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## KOBELT MANUFACTURING COMPANY LIMITED

### INSTALLATION & MAINTENANCE INSTRUCTIONS FOR KOBELT DISC BRAKES

Rev. 09/2009

“Leaders in Quality Marine Controls, Steering Gear, and Disc Brakes.”



## **BASIC PRINCIPLE OF OPERATION FOR KOBELT DISC BRAKES**

Low pressure actuators with large areas are used to apply the force against a mechanical lever, multiplying the brake application forces with a lever ratio of approximately 3.6:1 and up to 5:1. The application force of the actuator is therefore directly related to the brake force. Variation in the actuator pressure results in an absolute proportional brake torque reduction or increase. This results in very high torque capabilities.

Kobelt manufactures basically two different types of calipers. The box shoe type and the open shoe type. The box shoe type caliper is mainly used for high torque applications with relatively low energy input. This is due to the limited area of lining available. The open shoe type calipers have enormous lining surfaces and lend themselves extremely well for continuous high energy absorption. Both caliper types are available in either air or hydraulic applied version or in the spring applied configuration. Some of the brake calipers are also manufactured with a combination actuator which will provide both air applied and spring applied functions.

### **DISK BRAKE LININGS**

Kobelt engineers have developed a unique disc brake lining material. Available only from Kobelt, it offers a combination of advantages over most other materials. In situations where the brake disc is operating in relatively high temperatures, or where the <sup>1</sup>P.V. ratio will exceed normal allowable levels, localized plastic deformation in the disc will occur. Brake discs that are subject to high energy input, which goes beyond the thermal conductivity of the disc brake material, will result in plastic deformation of the disc. This results in uneven energy distribution which in turn causes disc failure. Kobelt lining material, with its slight abrasive characteristics, will minimize the uneven energy distribution. Unless Kobelt disc brake lining material is used, guarantees on the brake disc may be voided.

### **Discs**

Kobelt brake discs are available in a variety of diameters and thicknesses to accommodate nearly unlimited combinations of torque and energy input requirements. Kobelt provides four different types of standard discs.

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<sup>1</sup>P.V. - Pressure velocity = pounds per square inch x feet per minute

- (1) Medium energy input - solid steel discs. These discs are used for infrequent stopping applications. The energy in these discs is absorbed rapidly in the disc mass, but the disc requires a long cooling time.
- (2) Medium energy input - ductile iron, air cooled discs. These discs are designed for general purposes and will perform much better than a solid disc at higher speeds and continuous or intermittent brake applications, since the fan action of the disc will increase the heat transfer by drawing air over the internal cooling fins.
- (3) High energy input - ductile iron, internal air cooled discs. These patented discs provide the most refined internal cooling fin design and are ideally suited for continuous high energy input at higher speeds.
- (4) Very high energy input - ductile iron, internal water cooled discs. These patented discs, designed for high torque, low speed applications, have internal water passages which permit a high rate of energy dissipation.

Some Kobelt brake discs are available segmented (half or quarter). The purpose of these segmented discs is to facilitate disc installation or removal on disc adaptor flanges located between machinery parts which do not allow for a one piece disc installation without the removal of other components.

#### **AIR COOLED BRAKE DISCS**

Air cooled brake discs are designed to pump air efficiently when rotating quickly. In most cases a guard or some protective cover is needed to shield the brake disc. An improper design of cover may cause air recirculation through the disc or radiant heat reflection, which could result in the disc overheating. The cooling air pumped through the disc must be exhausted away from the disc to allow fresh, cool air to enter the inner vent openings of the disc. No back pressure should be generated on the exhaust side of the disc.

**CAUTION:** Under no circumstances should the disc cooling fins be painted or shielded.

#### **BRAKE ACTUATORS (POTS)**

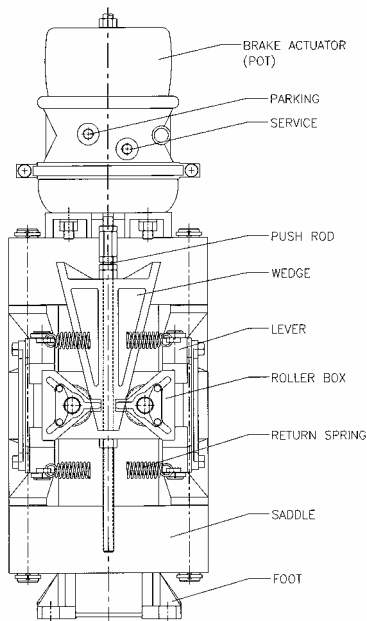
Kobelt Manufacturing provides three different types of actuator for the disc brake.

The most common would be an air applied only actuator which is of a dual diaphragm type and does not require lubricating. These diaphragms provide an optimum accurate and controlled response.

Kobel Manufacturing also provides a spring applied which is a piston type actuator. This actuator is equipped with a multi-spring pack and the springs can be adjusted to customer requirements. This actuator however, requires lubricating in order to prolong the seal life and its accuracy. This actuator is not as responsive as a diaphragm type.

The third actuator that Kobelt provides is of a truck type called Maxi Brake. This actuator is not manufactured by Kobelt and it is of a dual diaphragm type whereby one diaphragm looks after the spring applied portion and the other looks after the air applied portion. The combination comes in extremely handy when spring and air applied are both required. In order to release the spring brake, air must be accumulated in the spring chamber to compress the spring and release the brake. Then the air applied portion will now provide infinite control over the brake. The more air pressure that is accumulated in this chamber, the more torque the brake will produce. It is, however, important not to apply the spring portion and the air portion at the same time. This could cause an overload on the basic mechanical brake structure.

### WEDGE TYPE BRAKE CALIPER (CM TYPE)



The Wedge Type brake caliper offers two options to apply the brake.

The actuator mount on top of the brake is of an automotive type brake actuator used mostly on highway trucks. It has two ports: one is the parking port and the other port is the regular operation port called the service port. It also has a manual release screw which fits on the top of the brake actuator and allows the spring portion of the brake to be released manually.

The air applied portion is used for general operation whereas the emergency type is used for parking in case of air pressure failure. It is not recommended to use both the

air applied and spring applied at the same time. The wedge roller assembly is actuated by a push rod from the actuator. A minimum clearance must be maintained between the brake lining and the disc. The clearance can be practically zero, the smaller the clearance the less the air consumption. Failing to adjust the wedge down as lining wear occurs may result in brake failure as there is not enough mechanical movement to apply the brake shoe against the disc.

The port for the parking brake must be connected to a three-way valve and a quick release valve. The quick release valve should be mounted close to the brake so in case of any emergency, the air can be dumped out of the actuator instantly and let the spring apply the brake pushing the wedge downward. In order to make this port functional the manual release screw must be removed. In order to release the brake caliper, air must be applied to the parking port and should be energized at all times while the brake is in regular operating mode.

The Maxi Pot brake actuators are also equipped with a manual release screw whereby the spring portion can be manually released. It is important that air be applied to the spring portion if possible, so that the threads do not become over-stressed when using the manual release screw. In some actuators the thread screw is not designed to release the actuators without the assistance of air.

In order to control the brake for normal operation, air lines must be connected to the service port and varying air pressure from 0 to 100 psi will then apply the brake and the brake torque will be absolutely proportional to the air pressure applied. In other words, if there is little air pressure the torque is small and with a lot of air entering the service port, the brake torque will proportionately increase. The lower nut located nearest to the smallest end of this wedge must be loosened and the upper nut on the upper end of the wedge must be turned downward so that the rollers are spread farther apart and, therefore, reducing the clearance between the disc and the brake lining.

# INSTALLATION AND ADJUSTMENT INSTRUCTIONS FOR KOBELT DISC BRAKE CALIPERS

## BRAKE DISC INSTALLATION

The brake disc must be installed onto a rotating element that is machined flat and clean for the disc mounting surface. The rotating element should have bearings sufficient to carry the weight of the disc and also absorb the additional stress when the disc brake is applied. The bearings should also be of sufficient quality to make the shaft run through without wobbling. Any excess run-out (wobble) of the disc could cause premature lining wear and also cause the lever arm bearings to wear out prematurely. For special applications, some end float in the shaft can be tolerated.

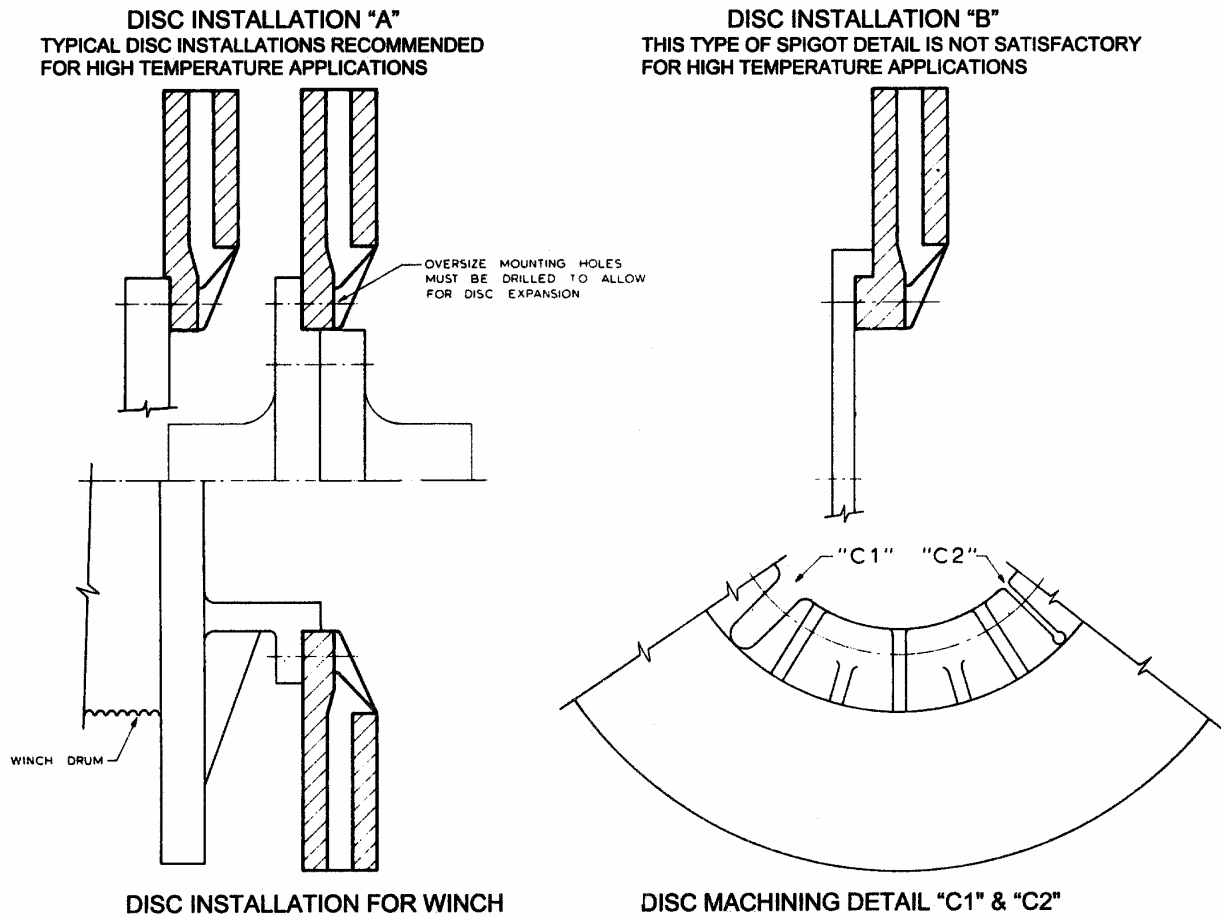
NOTE: Consult Kobelt for maximum float in shaft bearings

It is important to remember that the brake disc itself must be installed onto the rotating element before installing the caliper. This will then allow proper alignment of the brake caliper to the disc. The disc mounting bolts used must be suitable to absorb the brake torque plus any shock load in the system. For high temperature disc applications, the holes for the mounting bolts must be machined oversized to allow the disc to expand and contract during operation.

## BOLT MOUNTING HOLE DIAMTER OVER-SIZING IN INCHES

Disc Bolt Circle inches	Maximum Disc Temperature, °F			
	400	500	600	700
10	0.013	0.016	0.020	0.023
15	0.020	0.024	0.029	0.034
20	0.026	0.033	0.039	0.046
25	0.033	0.041	0.049	0.057
30	0.039	0.049	0.059	0.068
35	0.046	0.057	0.068	0.080
40	0.052	0.065	0.078	0.091
45	0.059	0.073	0.088	0.102
50	0.065	0.081	0.098	0.114
55	0.072	0.089	0.107	0.125
60	0.078	0.097	0.117	0.137
65	0.085	0.106	0.127	0.148
70	0.091	0.114	0.137	0.159
75	0.098	0.122	0.147	0.171
80	0.104	0.130	0.156	0.182

Since a brake disc is absorbing energy during operation, it will in this process, become hot and consequently expand. The hotter a brake disc becomes, the more it will expand. Depending on the type of material used, a disc may also shrink during initial start-up and could become considerably smaller depending on the maximum operating temperature. Therefore the spigot diameter between the male and female bore must be machined to such dimensions as to allow for the shrinkage of the disc. We would highly recommend that you contact Kobelt Manufacturing with all the operating criteria for assistance. The minimum clearance recommended is 0.5 mm depending on the working temperature and disc size.



- Figure 1 -

The disc must never be machined with a male spigot for high temperature applications since such spigot (see Fig. 1 detail "B") will prevent the disc from expanding due to heat.

In order to prevent disc deflection, the mounting flange of the disc can be machined or cast with relief cut-outs as indicated under disc machining details "C1" and "C2" (Fig. 1).

The caliper brake unit should also be mounted as to allow for disc expansion without causing interference between the outer circumference of the disc and the inner caliper frame.

The heat transfer from the disc to the mounting flange is relatively low; therefore fitted bolts cannot be used. If the maximum operating temperature of the disc is known, the clearance allowance can easily be calculated after the bolt circle is established.

It is also very important to obtain a fine grain casting disc material which should be machined to a fine finish (32 micro inches preferably). This will eliminate excessive lining wear.

***Important Notes:*** All the clamping force and torque values of Kobelt Disc Brakes are generated in house, and mostly theoretical. Each actual test that took place was generated under ideal conditions. We would, therefore, recommend that a safety margin in selecting our disc brakes is important, since in most cases, field applications don't come close to perfect conditions and, therefore, should be calculated at a lower value.

## **DISC BRAKE CALIPER INSTALLATION**

The foundation plate to support the brake caliper must be strong enough to withstand the maximum torque generated by the brake caliper. The foundation must also be flat and square to the brake disc. The caliper must be installed with the proper size bolts (grade 5 or better) as specified in our drawing and under no circumstances must there be a bolt missing. It is also important that these bolts be properly and evenly torqued. Failing to do so could cause the foot of the brake to fail. Ensure that the assembly fasteners are tightened before placing a brake caliper into operation. Again, loose bolts will cause the brake to fail and could cause severe injury to personnel.

With the 5000 series brakes, it is possible to undo the assembly bolts (or nuts) and raise the entire caliper arrangement away from the foot to allow installation of the mounting bolts into the brake foot. After the bolts are in place the brake can be re-assembled. The clearance between the brake and disc should be equally divided on both sides of the brake disc and the shoe should be parallel to the disc. The rugged design of Kobelt brake calipers allows for slight inaccuracy without adversely affecting the performance.

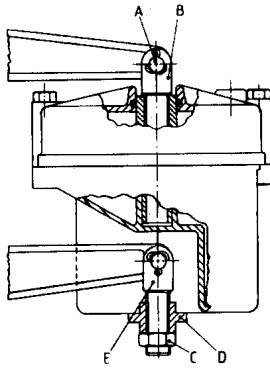
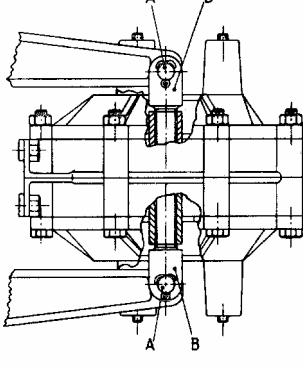
On the die-cast bronze 5000 series brake calipers, shims can be placed between the shoe bearing and the shoe to allow the calipers to be adapted to various sizes of disc thickness. The actuators themselves also have an adjustable clevis to allow for brake lining or disc thickness variations.

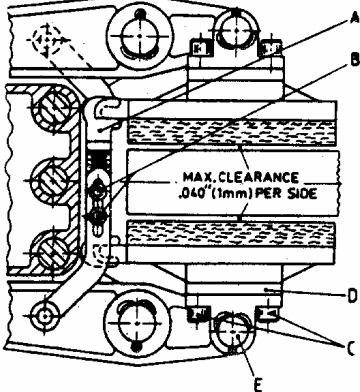
It is important that the clearance between the shoe and the disc be maintained at a minimum for fast response and also minimizes the air consumption in air applied calipers. The spring applied actuators are equipped with a single pipe port, with either 1/4" or 3/8" NPT thread, at the actuator piston housing.

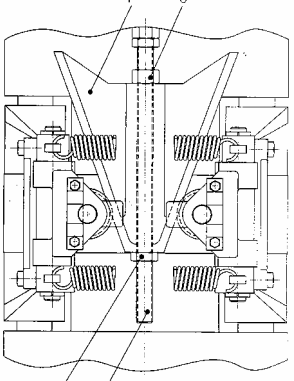
The air applied actuators from the bronze die-cast series have two supply ports per actuator. These ports are common internally. Normally only one port is connected to the control circuit. Only in cases of extremely fast response will it become necessary to connect both ports externally.

## CLEARANCE ADJUSTMENT

*Before making any adjustment ensure that the brake is released*

	<p><b>SPRING APPLIED ACTUATOR</b></p> <p>The clearance can be adjusted by removing pin "A" and then turning clevis "B". It can further be adjusted by loosening jam nut "C", then removing bolts in bracket "D" and rotating same.</p>		<p><b>FLUID APPLIED ACTUATOR</b></p> <p>Remove both pins "A" and turn both clevises an equal amount. Turn counter clockwise to decrease clearance and clockwise to increase.</p>
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 <p>MAX. CLEARANCE .040" (1mm) PER SIDE</p>	<p><b>BALANCING LINK ADJUSTMENT</b></p> <p>Most calipers are equipped with balancing links to ensure even lining wear. To adjust, loosen screws "B" and adjust link "A" to align the shoe parallel with the disc.</p> <p><b>SHIM KITS</b></p> <p>In order to adapt a caliper for a thinner disc, shim kits are available for use. These shims "D" fit between the brake shoe and the bearing. See products sheets for ordering information.</p> <p><b>LINING REPLACEMENT</b></p> <p>It is important to replace the lining before the rivets make contact with the disc. By removing screws "C" or pin "E", the shoes can be taken off from the caliper assembly. Drill out the rivets and install new lining with the proper rivets. When re-installing shoes into the caliper assembly, be sure to re-engage the balancing link "A".</p>
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	<p><b>For Combination (-CM) Brakes, ADJUSTMENT FOR DISC-LINING CLEARANCE</b></p> <p>To adjust the clearance between the disc brake and lining, adjust the nuts "G" and "H" on the extension rod "J" up or down to move the wedge "F" to a position that gives the desired clearance at the lining. Tighten the nuts securely once the position is set.</p>
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## **INSTALLING DISC BRAKE ON A DRILL RIG DRAW WORKS**

For many years the industry used drum brakes with a mechanical linkage to the driller platform. The movement of the lever was transmitted to the bank brake. In other words, any slight mechanical movement of the driller lever was an instant response at the band brake.

When installing a disc brake on a drill rig, the power is transmitted via pneumatic air lines and valves. For many years we have been trying to teach the oil industry to use generous air lines. Our recommendation for a single disc requires a  $\frac{3}{4}$ " supply line from the tank to the booster relay 3329, and from the booster valve to the brake. The air lines from and to the driller valve 2588 should be  $\frac{3}{8}$ " ID. This will give an immediate response to the brake calipers. If there is a delay in brake application the operator might have pushed the brake handle too far. Consequently, once the air reaches the brake caliper, it will be too much. So the operator will have to pull the handle back. All day long he will be searching for the right brake torque. However, if it happens instantly, he will feel much more secure and will enjoy running the rig with confidence.

## **TWIN BRAKE CALIPER INSTALLATION**

It is recommended to have a 1" ID line from the tank to the 3329 relay valves and a  $\frac{3}{4}$ " ID line from the brake relays to the brake caliper. It is also recommended to have a pneumatic interlock between clutch and brake. A crown saver valve can also be installed to avoid overshooting at the top.

There are many ways that we can provide pneumatic circuitry and valves to improve the operation of a drill rig. Please contact the manufacturer for various options.

For the emergency line, a 3 way valve of relatively small flow can be provided. A quick release valve must be installed near the brake actuator to dump the air rapidly in case of an emergency.

## **AIR SUPPLY AND TREATMENT OF DRAW WORKS DISC BRAKES**

It is of extreme importance that air compressors and storage tanks provide sufficient air during the operation of the brakes and clutches. There must not be any shortage of supply air. It is also of extreme importance that all the air lines between the tanks, control valves and brake actuators are of a generous size. An operator will lose confidence in the rig if the response between control handle and brake response is not instant. Actuators and control valves equipped with "U" cups and "O" rings require lubrication in order to provide long service life. "O" ring and "U" cups will become sticky and show wear if not lubricated properly. Diaphragm type actuators do not require lubrication. However, it is recommended that the control valve should have a lubricant in order to make respond accurately.

The main supply line to the control and brake system should be equipped with a filter and regulator. The filter's function is to remove moisture and dirt in the system and the regulator will provide a constant air pressure to the control system. It is therefore, important that the compressor pressure be set higher than the air pressure regulator. The oil that is required for the lubricator should be of a hydraulic type with a viscosity of 10 to 32. Heavy oils are not a good solution for lubricators. If the draw works is operating in a cold environment it is recommended to have an air dryer in the system to remove all moisture. In some cases, in extreme cold locations, it may be necessary to add a lubricator large enough to handle all the air flow. This lubricator should be equipped with a metal bowl. This lubricator can be filled with methyl hydrate (wood alcohol). The wood alcohol must, however, be used sparingly since it is not friendly to most synthetic rubber.

The Kobelt brake calipers and discs are installed in a wide range of environments. Some of them are running in very clean surroundings and some in absolutely dusty and dirty environments. Kobelt does provide brake calipers with grease fittings that must be greased in order to stop the calipers from seizing up. The frequency of lubrication depends largely on the environment. If Kobelt disc brake calipers are installed without grease fittings in a relatively dirty environment, it is highly recommended to take a good machinery oil and lubricate the pins with an oil can; this should be applied to all bearing and pin sections.

The original lining thickness of a 5026 is 5/8", 0.7" in the 5028, and 3/4" for the 5040. When the lining is worn down to 1/4" thick, it is time to replace it. We recommend that you use only original Kobelt linings.

## **INITIAL BRAKE START UP**

In order to achieve maximum brake torque, it is of the utmost importance that the brake lining is sufficiently burnished. This can only be accomplished if the brake is applied on a relatively low pressure with the engine or motor driving the brake disc. This should be done approximately three times. The maximum disc temperature that should be achieved is approximately 600°F and each run should take approximately 10-15 minutes. A normal brake lining will provide a coefficient of friction of 0.45 at 200°F and can go as high as 0.6 at approximately 400-450°F.

If the lining is not properly burnished, a coefficient of friction as low as 0.3 is all that can be obtained. Extreme care, however, must be taken not to overheat the disc during the process. If the brake system is running in an environment where maximum brake torque is required (see note), burnishing has to be done all over again after a lining replacement. On large brake shoes, it becomes necessary to cut grooves into the lining to allow lining vapour to escape. On water cooled discs it is extremely difficult to burnish the lining unless only a limited amount of water is fed into the disc during the burnishing operation. Again, extra care must be taken not to overheat the disc.

Note: To calculate brake torque, use the following formula:

**Brake torque = clamping force x coefficient of friction x acting radius of disc**

## **CHECK LIST: BEFORE STARTING DISC BRAKES**

- (1) Ensure that all bolts are of good quality and properly installed.
- (2) Make sure that brake lining does not make contact with the disc when the brake is released. Also ensure the brake is reasonably square to the disc.
- (3) Brake levers movement must not be obstructed and sufficient room should be allowed for actuator rod to come out completely without any interference.
- (4) Check the brake disc surface for foreign matter and grease. Remove all contamination from the disc with cleaning solvent. If the disc was damaged during installation with nicks or welding marks, remove the defects before put to service.
- (5) Check the source of fluid supplied that it complies with the specified pressure range and that it is properly interlocked with other machinery such as clutches, electric motors, etc.
- (6) Check that all bolts are tight and cotter pins are in place.

## **MAINTENANCE**

Over the years, it has been proven that very little will go wrong with the Kobelt disc brake calipers and discs. However it is important that periodic inspection and maintenance should be carried out. The lining must be replaced before the shoe lining bolts or rivets start making contact with the brake disc. Moving joints are to be adequately lubricated for smooth and safe operation.

### **ACTUATOR MAINTENANCE**

Kobelt actuators require very little maintenance. However, due to normal wear and tear on the parts, regular inspection and maintenance should still be carried out

#### **AIR (FLUID) APPLIED ACTUATORS**

In most cases these actuators are diaphragm operated and consist of two opposite spring-returned diaphragms with an "O" ring between the centre housing. Should any of the diaphragms or seal failure occurs, remove actuator, dismantle same, clean and re-install new diaphragm or seal and re-assemble actuator.

Operating temperature of fluid applied actuator is -40°C (-40°F) to 80°C (176°F).

#### **SPRING APPLIED ACTUATORS**

If maintenance is required on the spring applied actuator, it must first be removed from the brake assembly. In order to remove the actuator, pressure must be applied to the actuator to release the brake, or use the manual release screw if available. After removal it must be retained in a press strong enough to retain the spring tension of the actuator. CAUTION: It is important that this holding device maintains the actuator in a position square to the press. The bolts holding both housings can now be removed and the pressure of the press can be slowly released thus allowing the housings to separate. Clean actuator, replace seals, inspect springs and change parts if necessary. Lubricate all moving parts, re-assemble and re-install actuator in reverse order.

Operating temperature of spring applied actuator is -25°C (-13°F) to 120°C (248°F)

Disc brake calipers equipped with spring applied actuators must have lubricator in the control air system using light hydraulic oil as lubricant. This is to prevent premature seal wear and stickiness.

## **SPRING APPLIED ACTUATORS WITH MANUAL RELEASE SCREWS**

All Kobelt spring applied actuators can be supplied with manual release screws. This release screw serves to release the brake upon failure of the fluid pressure. It is very important that the fluid supply line is open to tank or atmosphere when winding the release screw inward, since the piston cavity requires a fluid supply source when doing this. This holds especially true in hydraulic systems where a vacuum plus the spring tension is generated. The manual release screw mechanism will fail if no source of fluid supply is available.

## **BRAKE SHOE CLEARANCE ADJUSTMENT FOR SPRING APPLIED ACTUATORS**

On the spring applied caliper, it is extremely important that the proper clearance be maintained between the shoe and disc. On the manual adjust actuator, remove the clevis pin and the clevis can be manually rotated so that an optimum clearance between the disc and shoe can be obtained. When a lining is replaced it will be necessary to turn the clevis inward to allow for the extra thickness of a new lining. During normal use, our automatic adjust spring applied actuators will automatically adjust for the wear on the brake lining. When new lining is installed, the clevis pin must be removed from the actuator rod and the clevis turned, allowing the actuator rod to be pushed in completely for the extra lining thickness. Re-insert the clevis pin after the adjustment.

For optimum performance, it is essential that the clearance between the shoes and disc is kept at a minimum without inducing drag. The clearance should not exceed 0.040" (1 mm) for each side. This will allow for fast response as well as the minimum fluid consumption with fluid applied actuator. On spring applied calipers, a minimum clearance is necessary to maintain the maximum brake torque.

Disc brake calipers equipped with spring applied actuators operated with air pressure must have a lubricator in the system and the lubricant must be filled with a light hydraulic oil. This is to prevent premature seal wear and stickiness.

## **OPEN SHOE TYPE BRAKE CALIPERS (5000 SERIES)**

On these calipers the brake shoes are attached with pins to the brake open lever. These pins must be removed in order to detach the brake shoe from the caliper. New lining can be installed and the brake re-assembled. It is important that the balancing link is connected to the back of the brake shoe.

## **UNEQUAL LINING WEAR**

The manufacturer has established a formula for replacing the shoe pin on our open shoe disc brake calipers in a location where there is an equal pressure-velocity balance. Lining wear, however, is mainly determined by disc temperature and several other factors. In order to provide relatively equal lining wear a balancing link is developed that

will control the lining wear from the ID to the OD of the lining. However, in some cases when the caliper is not centered, extreme stresses are put on the balancing link and in fact, will break or bend it. The balancing link is only intended to take up 3% of the unequal pressure, which is, in most cases, more than sufficient to keep the brake lining wear even from inside to outside. However, lining wear is very much affected by disc temperature and it is quite normal for the OD of the disc to not get as hot as the ID of the disc. Therefore lining wear becomes more rapid. If, however, a brake is operating under cool conditions, the lining should be balanced from ID to OD. Since every installation is different and various temperature profiles in disc exists, it is still very difficult to predict precisely what is going to happen to the lining wear.

### **BOX SHOE TYPE BRAKE CALIPERS**

The shoe is retained within the framework of the caliper by the upper retainer plate. In order to remove the brake shoe, this plate has to be removed. The pin attaching the clevis to the brake lever must also be removed. This will allow the clevis to be moved to clear of the lever and the brake shoe can then be removed. New lining can be installed and the brake re-assembled.