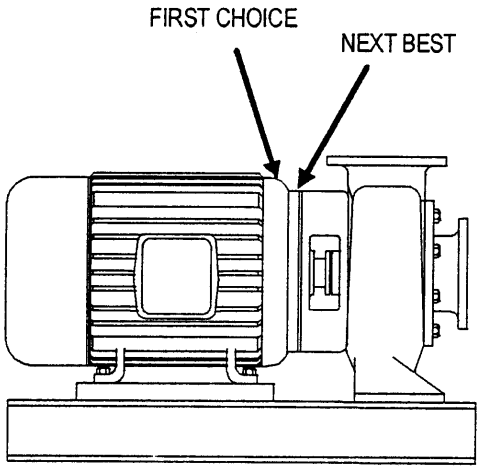
MACHINERY BLOCKING RECOMMENDATIONS

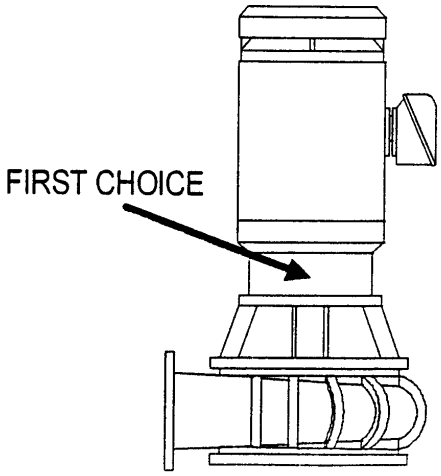
Blocking machinery is very easy if you use a little common sense. Defined rules will not always work as machine configurations and possibilities of local obstructions are limitless. The following are some considerations that will help develop a "train of thought" in considering block locations that we require.

MOTOR CLOSE-COUPLED PUMPS and FANS (MCC)



In the case of MCC units, the driven rotating component (impeller or fan wheel) is attached directly to the motor shaft. The pump housing and volute are attached to the motor housing. The shaft and driven components transmit vibration to the machine housing through the motor bearings. For motors under 40 HP, the block location is M2 or the motor driven end.

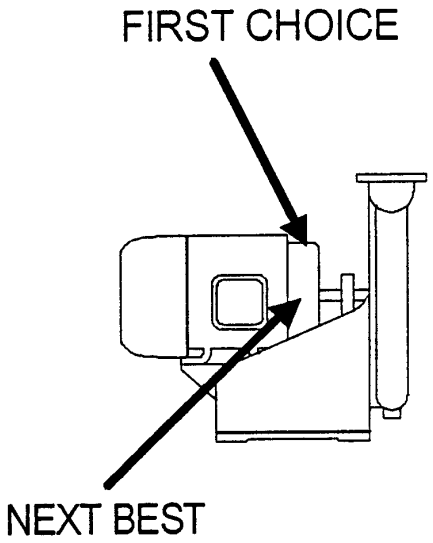
Sometimes you may encounter a poor mounting surface or obstruction (grease zerk) at the *first choice* location. If this is the case, move the block onto the pump attachment flange which would be the *next best* choice. If you need top move the block a few degrees from the vertical plane, you may, but keep it to within a few degrees. If for some reason a block cannot be attached to the preferred locations due to the shape, clearance of nameplate attachment, move it slightly further towards the pump volute or down on the side (horizontal plane) of the motor. However, it is unlikely that you cannot use the *first* or *next best* choice of locations.



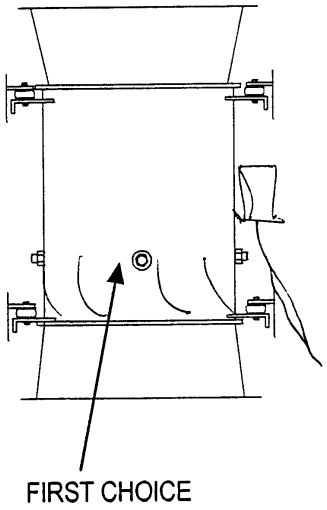
For MCC pumps larger than 40 HP, we add a second block location to the motor free end (M1). Another rule of thumb – if the span between M1 and M2 is greater then 30 inches, use two blocks on the motor.

On MCC machines, never move the block location from M2 to M1. M1 is physically too far from the driven component. The motor fan cowling is usually made of sheet metal (resonant) and is attached at only a few points, making it a poor test location.

In the case of MCC gland exhaust fans (main, auxiliary, and TG), again we want to see that position M2 is used. The shaft usually has a "heat sling" between the motor bearing and the fan wheel. Care should be used when working around the heat slinger. If there are obstructions that prevent locating the block on the vertical axis, then move the disk to the *next best* location, which is on the horizontal axis. Again, as in the MCC pumps, position M1 is not acceptable.



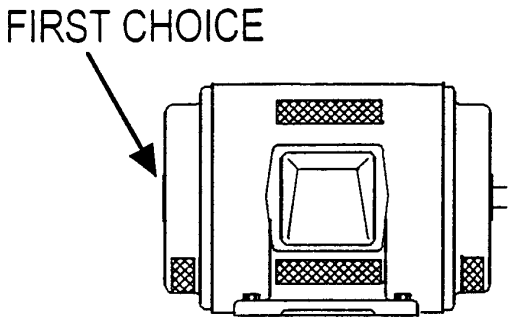
"Navy Standard" ventilation fans are also MCC machines. The motor and fan wheels are mounted on the inside of the ducting. Normally, the motor is mounted on the driven end by a stator vane assembly. The free end of the motor is normally attached to the ducting with steel rods. These are easily located as they protrude through the ducting in four locations with nuts attached.



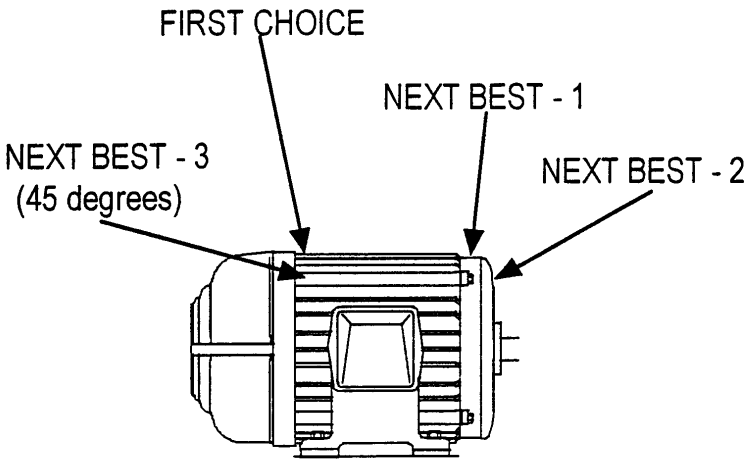
Our rules for MCC machines tell us to attach the block as close to the M2 position. However, it is difficult to locate exactly where the stator vanes meet the outer ducting. For this reason, we attach the block adjacent to the steel rod ends.

COUPLED MOTORS

In all cases of coupled motors, whether they are mounted vertical or horizontal, we use a common train of thought when considering block locations. Our preferred motor location is at M1 or the motor free end pickup location. The reason that we would choose this location is to minimize pump end "crosstalk". If the motor does not have a free end cooling fan cover, our *first choice* would be on the free end bearing housing.



If the motor has an external free end cooling fan, we would need to locate the block at a location not on the fan cowling. The motor fan cowling is usually made of sheet metal, which we call a *soft mount*. A soft mount such as this is often resonant and will transmit inaccurate vibration amplitudes and natural frequencies.

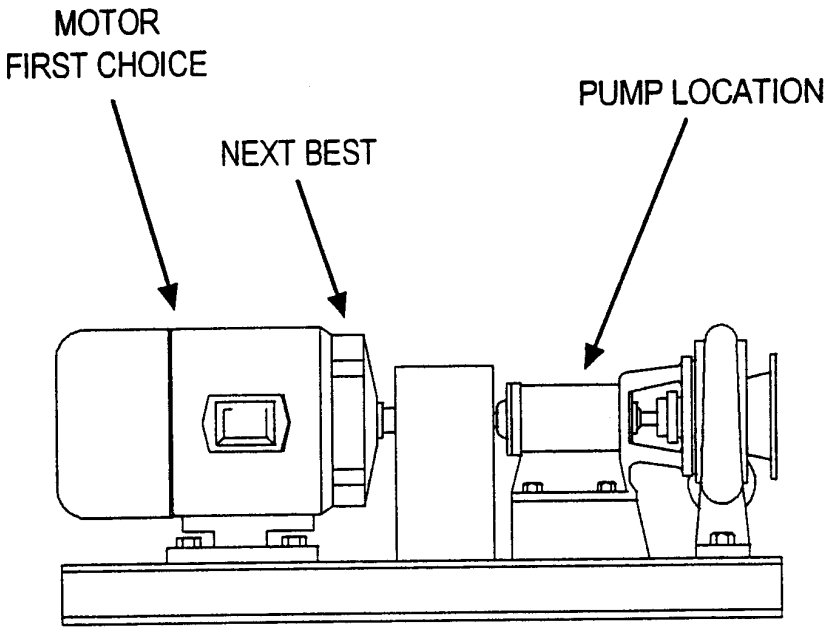


In interest of keeping the pickup at location M1, we would attach the block at the point indicated in the above drawing. In most cases, motors with cooling fans have finned housings. If the fins do not allow attachment of the block, we would move to wither a RAT at the *next best-1* or an ART at the *next best-2* location. If there is an obstruction preventing attachment at M2 on the top of the motor, you may be able to move the block down onto the side of the motor or the horizontal plane. Remember that when you do this, the EADS is still expecting vertical to be radial and transverse to be horizontal, so call the orientation accordingly.

In a few cases the housing fins extend down on the drive end of the motor, preventing attachment anywhere on M2. You may move the disk to one of the four fatter fins that encase the longitudinal end bell bolts at M1, see *next best-3*. These fatter fins are common on Reliance TEFC motors. The only problem with this location is that the flock face will be rotated 45 degrees from both the vertical (radial) and horizontal (transverse) axis as well as the driven end axis. Make note of this as the expert system expects, for instance, 2R and 4R to be in alignment with one another.

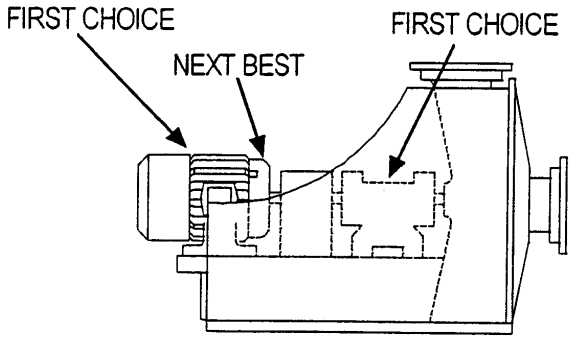
OVERHUNG COUPLED PUMPS AND FANS

The most common horizontal overhung pump style is illustrated below. In this case, there are two or more bearings inside the pump bearing housing. The preferred pump end location is on the bearing housing as illustrated below (P3). Beyond this housing are the pump gland seal and the pump impeller, but no bearings.



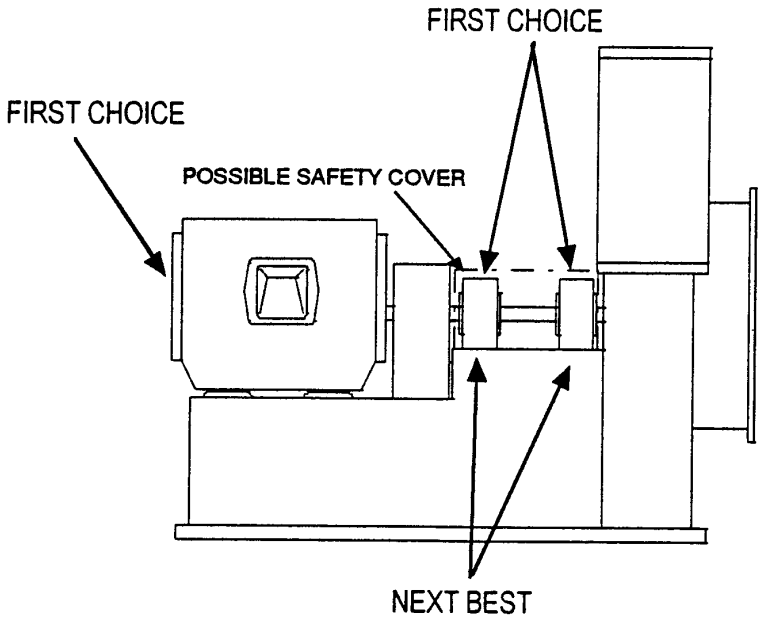
In the case of this illustration, the motor has a free end fan cowling, so we would mount the block where indicated. If the motor has cooling fins such that a block cannot be attached, we would move it to the drive end or M2.

Overhung, coupled fans primarily come in basically two flavors. The first is very similar to the previous overhung pump. This example is a gland exhaust fan with a cylindrical bearing housing at position P3. This is where the fan should be blocked. If for some reason you are unable to attach on the top of the housing, you may move the block down on the side of the same housing.



In the case of the motor, we would prefer to block at position M1. As in the overhung coupled pumps, the *next best* location would be M2.

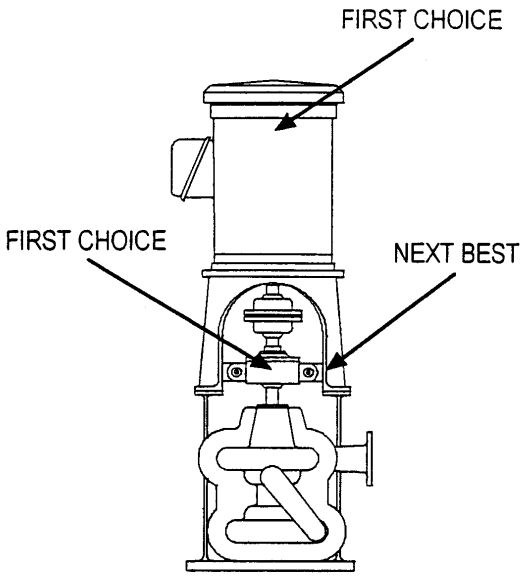
The example below is common to ventilation fans and motor driven forced draft blowers. This configuration includes a squirrel cage fan supported by pillow block bearings. We typically attach one block to the motor and one block to each pillow block bearing. The considerations in choosing a location on the motor would be the same as other coupled machines.



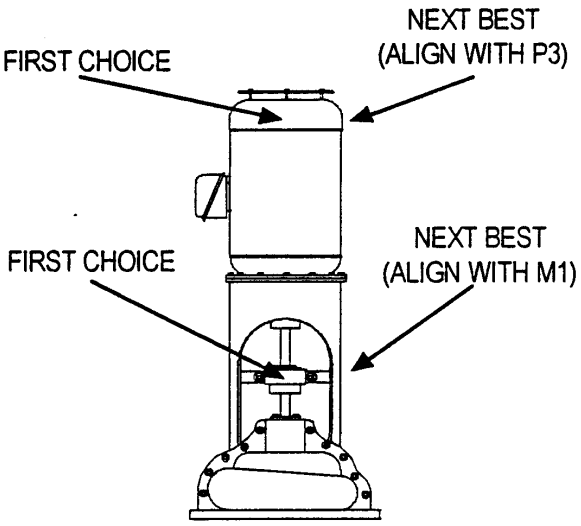
At times you may encounter a safety cover over the fan bearings and exposed shaft. There is one thing you can do to avoid removing the guard to block and test the bearings. If you have access to the underside of the plate which the bearings are bolted

to, attach the block to the plate directly beneath the bearing and between its mounting bolts. If this area is inaccessible, you must remove the guard.

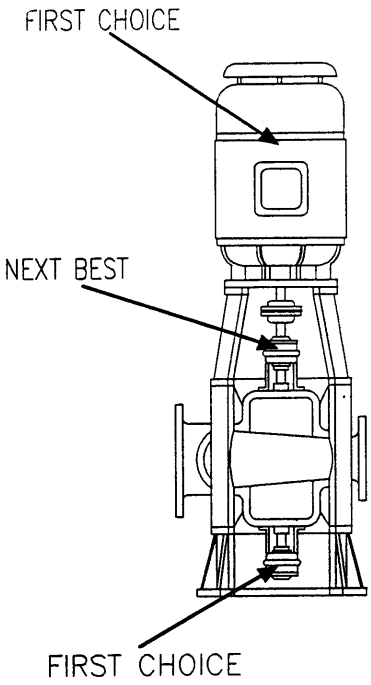
Vertical, overhung, coupled pumps are quite common. This example illustrates our *first choice* block location on the pump. This location is on the pump thrust bearing. If we were unable to attach directly to the pump bearing housing, we would next look to the area where the bearing housing attached to the pump structure.



The motor block location, in this case, would be simply at position M1 on the side of the motor. This motor is a *drip-proof* style, where there is no external cooling fan but simply a free end drip shield, which prevents water from entering the motor.



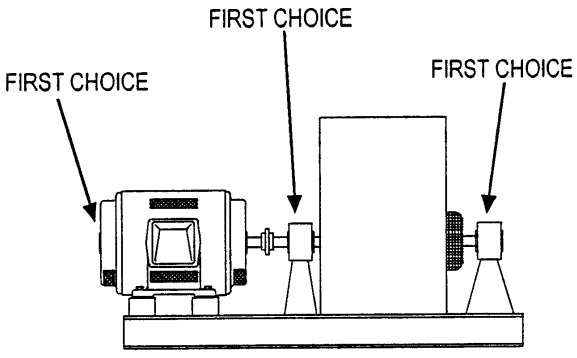
In the example to the left, we would first try to block the unit in the same fashion as we did above. If we were unable to find a good surface on the front side we would consider moving both blocks 90 degrees around the machine. If this is done, it is imperative that the pump end location is attached to where the solid bearing housing support meets the wall of the pump body. Insure that the motor block location is attached in vertical alignment with the pump block.



This vertical, coupled, double suction pump has bearings at both the drive and free end. Like the horizontal double suction pump, the free end bearing is usually the thrust bearing. We would prefer to locate the block on this bearing. However, there are two possible problems with blocking the bearing. First, access may be difficult. Second, if the pump glands leak, the system fluid may be running over this bearing housing. If either of these problems exist, go ahead and use the *next best* location.

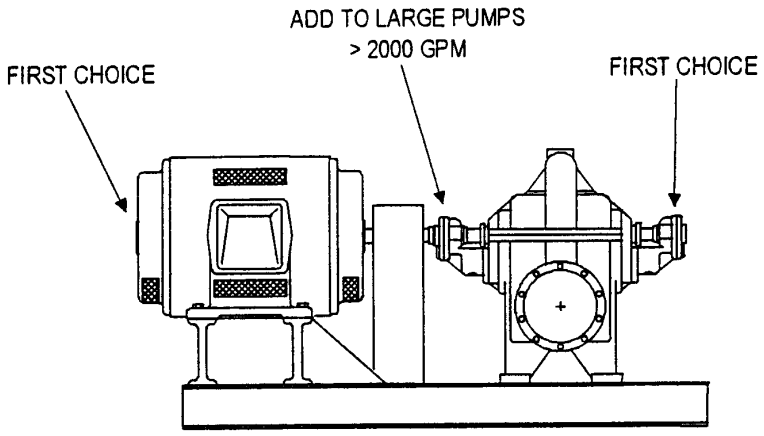
If this pump is greater than 3000 GPM, you should block both bearings.

This fan is somewhat different than the fans we already looked at. Both ends of the shaft are supported by bearings. We would block both fan bearings, as they are pedestal type bearings which means they are quite isolated from one another. Also, the fan shaft is quite long and may not transmit vibration as well as it would otherwise. This particular motor has no free end fan cowling so it blocked on the free end (M1) at the bearing housing.



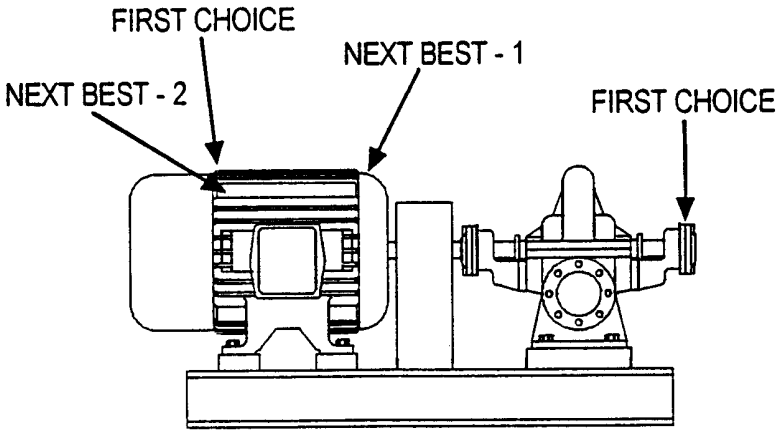
COUPLED DOUBLE SUCTION PUMPS and FANS

When blocking horizontal, coupled pumps, we try to block pickups M1 and P4. In this example, our *first choice* would be on the bearing housings at the motor free end and the pump free end.



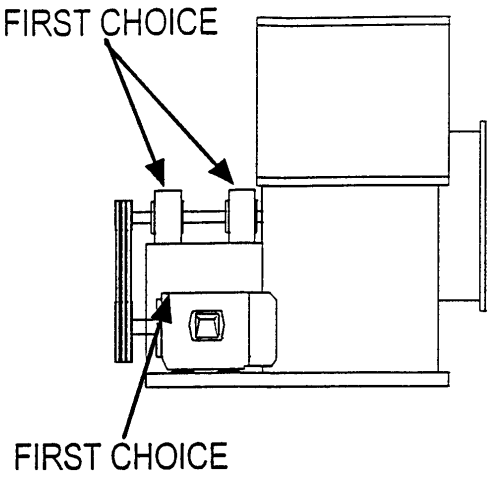
If the motor has an external cooling fan cowling, the same rules apply that were discussed in the previous sections.

The pump free end bearing is always blocked. This not only keeps out two pickup locations at the desired proximity from one another, but it is also the pump thrust bearing. In the case of large pumps (greater that 2000 GPM), a block should be added to the drive end bearing (P3) as well.



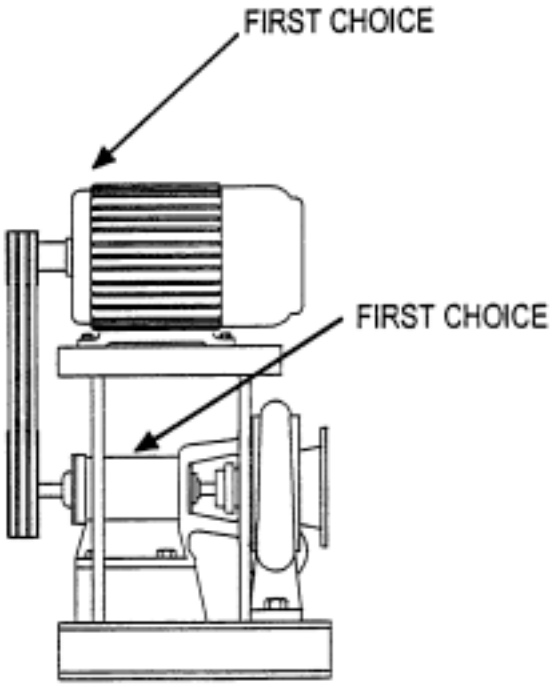
BELT DRIVEN MACHINES

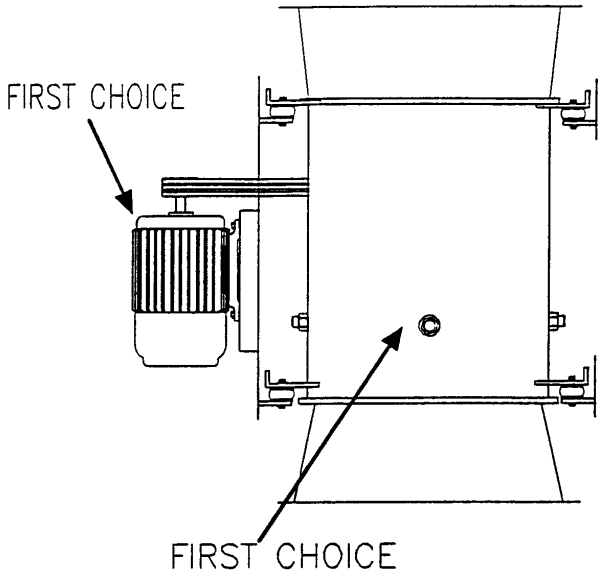
This belt driven fan is of the overhung type. Previously we discussed blocking each of the pillow block bearings.



The motor blocking scheme is different than for coupled machines. For coupled machines we are interested in keeping the blocks on each component physically apart. In the case of a belt drive, this is not an issue. We typically block M2 on belt driven motors. One reason is that belt and sheave problems will be better identified.

This





This belt driven fan would be blocked at M2 and F4. This type of fan may not have threaded rods protruding through the sides of the ducting. In many cases, the fan bearing assembly is bolted to the welded struts. Try your best to locate where the struts attach to the ducting and attach the block there.