely important that the wheel is centered and fastened securely to the mounting platen. Mounting should be done as follows:

Place the wheel on the Mainshaft Platen and turn it so that the slots line up. If you have a five-lug wheel, all five holes should line up with the slots. Once the wheel has been positioned over the slots, drop in the Mounting Bolts. Make sure the tapered washers are on top. Attach the washers and flanged nuts on the underside of the wheel and just finger tighten them. Now the wheel must be centered, with the appropriate centering cone. But make sure the nose of centering cone does not contact the Mainshaft Platen or a larger cone must be used.

If the centering cone extends too far past the bolting surface of the wheel, it will contact the Mainshaft Platen and interfere with proper centering. The right photo shows that a larger cone will center the wheel properly because it does not protrude through the centerbore.

After making sure the cone has centered the wheel and is "seated" properly in the centerbore, install the Mainshaft Spanner Nut and use the custom open end wrench to tighten it and secure the cone in place. The wheel is now centered and secure. Lastly, tighten the mounting bolts in an opposing pattern, the same way as you would tighten them if the wheel were on a car. The combination of the secured cone and tightened bolts ensures that the wheel will not move during straightening operations. During straightening operations, the mounting bolts can become loose. It is a good practice to check the tightness of the mounting bolts periodically.

Although most of the time the tapered washers are sufficient, some lug holes are bored flat at the bottom. If there is no taper, there is a risk of damaging the lug holes, so a more appropriate flat washer should be used. Also, sometimes longer bolts will be necessary. Therefore, it is a good idea to keep an extra supply of washers and bolts on hand.

> **Hint:** *Replace your mounting bolts periodically and keep the threads of your bolts in good condition. It takes much less time to spin a nut effortlessly on and off when the threads are smooth. If threads become nicked, the nuts will not spin on easily. Threads become nicked if they are tossed into a toolbox or storage bin, where other tools or hard objects are kept.*

WHEN CONES WON'T WORK

The purpose of the centering cone(s) is to take the drudgery out of centering the wheel before fastening it to the mainshaft platen. However, centering cones might not work on some wheels. If the cone does not fit the wheel or it continues to contact the mainshaft platen, there are still some quick alternatives, which are as follows:

1. If only the very tip of the cone is contacting the platen, the wheel can be raised up slightly by using three shims. Just make sure that the shim stock is all the same thickness. Simply place these shims on the mounting platen of the Mainshaft at 120 degrees apart, making sure that they will not interfere with the mounting bolts. With these risers in place, the mounting surface of the wheel will rest on the shims.

2. Use nylon shims between the mounting cone and the centerbore. With this method you will essentially be making the centerbore of the wheel smaller. Place the wheel on the mainshaft platen and center it as close as you can by eye. Next, place the shims at an angle inside the centerbore at 120 degrees apart. Now install the cone so that the shims contact the cone uniformly. The cone will then be able to center the wheel as intended.

3. Make a bushing that resembles a "doughnut". This alternative is only a good choice when you are encountering a large quantity of wheels with the same centerbore. For example, you already know that the OD of the machine mainshaft is 42mm or 1.654". So if you have a lot of wheels with centerbore of 2.750" then the doughnut would have an OD of 2.750 and an ID of 1.654. Aluminum doughnuts are best but they could also be made out of nylon or even hardwood. The advantage of a cone is that you also get some downward pressure on the centerbore as well, which is helpful in keeping the wheel in place during the wheel straightening process. If the doughnut choice is appropriate for you, it is best to secure the mounted wheel with 5 bolts instead of 3.

If none of the above choices will work, there is still a way to center the wheel. An example is when a wheel has a five-inch centerbore that is only about a half inch thick. This design usually necessitates the use of another centering method. The wheel can be centered by using the method a machinist uses to accurately measure the bore of a part. This is done with the use of a Test Indicator to measure the runout of the actual centerbore as the wheel is slowly turned.

Here is what’s called a Test Indicator is set up to check a centerbore. The wheel is slowly spun and tapped into position until the indicator shows the bore is centered.

Before using this method, the mounting bolts should be in place and slightly tightened. This is because, once the wheel is centered, tightening the bolts could move the wheel slightly. If that happens, it will be necessary to indicate the bore again.

If you do not have a Test Indicator, a less accurate method will work nearly as well. Use a pointer of some kind, such as a thick wire. Clamp the pointer on the machine Swingarm so that it is stationary. Then bend the wire to adjust the tip as close as possible to the bore of the wheel without touching it. The pointer should remain stationary as the wheel turns. Use the tip of the pointer as a reference the same as if it were a dial indicator tip without the gauge. As the bore turns the gaps between the centerbore of the wheel and the tip pointer will vary. Keep tapping the wheel to adjust the space until the gap remains constant all the way around. If you do it carefully, you should be able to get the bore centered within a few thousandths.

SAFE STRAIGHTENING PRACTICES

Proper ram setups are of critical importance for safe straightening practices. Correct positioning techniques will prevent a ram from bursting out of a setup. The maximum pressure should aways be at the centermost position of the straightening die. Initial pressure should then be applied very slowly to make sure die does not move out of position.

Positioning pressure should be light enough that the die can be moved slightly if tapped. Once proper position is achieved additional pressure can then be applied. The next section will explain proper setups in more detail.

SAFE RAM CENTERING DURING STAIGHTENING SETUPS

Centering the rams is the single most important factor to consider when positioning them for wheel straightening. First, the centerline on the ram should line up with the imaginary centerline of the Mainshaft. Next, the centerline of the ram should be exactly perpendicular to the surface being straightened, particularly if you are using an angular set-up.

Once the ram(s) are in the desired position, load them very slightly by locking them in place with the pump. Apply only enough pressure to hold the ram(s) in position. The amount of pressure to hold the rams in position should not even register on the gauges and there is no danger of slippage. You can look down the centerlines of the ram(s) to make sure they are properly centered and tap them to make slight adjustments in the setup. But you should ***NEVER look down the centerline of a ram while readable pressure is being applied!***

When you are satisfied with the set-up, swing the wheel sideways slightly so that you are not in front of the pressure. You never want to be in the “line of fire” in the event of a ram setup slipping off the edge of the rim. Do this BEFORE applying additional hydraulic pressure.

ROUGHING ATTACHMENT

This attachment allows the operator to lock the lower rams in the desired setup position without contacting the surface of the wheel. This not only reduces the chance of slippage, it speeds up the process because re-positioning is not necessary.

You can lock the lower ram in the desired position without actually contacting the wheel. Then simply swing it out of the way to heat the damaged area. After heating, you can quickly re-position it and commence straightening. The speed of this re-positioning allows you to take advantage of the malleability of the heated metal.

You can also use it as a reference indicator. While spinning the wheel you can observe the gap between the die and the bend.

PUMP FEEDBACK

The Enerpac P141 is a single a speed hydraulic pump. The advantage of using a single speed is the "feedback" you will feel, when increasing pressure is applied. How the pump "feels" can tell you a great deal. A simultaneous combination of observations and feeling will aid your strategy, during straightening. There are three "sensory feedbacks" during wheel straightening. Two are visual and one involves "feel". These sensory feedbacks come from the following:

1. Observing the pressure readings being displayed on the hydraulic gauge.
2. Observing how the metal is moving (or not moving) in response to the applied pressure.

   Keep a sharp eye on the both the hydraulic gauge and the movement of the metal as you increase pressure.
3. The "feel" of the pump, which is the ***most important*** sensory feedback.

Be mindful of this feedback. As you gain experience, you will begin to understand its importance. It is best that the "feel" be soft or sort of "mushy" as you watch the metal moving. This does not guarantee that the wheel will not crack. It is only a guideline sensation. ***If the "feel" is tight, the pressure is rising and you don't see any noticeable movement in the metal, the likelihood of wheel cracking is greatest.***

FALSE FEEDBACK

If the feedback feels "tight" as described above, it could also mean that the hydraulic ram has reached its stroke limit. When that happens, the pressure will rise but the ram will not extend any further. So make sure that there is additional stroke available if you start feeling tight pressure.

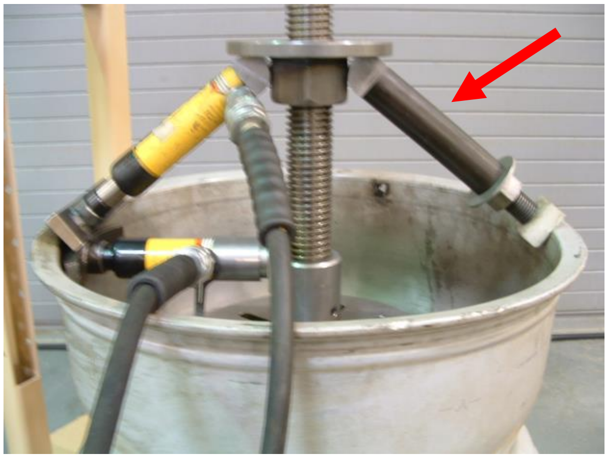
FLEXING CONCERNS

During straightening operations, it is typical for both the wheel and the Machine Mainshaft to flex. Actually, one of the many advantages to this machine is the fact that you can apply both flexible and rigid pushing actions without changing the setup. Although flexing is normal and sometimes even desirable, too much flexing can cause the pressure points to slip.

If that happens, it is possible for the dies or nylon pieces to burst out of position. This is not only dangerous to the operator; the sudden motion could damage the wheel. This is why you must ***never*** keep your face near any pressure point. ***Before*** applying enough hydraulic pressure to register on the gauge, swing the wheel about 90 degrees away from your face and body.

> *Do this even if you are using the Position Holder attachments. You can easily keep a sharp eye on the metal movement from that point and, should such a sudden slippage should occur, you would also be in a safe position.*

When angular straightening pressures exceed 5,000 psi, we recommend that the Mainshaft Pusher Support Attachment be used (red arrow in photo below). This support will not only limit wheel flexing, it provides Mainshaft support as well.



The Mainshaft Support Attachment has the same OD as that of the Enerpac rams, which allows for the attachment of Pusher Spacers and Rockers. It is a simple jackscrew composed of a plain steel tube in which a threaded rod is inserted. The length of the rod and tube can be adjusted by turning the nut. Simply attach a rocker over the end of the support tube and mirror the position of the hydraulic ram on the other side of the Mainshaft.

You can place a piece of wood or nylon (as shown in photo) against the wheel surface for protection, if you so desire. Once positioned, tighten the nut on the threaded rod until the support is locked in place. Since this part is merely for support there is no need to over-tighten. Hand tightening the nut is sufficient. Final positioning of this support should be done before any readable straightening pressure is applied.

The Gen III™ machine is capable of both flexible and rigid pressure applications in the same setup. An example of a setup where flexing is needed can be seen on page 21. Rigid setups are discussed in depth, starting on page 18.

HEATING A WHEEL

When straightening wheels, sometimes very little heat or no heat is necessary. Other than heat to warm the wheel in the winter, it is sometimes possible to avoid heating entirely.

Whenever a decision is made to heat a wheel, do not heat it while the rams are in position. Such heating can damage the ram seals. Pre-position the rams but swing them out of the way or remove them entirely before heating. Once the area is heated properly, reconstruct the setup as quickly as possible to take advantage of the malleability of the heated metal. In regard to heating, there are other issues that need to be considered as well.

Heating with either MAPP gas or Propane is done most of the time. MAPP gas is a blend and burns about 200 degrees hotter than propane. In its primary form MAPP gas is about 3650 degrees F. The size of the torch will affect how fast this temperature is applied to the wheel surface. The bigger the torch the quicker the wheel surface will reach critical temperature. Also, if MAPP is mixed with oxygen, it will reach over 5,000 degrees F, which can rapidly melt aluminum. A wheel can only be damaged if a critical temperature is maintained for too long. The combination of time ***and*** temperature is the secret to avoid damaging a wheel. The higher the temperature applied, the quicker the heat application must be.

> *Some torches can only be used with Propane. Others can be used with either Propane or MAPP gas. Be sure to look carefully when you buy. If you use a torch that does not have a tip suitable for MAPP, it will become damaged.*

When using small portable torches, the temperature displacement is usually not enough to damage a wheel. Since aluminum has such a high rate of thermal conductivity, there is no danger of bringing the wheel up to melting temperature with these torches. There is also little danger of compromising the heat treat level of a wheel.

An oxy-acetylene torch is capable of delivering high heat at a rapid pace. Using such a torch can be risky. If done improperly, it can easily render a wheel so soft it will be worthless. The way a wheel becomes annealed is when too high a temperature is reached and maintained while heating. This is why all heat application should be monitored.

A wheel can be heated to a high temperature ***for a brief period of time*** and still maintain a dependable heat treat level. It should be again stressed that both temperature and ***time at temperature*** are critical. This means that, when you need to heat a wheel to a higher temperature, you must be ready to work quickly in order to take advantage of the heat. The best way to control the heat is to know when you have reached the precise temperature you want for heating the aluminum.

You can best do this by using the standard issue Infrared Thermometer (193). The IR Thermometer will not work well on shiny surfaces, so if you are heating a polished or chrome wheel, it is best to put a piece of black gaffer's tape on the opposite side of the spot you are heating and take the sensor readings from the tape.

> *Another method of monitoring the temperature is through the use of Tempil Sticks, which are basically crayons that melt at a specified temperature. These are widely used in the welding and heat-treating industries and can be purchased at any welding supply store. The stick may be used by making a mark on the surface and heating the material until the mark melts, or stroking the already heated surface until the stick leaves a liquid smear.*

The wheel can be heated to 400 degrees but do not maintain that temperature. As soon as you remove the heat source, the rams should quickly be put in place and straightening pressure should be applied promptly but not hurriedly. If repeated heating is necessary, let the wheel cool to the touch before reheating. Try to minimize damage to the finish of the wheel, especially on the outboard side.

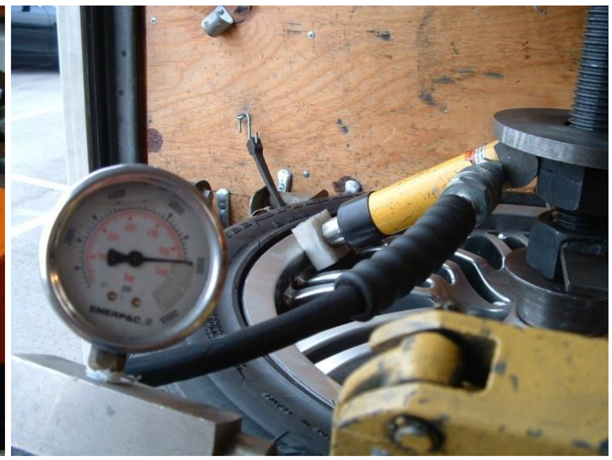
Prolonged temperatures from heating will increase the chances of damaging the tensile strength of a wheel. Avoid cracking the wheel at all costs. If the wheel cracks or all your efforts have failed to straighten the wheel, then the wheel should be taken out of service.

> *Additional research and testing is being done to determine if a cracked wheel can be repaired in methods that will meet SAE standards. Results will be forthcoming.*

HOW MUCH IS TOO MUCH

The hydraulic equipment is limited to 10,000 psi, so it is obvious to never exceed that pressure. However, pressure limit on specific wheel s will vary but the only important factor is safety. The strongest side of the wheel is the outboard side. It is also the side which has the highest metallurgical and microstructural requirements as mandated by the OEMs. Both quality standards and manufacturing methods are strength factors, with forged wheels being strongest.

Since the outboard side is the strongest on any type of wheel, it requires the most pressure to move the metal. **However, keep in mind that the higher the pressure, the more dangerous the situation.** The photos shown below illustrate some testing that took place on two different BMW wheels.



The above two photos show extreme pressure being used on wheels with front bends. When pressure over 5,000psi is used, we recommend the use of the Pusher Support Attachment to support the mainshaft. An excellent view the attachment can be seen on page 11 of this manual.

IMPACT AND OTHER CONSIDERATIONS WITH A WHEEL UNDER PRESSURE

During typical wheel straightening procedures, there are many instances where impact is against a wheel surface is necessary. Whenever you strike a wheel, either directly with a lead hammer or indirectly with the aluminum drift punch (337), always be mindful that the danger of a pressure setup slipping out of position is greater. When you have the spot of the bend under pressure, you can expect different results when you strike the area with impact. The most common type of impact is directly with an appropriate hammer. However, sometimes the nature of the setup might necessitate the hammer be used with some type of drift punch. The most controllable results can be expected **without** impact but with impact, different results can be expected, which are not as easily predicted.

USING IMPACT

Hammers are very effective at moving metal but they can also damage the surface. Even where cosmetic appearance is unimportant, never use a steel hammer. An appropriate impact can be delivered effectively with a lead or babbit hammer. An even “softer” impact can be delivered with a dead blow hammer, which will usually not damage an expensive surface. When choosing impact to cosmetically important areas, the best all-round results will come from using a dead-blow hammer. Drift punches made of softer material can be used with a heavy steel hammer to deliver more precise impacts.

When using drift punches made of impact absorbing material, both “soft” and “hard” hits can be delivered. A “soft” impact is done with a drift made out of nylon or wood. A “hard” impact is done with a drift made out of aluminum or another soft metal. The difference is that the nylon disperses the energy and delivers a blow without leaving any tool marks but is limited in efficiency. A metal drift does not scatter the energy as much and delivers a sharper blow. This is more effective at moving the metal but could leave noticeable tool marks.

Impacts can be delivered laterally to lower a high spot along the rim. Part of the reason you place a hydraulic ram at an angle is to correct lateral runout. Using lateral impact while the bend is under pressure could also produce great success. Radial impacts will aid in bringing the bend back into a circular plane and should be delivered directly toward the centerline of the Mainshaft.

CRACKING A WHEEL

Some wheels crack at 500 psi, while others can withstand well over 6,000 psi. There are many factors that must be considered in addition to the size and nature of the bend. These factors include such information as manufacturer, manufacturing method, alloy content, heat treatment, hardness, tensile strength and other coding information recorded on the wheel itself. A well-marked wheel usually indicates high quality and you can be more confident about your strategy.

No matter how careful you are, some wheels will crack during straightening. Our patented multi-axis process has been proven to be the best method possible to circumvent the likelihood of cracking. So, if you are using our process carefully and the wheel cracks, you can rest assured that the reason was the result of the driver hitting the pothole and not your skill as a professional technician. It’s a good idea that a customer be made aware of these facts beforehand.

As of April 2016, all cracked wheels must be taken out of service. Additional research is planned to test various methods of repairing some cracked wheels. The results of that research will be submitted to the SAE and will then be made available to the public as soon as possible.

INBOARD BENDS

These are the most common types of bends and are usually the easiest to repair. After the wheel has been properly mounted, tip the Mainshaft out of the base and remove the bottom module. Place the module on the other end of the Mainshaft and then stand the assembly back upright in the base. The centering guides in the base will automatically return the module in its proper position. Next, lower the swingarm over the Mainshaft and place the bronze bushing through the swingarm bearing and over the end of the Mainshaft. Install the swingarm safety bolt.

On minor rear bends, you might only need a single axis setup and can you can even try cold bending to start to get a “feel” of the bend. After the setup is complete, begin applying pressure as previously described. Keep a close eye on the movement of the metal and the hydraulic gauge. Also remember to be mindful of the “feel” of the pump. More severe rear bends might require a two axis setup. For a detailed explanation of this method along with some photos of an actual repair sequence refer to page 23 of this manual.

OUTBOARD BENDS

Outboard bends are the most difficult and severe bends to the outboard flanges usually cannot be repaired properly. Bent wheels ordinarily never become an issue until there is either a vibration while driving or the bend is cosmetically annoying. Minor inboard bends frequently go unnoticed and ***will likely crack*** with continued use.

Outboard bend are much more visible. Even the smallest bend is noticeable to some car owners. They are unsightly and are particularly bothersome to owners of upscale vehicles.

One of the great features of the Gen III™ machine is the ability to do quick and easy outboard straightening on minor bends. If done carefully and with nylon support pieces, you can accomplish the job without leaving a toolmark. Simply select an angle setup that will insure clearance over the spokes. It is imperative that care and precision be used when setting up the angle. Also take extreme measures to make sure that the ram is centered over the bend and that it is not contacting any part of the wheel surface. Only the nylon should contact the surface. As you begin pressure, watch the metal move. Straighten it slowly and work progressively. Release and reapply pressure carefully, moving back and forth along the bend. If you are not using the Position Holder attachments, make sure to hold the ram so it cannot fall and scratch the surface of the wheel when you release the pressure.

The outboard side of the wheel is the strongest and straightening bends in these areas usually require a great deal of experience. Since severe outboard bends are the most likely to crack, there is little chance of success of avoiding some cosmetic damage since such bends can involve heavy heat, high pressure, and heavy impact. There are many variables and it takes some resourceful techniques to accomplish a successful straightening on outboard bends.

MULTIPLE AND COMPLEX BENDS

Some wheels are bent in many spots, both front and rear. Even a wheel that is bent in only one spot has three locations that require attention. For every high spot, there are two low spots. Where a wheel is bent in many locations, it can become a nightmare to deal with. It is both difficult to measure and difficult to determine a strategy. It is frequently a trial and error scenario at first until you can get a handle on how the wheel is responding to treatment.

Wheels with multiple bends might require multiple axis straightening procedures as well. It might be necessary to use two ***or more*** rams, which is possible with our machine *(page 22 of this manual shows multi-ram setup examples)*. Experience dictates a great deal when it comes time to make a decision on what methods to use.

LATERAL BENDS

Another difficult straightening is when you are faced with a wheel that is bent laterally (somewhere across the center). This can clearly be seen as a back-and-forth "wobble" when the wheel is spun. The origins of these types of bends are difficult to determine. It is not difficult to measure ***how much*** the wheel is bent but it can be impossible to determine exactly ***where*** it is bent. If this is the case, you just need to find the high spot of the wobble and try to examine it further. An important rule to use for this examination is the ***180 degree rule***.

180 DEGREE RULE

Spin the wheel and mark the locations of both the highest lateral movement and the lowest lateral movement. If they are 180 degrees opposite each other, the assumption is that the lateral runout can be fixed. On page 21, an example of how such a bend was straightened on one of the original prototype machines. The photo shows the machine laid on its back and two rams set up 180 degrees apart, each on the high spots. It will usually take very little pressure to remove the lateral runout if the bend meets the straightening criteria of the 180 degree rule. If your examination shows marks are substantially less than 180 degrees apart, the assumption of the rule says that a spoke is probably bent and the wheel should not be repaired.

INDICATING A WHEEL

Clamp the dial indicator to a stationary and solid surface. The most common surface is under the frame Swingarm. Position the indicator plunger tip against the surface of the wheel directly in the bead seat. Readings can also be taken on the inside of the wheel, directly opposite the beadseat. These readings can also be done without having to remove the tire. Just remember that the readings will be the same but the rotation of the dial needle will be opposite. For this example, the indicator readings will be taken from the inside of the wheel.

First, make sure that about 1/8th" of the plunger is always sticking out of the top of the gauge. This assures you that the plunger tip will remain in contact with the wheel during all 360 degrees of rotation. Next, slowly spin the wheel and watch the indicator dial needle. It will spin both clockwise and counter-clockwise.

As the dial spins clockwise, you will notice that the plunger is moving inward and as the dial spins counter-clockwise, the plunger moves outward. No matter how many times the needle changes directions, there is a point where the needle will move to the most counter-clockwise position. That represents the farthest point from the exact center of the wheel. That point should be marked on the wheel as ZERO. With the plunger tip of the indicator aligned with the zero mark on the wheel, move the indicator dial so that the zero on the indicator is aligned with the dial needle. That is the lowest part of the bend.

From that point, all indicator movements will now be inward or clockwise. The needle should never drop below the zero you have found. Now again slowly spin the wheel, read the dial. As the needle moves clockwise, it will record the highest spots of the bend. If the needle changes direction, mark the spot that was the highest. That is the point at which you will be applying pressure. Some wheels are bent in many spots, but the clockwise-most travel of the needle represents the TIR (Total Indicated Runout).

After each pressure application, the metal will move and the dimension of the bend will change. It is therefore usually necessary to repeat this indicator exercise again to determine find the ZERO or lowest part of the bend again.

Wheels with multiple bends are more difficult to get round and can be an indicating nightmare. It is always a valiant goal to get a wheel to less than .020". However, sometimes you will be lucky to get under .040".

REMEMBER THE 180 DEGREE RULE
Always be mindful of the 180 degree rule when incorporating an angular axis of pressure in your straightening process. Sometime it will seem as though you are "chasing" a bend, which appears to be changing locations. The problem might be a slight lateral movement of the wheel. The reason for this is that some of your straightening pressure has come from the angled axis, which caused the wheel to move both outward and downward. This could impart a slight lateral movement to the wheel. If you seem to be "chasing" a bend, always take a lateral reading with the indicator. Mark both the highest and lowest spots on the wheel. If the highest lateral spot is roughly 180 degrees from the lowest spot, then set your Ram on a steep angle over the high spot and use some light pressure to push the wheel down.

> Example*: Your straightening was going fine and the indicator readings were improving steadily. However, when you got to around .040", the bend began to change locations. You take a* ***lateral*** *reading and learn the there is a .035"* ***lateral*** *movement and the high spot is exactly 180 degrees from the low spot. You use a single axis setup at a high angle and apply only about 1000 lbs of downward pressure at the high spot. When you take another* ***radial*** *reading, you will find an improvement.*

A steep angle single axis setup enables the operator to exert both downward and outward pressure to correct lateral movement. Very little pressure is needed to correct slight lateral runout. To see how the machine can be used to correct a severe lateral bend, refer to page 21 of this manual.

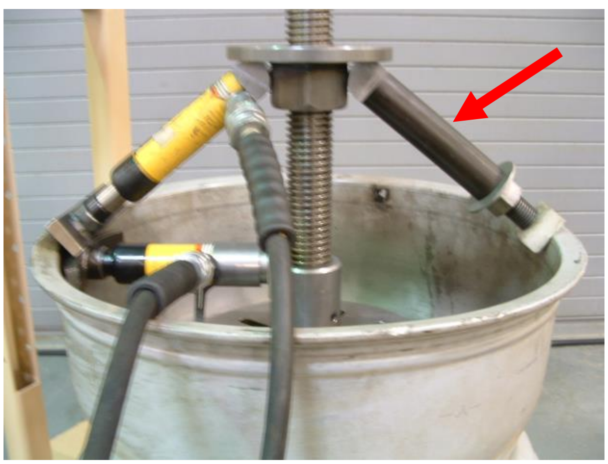
HOW TO TELL WHEN YOU ARE PROBABLY FINISHED
There are many factors which limit your ability to return a wheel to an optimal condition. Factors such the severity of the bend, the number of bends, the age of the bend (s), and the quality of the wheel. The best way to tell when you are finished is to record your measurements. When you keep trying to improve the wheel but get to a point when additional efforts simply make it worse, it is time to take a "step backward" and get the wheel as round as you once had it. Even though the wheel is still bent a little, if it can be balanced, the assembly will be much safer that if it were driven on with the original, more severe bend and the likelihood of the wheel cracking has been drastically reduced. Unless you are doing something else wrong, this choice is your only alternative.

STRAIGHTENING SETUPS

OUTBOARD RAM SETUPS
Bends on the front or outboard side of the wheel can be the most difficult to repair. Setting the ram(s) at an angle is particularly important on outboard bends. With the adjustable pusher platen you can choose a steep angle or a more suitable position from which to apply straightening pressure. The photos below illustrate some common setups.

A steep angle is shown over the spokes on an outboard setup. Either a die or a piece of nylon (as shown) can be used against the bent surface. Type and severity of the bend and operator experience will influence setup choices.

Although it is most likely that only one ram can be used at a time on outboard bends, some wheel designs allow for the use of two. Here the upper ram is set on a high angle and anchored against the Pusher Platen, while the while the lower ram is set up in a lower angle against the wheel. The ram is anchored against the edge of the centering cone with a piece of nylon. It is necessary to be resourceful when choosing a setup combination.



Steep angle setups likely result in more Mainshaft flexing. Also, when a high amount of hydraulic pressure is required more flexing will be evident and a more rigid setup might be required. In such cases, use the Mainshaft Support Attachment, as shown here, is being used on an inboard bend.

There are different methods of setting up a dial indicator for recording runout on a wheel. Test Indicators, as seen on page 8, can be used to access all types of difficult to reach surfaces. However, they are costly and are intended to record measurements at a level of accuracy not needed for straightening applications.

A generic indicator set up on an angle to measure radial runout is sufficient. Shown here is an example of measuring the inside edge on the outboard side of a wheel over very high spokes.

INBOARD RAM SETUPS

The most common bends will happen on the rear or inboard side of the wheel. These are also the easiest to repair. The operator has more control because more setup variations are possible. Most of the time more than one ram can be used, which generate the best results. Experimentation and resourcefulness are important. Some setup variations are shown here.

Here a single ram is setup at an angle against the upper part of the wheel weight flange. The rocker (39) is used over the end of the ram as it is secured against the pusher platen (111). Note that a piece of nylon is used at the business end of the ram. When nylon is used in place of a die, the pressure can be focused just as precisely and the surface of the wheel is better protected.

Here a single ram is setup at a low angle inside the barrel of the wheel. The nylon placed against the Mainshaft threads is mainly to protect both the end of the ram and the Mainshaft itself. Nylon is an excellent source for surface protection.

Sometimes, because of the design of the wheel, it is necessary to keep a slight angle on the ram to prevent it from popping out when using nylon. Here a low setup is shown on a wheel that is built with a more profound outward angle under the inboard flange.

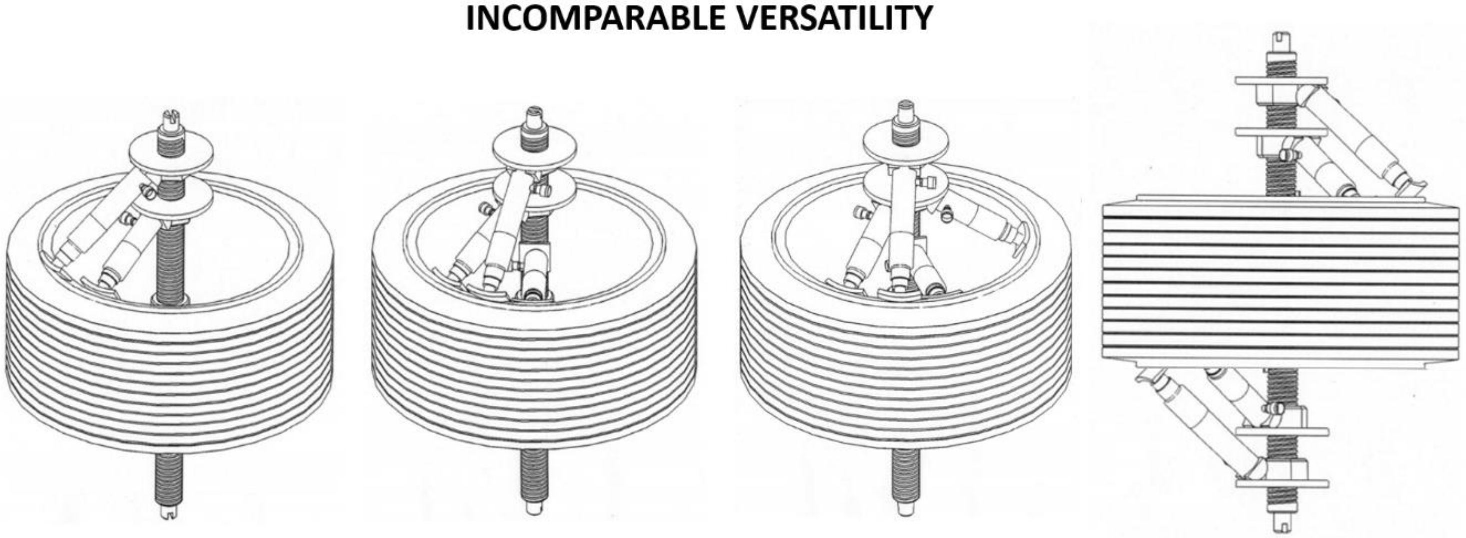
FLEXIBLE SETUPS ON LATERAL BENDS

With this machine, it is possible to straighten wheels that have a lateral wobble. This indicates that the bend is somewhere through the center of the wheel. The only way a later bend can be straightened is if it meets the conditions of the 180 degree rule. Refer to page 15 of this manual for a detailed explanation of the 180 degree rule. For all lateral runouts that qualify for straightening, a flexible setup is important.

Here two rams are setup on a severe lateral bend that was qualified, using the 180 degree rule. Each ram was set on the high spot on opposite sides of the wheel. Pressure from this setup applies a twist to the center. Lateral runout must be measured and marked before constructing this setup.

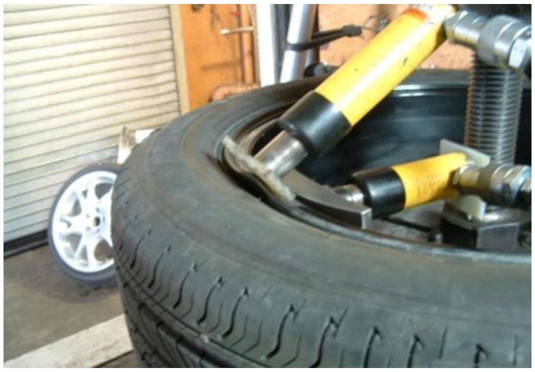
It is best to start this procedure slowly and frequent checks will be necessary to monitor progress. This setup can be done with the machine either in its normal vertical position or in a horizontal plane, as shown here, using an old prototype.

INCOMPARABLE VERSATILITY



With our patented process, it is possible to create multiple ram setups at varying angles and in separate planes. The setup on the far right shows a unique lateral straightening creation. Needless to say, setups such as these would be very time consuming but these concept drawings depict the incomparable versatility of this machine.

MULTI AXIS PROCEDURES
The best results on the more severe bends are achieved with the simultaneous use of two (or more) rams. This technique spreads the straightening forces and reduces the strain on the metal in each location. This patented procedure is indisputably the best way to avoid cracking.



Gradual and alternating pressure applications generate the best results. But always be aware of the following:

- Keep a close watch on the movement of the metal.
- Monitor the hydraulic gauges carefully.
- Be cognizant of pump "feedback".
- Remember the safety issues concerning high pressure.

When using two rams on the same bend, it is possible for the lower or inner ram to hold pressure on the barrel, while pressure on the upper ram is released. This enables the upper ram to be moved back and forth over the outermost area of the bend.

This method of "staggering" the two rams, as shown here, produces a very effective "massage", which yields the lowest crack rate possible.

When a wheel is bent in more than one spot, both areas can be pressed at once. Two (or more) rams can be setup at any angle on the wheel as long as the end is centered on the Mainshaft. Here an opposed setup is used on a wheel that had become "egg shaped". Setups with additional rams are even possible.

ACTUAL REPAIR SEQUENCE

The following series of photos are of a repair on a BMW wheel, which had a severe inboard bend. The rear bead had a raised wheel weight flange, which had to be both pushed out and pushed down. Without the simultaneous use of two rams, this wheel would most likely have cracked. The sequence is as follows:

The inboard side of the wheel, showing the bend site. An approximate bend deflection was determined to be over ½". The inboard bead on the tire was then broken to enable maximum heating without having to remove the tire entirely.

This shot shows how 2 rams were set up on the bend. Instead of using regular dies, both rams were used with small pieces of nylon as pusher dies. After adjusting the ram positions to fit, they were both removed and the area was heated with Mapp Gas and the heat was monitored with a IR Thermometer.

After heating the area for about 2 minutes, the pre-set rams were quickly repositioned in the exact same spots on the wheel. First, the ram in the barrel was loaded to about 2,000 lbs of pressure. The upper ram was then loaded to about 2,000 lbs. This dropped the pressure of the inner ram to well under than 2,000 lbs. The inner ram pressure was then pumped up to 3,000 lbs.

Pressure on the upper ram was next increased to about 3,000 lbs. This dropped the pressure on the inner ram back to about 2,000 lbs. Alternating pressure was added until both rams were reading 3,000 lbs. A progress check was done as the upper ram was slowly removed and the bent area was inspected. When pressure was released from the upper ram, pressure on the inner ram increased to 4,000 lbs. The bend was inspected and appeared OK for additional pressure.

The upper ram was “staggered” to a different plane in the setup and then gradually pumped back up to 3,000 lbs. This dropped the pressure on the inner ram back to about 3,000 lbs. Pressure was alternately and carefully increased while the bent area was observed closely.

This back-and-forth “massaging” process continued until the physical appearance of the bead was blended nicely with the rest of the wheel. We then began indicator readings.

After the bead looked symmetrical, both rams were removed and the dial indicator was mounted. After a runout measurement was taken, a single ram was then setup in the barrel of the wheel with a piece of nylon to complete the final touches. This setup was chosen so as to apply the most focused pressure on the bend to achieve the final roundness desired.

A shot of the wheel, after straightening. The final runout was less than .030” and the total time for the repair was around 20 minutes. It can now be returned to service without the fear of cracking. The fatigue life has been restored to a level equal to an unbent wheel.

WHAT YOUR CUSTOMER SHOULD KNOW ABOUT STRAIGHTENING
Basically, if a wheel is worth keeping then it should be fixed. Customers should be made aware that if even a slightly bent wheel is left unrepaired, it will likely crack. The latest scientific testing has shown that wheel straightening will not only prevent a bent wheel from cracking, it will restore the fatigue life of the metal to a level equal to an unbent wheel.

They should also be informed of the inferior quality of the off-brand replica wheels. A quality factory wheel, which has been straightened, is still much stronger and safer than any of the junk "knock-offs" or aftermarket wheels that are on the market. And if your customer's wheel is in fact a replica, it will most likely crack and is probably not worth straightening.

However, in some cases, you might not have a choice. Typically, a customer will bring you a cheap wheel to fix because they can no longer get a replacement. Their only choice is to buy an entire set, which is obviously cost prohibitive to them. If that is the case, then you should take on the repair only with the understanding that the wheel is very likely damaged to the point where a crack is unavoidable and if a crack "opens up", the wheel should be deemed unrepairable. Further SAE testing is underway to determine if ***some*** cracked wheel can be safely repaired. Until the results of that testing is completed, any cracked wheel should immediately be taken out of service.

The more expensive wheels are not only stronger; they are much easier to straighten. They respond better to both cold and warm bending. The manufacturing process, the superiority of the alloy and other factors all contribute to superiority of high-priced wheels. Customers should take comfort in the fact that you are employing not only a patented and SAE approved method, but the best wheel straightening technology available.

Keep in mind that a .040" movement on a dial indicator looks like a lot. In reality it is less than $1/16^{th}$ of an inch, which is .0625". Your customers should be aware that .030" is about the thickness of a standard business card. Let them know that the acceptable standard for a brand new wheel is .008"and that a random runout check of a wheel on a typical car would probably be between .010" and .020". Also mention that acceptable runout from wheelmaker Alcoa Aluminum is .030" So when you tell them that your goal is to get the wheel under .020", they will better appreciate your service to them.

STEEL WHEELS
Straightening steel wheels is actually easier than aluminum alloy wheels because the steel responds so much better to straightening. It is also much less likely to crack. If you are not sure if a wheel is steel, use a magnet to test it.

INSPECTION & MAINTENANCE

This section of the manual deals with inspection and maintenance of your Gen III™ machine and related components. Not only is it essential to keep this equipment in good working order, it is important that you do periodic evaluations of everything. Inspect all moving parts for wear and replace, if necessary. To order replacement parts, please refer to the appendix of this manual for part names and numbers.

INITIAL INSPECTION

Before you begin to use the machine for the first time, it is advisable to do your own inspection of the machine itself and of all the parts to make sure they have not been broken or damaged during shipment.

MACHINED SURFACES

Keep the metal surfaces clean and wiped off occasionally with a non-silicone rust preventative. The silicone free choice we recommend is Boeshield T-9, especially for the machined surfaces of the NewBee™. It is both a rust preventative and a lubricant. So it can not only be used to protect the frame of your machine, it can be used to lubricate the Timken bearing as well. You can learn more about Boeshield products at www.boeshield.com.

Boeshield T-9 was developed by The Boeing Company for protecting and lubricating precision tools, ***bearings*** and steel aircraft components. The spray-on version is easy to apply and dries to a thin waxy film that clings to the metal for weeks.

It will loosen rusty and corroded parts, will lubricate the bearings and other moving parts, and will not harm the nylon components. Monthly applications of this product will keep you machine in sound condition.

INSPECTION AND CARE OF BEARINGS
The bearing in the Swingarm is sealed and can only be replaced if it becomes worn. For replacement identification of the bearing, please refer to machine parts list in the appendix.

TIMKEN BEARING
The thrust bearing used in the lower module of the NewBee™ machine is a Timken tapered roller bearing, which is extremely strong and durable. It should rarely need to be replaced. Occasional cleaning and lubrication of the bearing is all that is necessary. Periodically, it could become dirty and lubricating the bearing surfaces should only be done if they are clean. The bearing can best be cleaned with mineral spirits and compressed air. Use Boeshield or oil that is appropriate for lubricating bearing surfaces on precision machinery.

If it becomes necessary to clean or replace the Timken tapered roller bearing assembly in the Mainshaft lower module (325), the nylon support bushing (327) can be removed by loosening the cone point set screws (228) and sliding the bushing out. Since part of the job of the support bushing is to contain the bearing, the cone part of the Timken bearing will now fall out when the lower module is turned upside down. The components can now be properly cleaned.

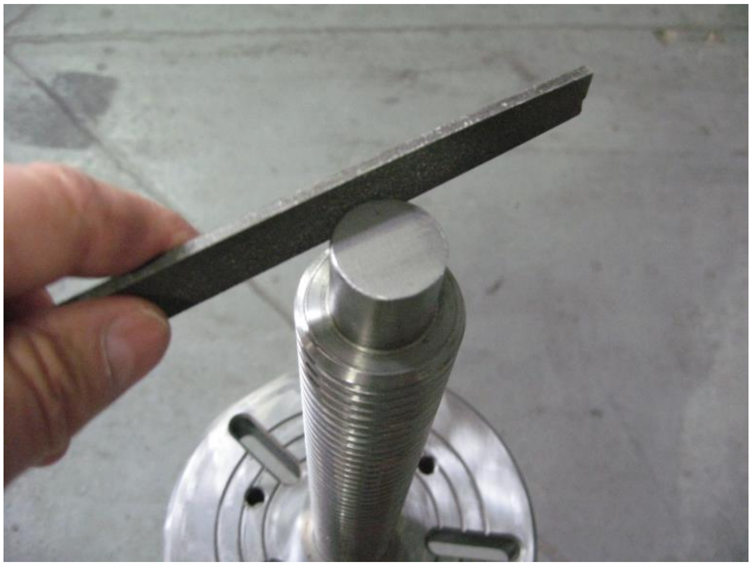
If replacement is necessary, the remaining contents of the module can be pressed out from the bottom. Use a socket or other pushing device that is slightly smaller than the access hole in the bottom of the module. Both the bearing cup (77) and cone (4) should be replaced. The Timken part number for the cone is 1780 and for the cup is 1729.

The photo on the left is a view from the underside of the lower Module (325). You can see the edge of the support bushing the Timken bearing cup sits on. The photo on the right shows the entire assembly as it goes together.

The white nylon tube at the top of the photograph is the nylon support bushing, also referred to as the containment bushing (327). That is the final piece of the assembly and it is held in place by cone point set screws (not shown). As the lower module is repeatedly removed and replaced, the containment bushing protects the threads of the mainshaft. In addition it keeps the Timken bearing cone the proper place.

CARE OF MAINSHAFT JOURNALS

Each end of the machine mainshaft runs inside bearing surfaces. The sliding fit between the bearing and the shaft end is precise and can be affected by burrs or dents to the ends of the mainshaft. When the end of the mainshaft becomes damaged, it can "hang up" in the bearings. This is particularly troublesome in regard to the Timken bearing. If the mainshaft end sticks in the Timken bearing as it is being removed, the bearing will strike the underside of the nylon containment bushing. If the bushing becomes damaged, it could raise up. If the bushing rises up too much, the Timken bearing can become dislodged and could actually turn over. If that happens, serious damage can be done to the Timken bearing cone, rendering your machine inoperable. To prevent this costly and time consuming problem from happening, make sure the mainshaft goes in and out of the bearings smoothly.



Regularly inspect the mainshaft journals. If they become dented or otherwise damaged, repair them immediately.

Light passes over the more heavily damaged spots with a file or hone might be necessary.

Sanding with aluminum oxide paper or crocus cloth can also be effective. Sometimes the use of lapping compound might even be necessary.

Whatever method you use, just make sure the journals will slide smoothly in and out of the Timken bearing.

CARE OF MAINSHAFT THREADS

When the ends of the mainshaft are turned down, the lead thread on each end of the mainshaft becomes very thin. Consequently it can become bent and is easily damaged. This is not serious but it becomes irritating if the mainshaft nut "jams" on the thread or does not go on smoothly. If this happens on your shaft, simply reduce the size of the lead thread. File down the thinnest part so that it cannot get caught inside the nut.

The photo on the left shows the lead thread on the end of the mainshaft, which can become very thin. If this thread becomes damaged it can cause the nut to snag on your shaft. The easiest way to take care of this problem simply to reduce the size of the lead thread by filing down the thinnest part so that it cannot get caught inside the nut.

CARE OF CENTERING CONES

The inside diameter edges of the cones can become damaged or dented. If this happens they will not slide smoothly up and down the mainshaft. Care should always be taken when handling cones and if the lips become damaged they should be repaired immediately.

If the inside edges of the cones become damaged, the easiest way to repair them is to use a rat-tail or half-round file. Simply take very light passes with the file to flatten out the dents. Use a fine grade of file. Never use a coarse file to do these types of repairs.

CARE OF PUSHER SPACERS

Pusher spacers are used on the ends of the Enerpac rams and are designed to be stackable. They should go together and come apart smoothly. If the edges of the stacking surfaces are damaged, they could get wedged together and could even get lodged on the ends of the rams. Damage to the edges of the spacers is most common when the spacer is forced directly against the threads of the mainshaft. This problem is not serious but should be repaired.

If the edges of the stacking surfaces become damaged, simply remove the damage with a fine flat file until the spacers stack smoothly and fit properly on the Enerpac rams.

CARE OF MOUNTING COMPONENTS

The wheel mounting bolts and flange nuts are ½"-13 pitch Grade 8. Abnormal wear will result from the frequency with which the nuts are removed and replaced. So keep extras and replace them frequently. If the threads of the mounting bolts become prematurely damaged, they will not allow the nuts to spin on easily. If this happens and replacements are not readily available, they can be repaired by "chasing" the threads with a standard ½-13 thread die.

.

When mounting and dismounting wheels, it is a time saver if the nuts turn freely. If the nuts "hang up" on the bolts it is because the threads have become damaged in some way and they do not ride smoothly inside the nuts. Tossing the bolts among other steel parts or tools can easily damage the threads. Cure this problem using a ½"-13 die as a "chaser" over the threads will temporarily restore them to a smooth condition but you should still replace them as soon as possible.

CARE OF DIAL INDICATOR COMPONENTS
The dial indicator is a precision instrument. If has jeweled movements and is somewhat fragile. It should be handled carefully and stored in a secure location. No maintenance is required other than a few drops of light oil occasionally on the plunging stem. Before clamping the flex-arm in a desired position, make sure it adjusted correctly to insure accurate and rigid positioning. Be mindful of the indicator. Make sure it does not come loose when using impact on the wheel. It is also very important to make sure the tip of the indicator is not in contact with the wheel when impact is being used or damage to the indicator movement could result.

Here the indicator has been clamped to the swing arm. It can also be clamped to other areas of the frame if desired.

You can use any statically mounted device as a "pointer". By placing it near the rotating surface of the wheel, the tip can be used as "roughing" indicator. These rough readings are adequate to get the wheel close. Then the final readings can be "tweaked" with the dial indicator.

CARE OF HYDRAULIC COMPONENTS
If you experience retraction or lock-up problems with Enerpac rams, there are a couple of things to check. Ordinarily, when a ram is jacked out, turning the valve on the pump should release the hydraulic pressure. The oil in the tube is then forced back into the pump by the return spring inside the ram. However, this only works this way if the equipment is set up and used properly.

PROPERLY FASTENING THE QUICK-CONNECTIONS
Inside every Enerpac ram, a spring-loaded **one-way** valve keeps the oil from leaking out. When the hose is coupled properly to the ram, a detent pin inside the hose coupler pushes the spring-loaded valve open. Now the passageway between the ram and the pump becomes **two-way**. With the valve held off its seat, the oil in the ram is allowed to return to the pump.
Whether you are connecting the ram to the pump for the first time or whether you are changing rams, the connection procedure used should be the same. The ultimate goal is to make sure the one-way valve in the ram is pressed into the fully open position and held that way.

First, place the ram on the ground with the connector facing up. While holding the ram still, carefully insert the detent pin into the bore above the ram's valve housing, making sure it actually contacts the one-way valve. Now, using your body weight, push the detent pin in the hose connector into the valve bore in the ram connector. As you do this, you will feel the spring-loaded valve open. When the mating surfaces of each quick-connector come in contact with each other, you will feel the downward motion stop. At this point the ram's valve will be fully open. Now simply spin the knurled nut from the ram onto the hose until it is finger tight. The quick-connect is now secure and there is no need to tighten the connection any further.

The left photo shows the detent pin on the hose male coupler being positioned over the bore of the ram's female coupler. On the right the detent is being pushed into the bore. As downward pressure is applied, the one-way valve inside the ram will begin opening

Downward pressure should be continued until the mating surfaces of each coupler meet. At that point, the one-way valve in the ram will be fully open. While holding the coupling fully closed, as shown on the lower right, the knurled nut on the ram can be spun onto the hose quick-connect.

Keep downward pressure on the coupling as you spin the knurled nut upward. A proper coupling is when the knurled nut is flush against the hex edges, as shown by the red arrow. Although there is no need to tighten further, it is advisable to occasionally check the security of the connection. If you should start to feel "slop" when you push down on the connection, simply hold the coupling together and re-tighten the knurled nut. Finger tightening is all that is necessary to secure the connection. Never use tools.

BLEEDING THE SYSTEM
After the ram and pump are connected for the first time, it is necessary to bleed the air out of the system. Hydraulic oil must be pumped into the rams so that the air can be removed. The bleeding process is done in as follows.

Place the pump on a table and leave the ram on the floor. Whatever arrangement you use, just make sure that the pump is ***above*** the ram. This is to insure that any air in the system will rise to the highest point. Now, simply operate the pump until the ram moves out. Once the ram is all the way out to its limit, release the valve on the pump. The internal spring on the ram should allow the oil inside to release into the system and back to the pump. Repeat this procedure a few times until the sound of air in the system can no longer be heard.

RAM "LOCK-UP" AND HOW THE PROBLEM OCCURS
The most common reason for ram "lock up" is that the male/female connection between the hose and the ram is not tightened all the way. This allows the oil return valve to close. In order for the ram's check valve to remain open, the hose connection must stay secure. Periodically, the threads on the quick-connect must be spot-checked for tightness. This quick-connect is designed to be finger-tightened only. It should never be over-tightened. However, during normal use, this connection sometimes begins to back off slightly. If the connection becomes too loose, the two-way passage is lost and the ram will be hydraulically locked.

It is very important to note here that, even with a loose connection trapping the oil in the ram, it is still possible for additional oil to go ***from*** the pump ***to*** the ram. This is what seems to be causing some confusion. As the pump is operated, the ram can be seen working and all seems fine. However, the ram will not release because of the previously described loosened quick-connect situation. It is a good idea to periodically check the connection.

ANOTHER POSSIBLE CAUSE OF RAM RETURN FAILURE
When the valve on the Enerpac pumps is released, pressure from the return spring in the rams cause them to retract. When the valve on the pump is released (and, if the check-valve in the ram is operating properly) the return spring action inside the ram pulls the oil in the ram back to the pump. If the return spring inside the ram is broken, the ram will not return properly. Even if the valve inside the ram is operating properly, there can be no retracting pressure without assistance from the spring. But even if the spring is broken, the ram will not "lock up", as long as the hose is coupled properly.

If the spring is indeed broken, the ram can still be used. All you have to do is manually push the ram to the fully retracted position. Essentially, you are accomplishing the job of the return spring. This might not be convenient but it is an effective solution until the ram spring can be repaired. Enerpac hydraulic tools are quality products and, unlike the cheaper versions, all components can be repaired and rebuilt. Check Enerpac's website for additional information on distributors and service centers near you.

The only other thing that could cause ram return failure is over-filling the oil level in the pump. The reservoir on the pump enables you to monitor the oil level. It is possible to disconnect the hose from a ram while it is in the extended position and sometimes it can even be necessary to do that to hold a position.

> *As the hose is removed, the aforementioned valve in the coupler closes, trapping the oil in the ram.*

But if you should do this, keep in mind that you will get a false reading on the oil level in the pump. Then, if you top off the oil according to specs, the oil remaining in the ram will not fit into the pump chamber.

NYLON SUPPORT BUSHING

No care is needed for the nylon support bushing. It is made out of natural nylon stock and is extremely durable. After machining, the bushing is pressed into the lower module of the machine and is held in place by cone point set screws. Since it also secures the Timken bearing cone, it should not be allowed to rise up for any reason. The bushing should always remain bottomed out in the module.

The nylon bushing serves two functions. It protects the mainshaft threads when removing and replacing the lower module. It also keeps the Timken bearing cone in proper position. If the bushing starts to rise up out of the lower module, the bearing cone could become dislodged. If you notice that the bushing is not bottomed out, reposition it properly and retighten the set screws.

LIMITED WARRANTY

NORMAL USE
Normal use of this Gen III™ Machine, as directed in the manual requires safety procedures. If these procedures are followed, no damage will occur to the Gen III™ Machine, any person, any vehicle or any structure. Also no damage should occur to any surface of a wheel other than that area upon which the operator is working.

ACCURACY
The Gen III™ Machine, as delivered, is guaranteed accurate enough to straighten wheels to a serviceable condition. We guarantee that the lateral and radial accuracy of Gen III™ Machine Mainshaft upon delivery will be ±.005 inches. Normal use of the Gen III™ Machine should not change that accuracy. Improper use of the Gen III™ Machine can damage the Mainshaft to the point it will no longer be accurate.

PARTS REPLACEMENT AND REPAIR
Parts broken as a result of normal use will be replaced or repaired free of charge for 1 year. This does not include nylon components. Parts replacement and warranty applies to Gen III™ Machine only. Warranty includes all parts manufactured by NewArc Tech but no purchased parts, such as Enerpac components, inspection or marking equipment. For warranty coverage on auxiliary components, see individual manufacturer. Owner will be responsible for any applicable freight charges.

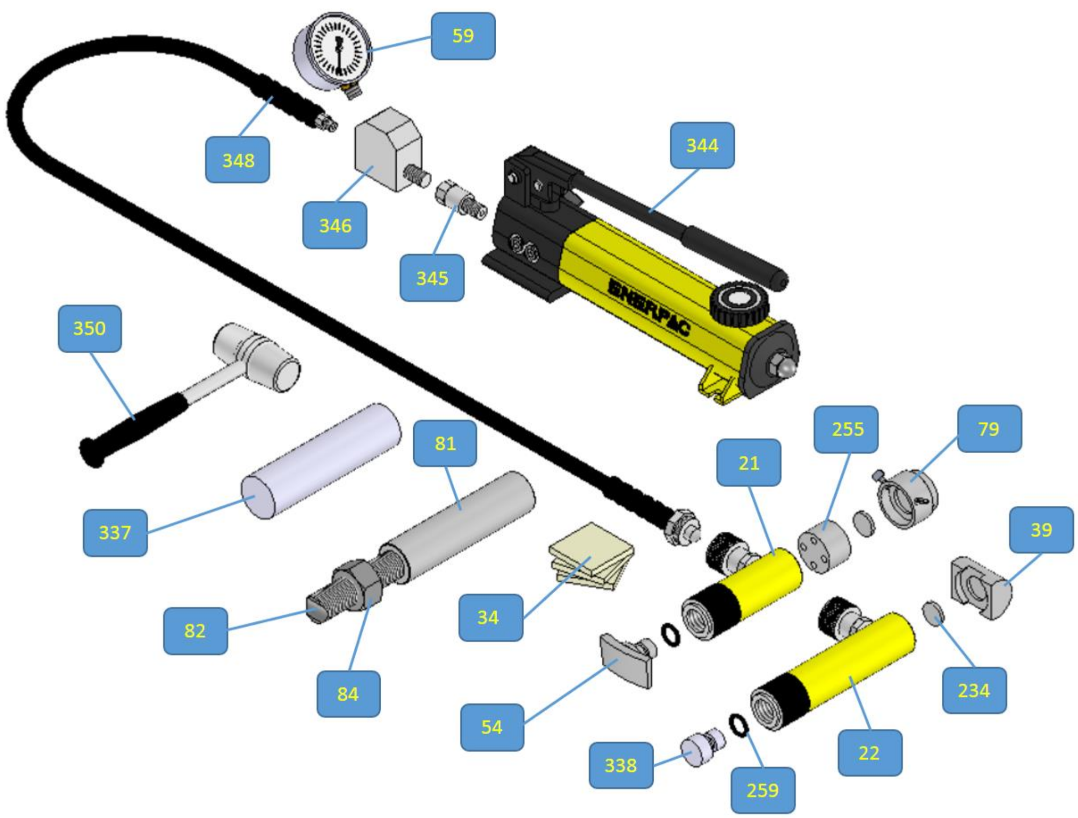
WARRANTY DOES NOT COVER

- Mainshaft accuracy after delivery
- Parts damaged due to improper assembly, impact or any other type of misuse or abuse
- Parts used for purposes other than what they were designated for
- Damages done to a wheel, vehicle or structure as a result of use of this Gen III™ Machine
- Shipping costs related to parts requiring repairs.

TABLE OF CONTENTS

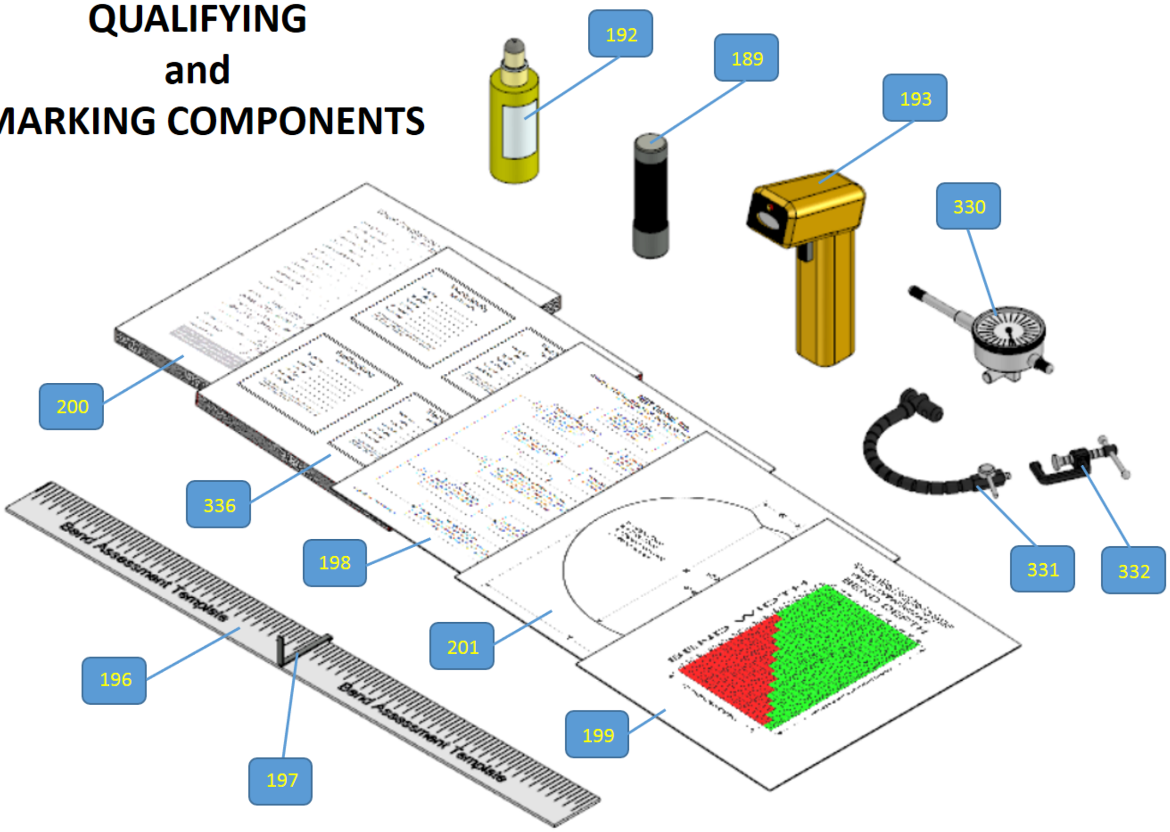
APPENDIX

PRESSURE & IMPACT COMPONENTS



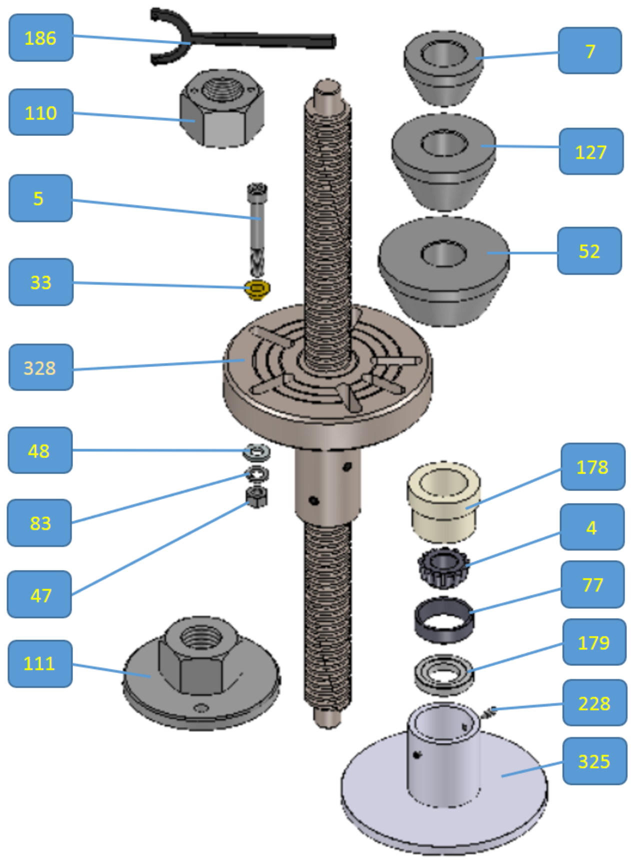
PART	DESCRIPTION
21	RC51 Hydraulic Ram
22	RC53 Hydraulic Ram
34	Nylon Press Protectors
39	Magnetic Ram Rocker
54	Steel Straightening Die
59	G2535L Hydraulic Gauge
79	Magnetic Pusher Spacer
81	Pusher Support Tube
82	Pusher Support Threaded R
84	Pusher Support Adjuster Nu
234	Disc Magnet
255	Bolt-On Ram Extender
259	Die O Ring
337	Aluminum Drift Punch
338	Aluminum Button Die
344	P141 Hydraulic Pump
345	FZ1055 Adaptor
346	GA45GC Manifold
347	CR400 Coupler (Disassemble
348	HC9206 Hose Assembly
350	Cook Lead Hammer

QUALIFYING and MARKING COMPONENTS



PART	DESCRIPTION
189	UV Inspection Light
192	Fluorescent Dye Penetrant
193	Infrared Thermometer
196	Bend Assessment Template
197	Template Scale Clip
198	Decision Flow Chart
199	Bend Ratio Chart
200	Quality Assurance Reports
201	Do Not Straighten Formula
330	Dial Indicator
331	Indicator Flexbar
332	Indicator Flexbar C Clamp
336	Temporary Repair Labels

MAINSHAFT COMPONENTS



PART	DESCRIPTION
4	Timken Bearing Cone
5	Wheel Mount Bolts
7	Small Centering Cone
33	Wheel Mount Tapered Washers
47	Wheel Mount Nut
48	Wheel Mount SAE Washer
52	Large Centering Cone
77	Timken Bearing Cup
83	Wheel Mount Lock Washer
110	Mainshaft Spanner Nut
111	Mainshaft Pusher Platen
127	Medium Centering Cone
178	Lower Module Nylon Bushing
179	Lower Module Spacer
186	Mainshaft Spanner Wrench
228	Cone Point Setscrew
325	Lower Module Housing
328	Mainshaft Assembly