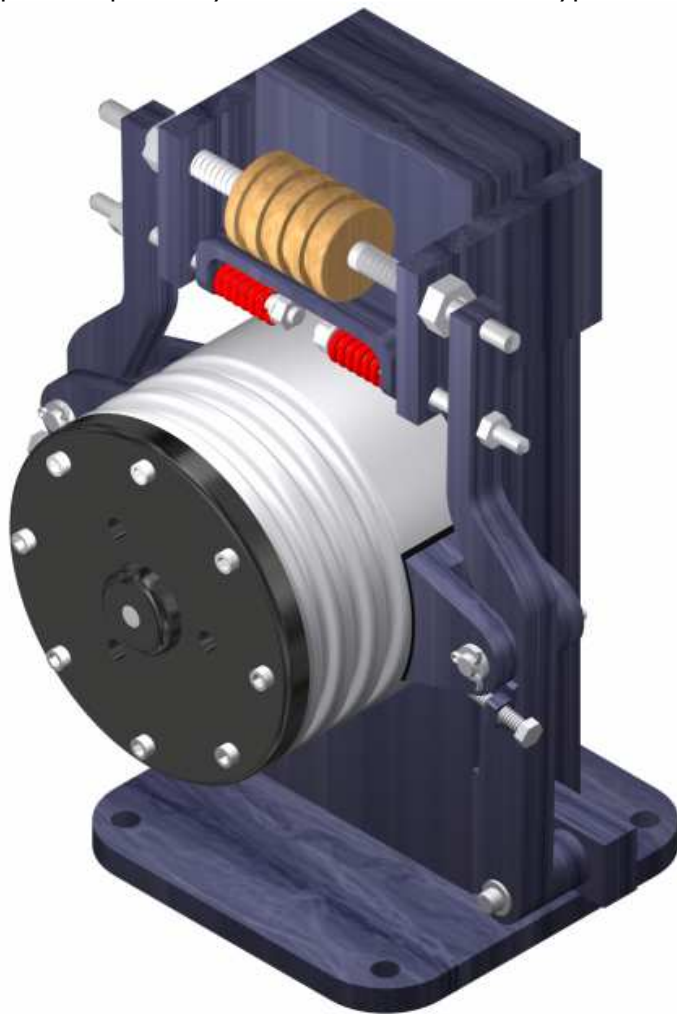
 -for Liftreport and our customers-	Technical Customerinformation	KI0107e0
	Peculiarities in commissioning and maintaining gearless drives Advantages and drawbacks of gearless drives: which system is ideal?	2001-2008
		page 1 von 5

Mechatronics for elevator installers and drive techniciansI


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1 Peculiarities in commissioning and maintaining gearless drives

The engineering for modern elevator drives incorporating synchronous gearless technology appears at first sight to be strikingly simple, making do with just a few assemblies. At the same time this means, however, that the demands on individual components are very high. The motor shaft, bearings and braking systems are subjected to extreme loads. That is why the brake shoes and brake disks have to be handled carefully and monitored to avoid any incidents while ensuring that the lifting gear always operates perfectly Let us take a look at a typical drive.



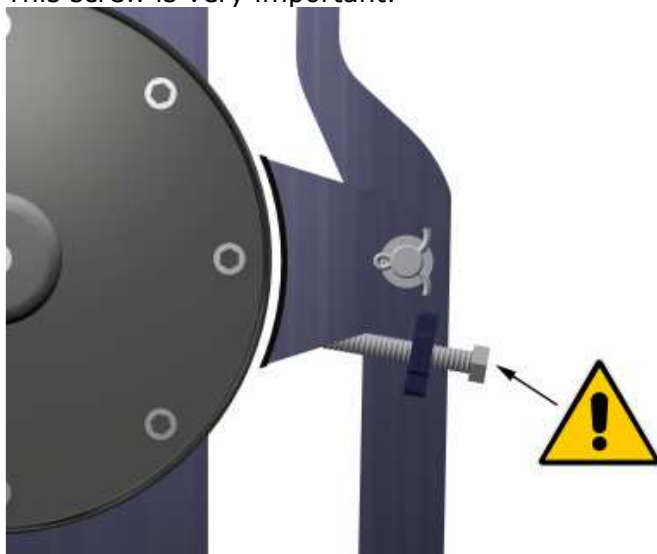
Shown in our example(**Figure 26**) is the typical gearless winch configuration. Here the drive sheave is identical with the brake drum; in extremely shallow designs a brake disk in the form of a collar may be present instead of the drum. In the version using a drum, two lever arms press the brake shoes against the drum. A powerful solenoid here works against the two adjustable spring systems to keep the brakes open.

 -for Liftreport and our customers-	Technical Customerinformation	KI0107e0
	Peculiarities in commissioning and maintaining gearless drives Advantages and drawbacks of gearless drives: which system is ideal?	2001-2008
		page 2 von 5

It is important, in the interest of achieving adequate braking moments, that the radius of the brake lining be identical with the radius of the drum. The problem here is that the brake shoes ought to be set to execute the shortest possible stroke so that the brakes can engage with the least possible delay and, in spite of this, without striking the drum sharply and making noise. The information on adjusting the brake system varies widely from manufacturer. The supplier of the braking solenoid prefers to specify the longest possible stroke while the operator of the lift system needs a short stroke in order to keep the noise level at the drive unit as low as possible and to protect mechanical components.


All this is no problem whatsoever for drives which incorporate gearing. Here the spring forces are lower by a factor of at least 25, the circumference of the drum is considerably smaller and the rotation speed will typically also be greater by a factor of 25. The smaller braking moments required for the geared unit are far easier to control and meter and the switching point is unusually not critical.

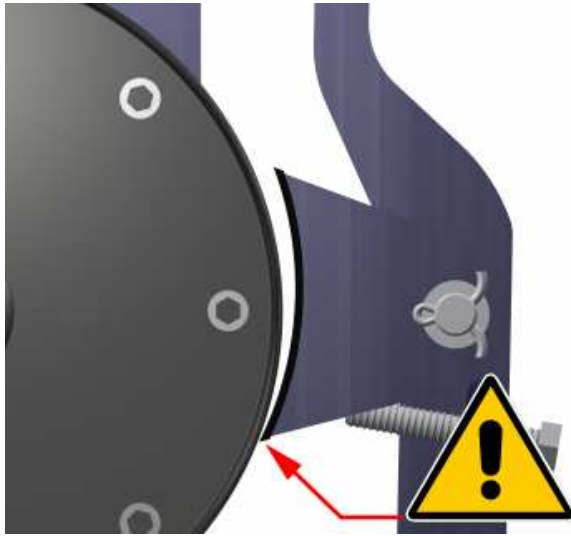
The situation is much different for the gearless drive. It should be set up at the factory or, if at all possible., before installing the ropes. Some drive units have a scale applied to the springs; this is calibrated directly in Nm for each brake lever. The spring force is always to be set first. The distance and the angle of the brake shoes are adjusted in a second step. To do this the braking solenoid is energized and the screws at the solenoid are set to give the desired stroke. The brake lining may not be in contact at any point. In our example (**Figure 27**) one sees a further adjustment screw below the brake shoe. This screw is very important.



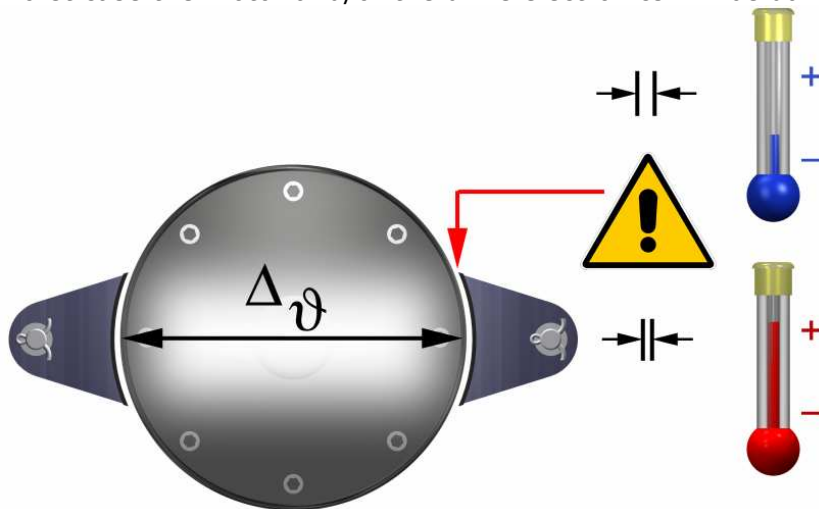
Ist purpose is to prevent the upper edge of the brake shoe scraping along the drum due to its own weight when the brakes are released. Adjust this screw so that the brake lining – as shown in the illustration – is parallel to the drum. Now check the desired distance between the lining and the drum (only a few tenths of a millimeter are required). Great care must be exercised here. If the screw is turned down too far, then the lower edge of the lining can suddenly touch the drum – while the brake is released (Figure 28) – a situation which is more than serious since undesired brake action will occur.

Under certain circumstances this fault will not be noticed immediately. At the beginning the drive unit operates in a perfectly normal fashion. Only after a longer period in continuous operation will the current start to rise gradually; scraping noises and squeals develop. The drive heats up more and more as a result of rising power consumption.


 -for Liftreport and our customers-	Technical Customerinformation	KI0107e0
	Peculiarities in commissioning and maintaining gearless drives	2001-2008
	Advantages and drawbacks of gearless drives: which system is ideal?	page 3 von 5



The friction at the brake drum increases and heats up the brake system so much that the thermal expansion of the drum will, after about 30 minutes, cause the brake shoe to bind (Figure 29). The motor then comes to a complete standstill and the elevator is shut down by either the motor overheating detector or the running time monitoring circuitry. In the worst case the motor and/or the drive electronics will be damaged.



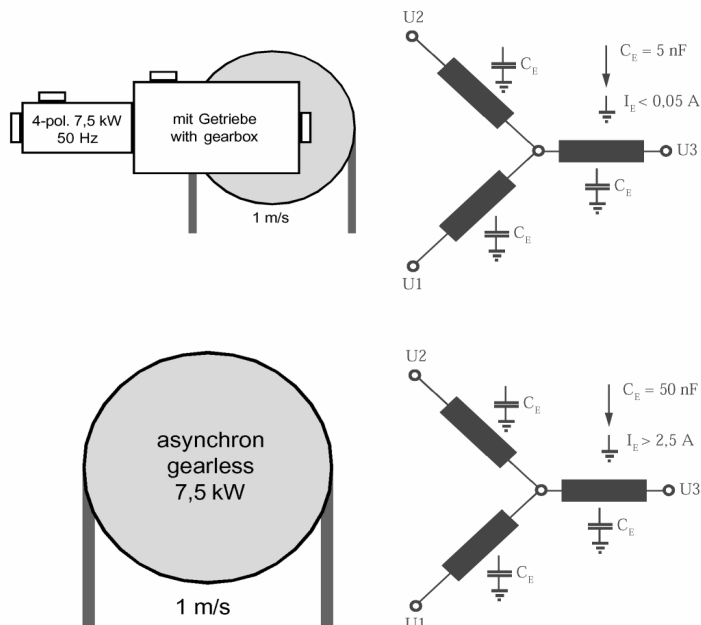
Thus it is absolutely necessary, with the machinery at normal operating temperature, to check to see whether the gap is sufficiently large when the brakes are released. (A simple strip of paper, glued to the drum, is sufficient for this test. The brakes will operate reliably if the „label“ thus applied is not worn away by the brake linings.) Checking a braking system located inside the motor is somewhat more complex. In this case one simply has to rely on the fact that the manufacturer adjusted the system correctly at the factory. Drive equipment using disk brakes is, indeed, not so sensitive to heating but once again the adjustment is more a function of the manufacturer. Under certain circumstances where high payloads are anticipated gearless drives using disk brakes will augment the pure electromagnetic system with electrically actuated hydraulic rams. Special commissioning rules apply here. Important with dealing with disk brakes is that the disk collar not show any lateral deflection (This can be, for example, due to undetected shipping damage). Drums which are off-center or sheave collars which oscillate to the sides will ruin the braking system immediately. Consequently you must always be on the lookout for this type of fault when setting up the drive unit. A helpful hint: Since (at least when installing drive units using


 -for Liftreport and our customers-	Technical Customerinformation	KI0107e0
	Peculiarities in commissioning and maintaining gearless drives	2001-2008
	Advantages and drawbacks of gearless drives: which system is ideal?	page 4 von 5

synchronous motors) an initial test is in any case to be made without ropes and load to ensure that the drive unit operates properly, deficiencies at the braking system can be detected immediately. It is in your own interest to lodge complaints where this type of error is found. The commissioning of gearless drive units is and continues to be a matter which must be left to specialists (see the previous chapter in the series on mechatronics).

Advantages and drawbacks of gearless drives: which system is ideal?

This question is posed quite frequently and is sometimes not easy to answer. An incorrect decision in this area can lead to quite unexpected surprises. In our example an architect`s office specified asynchronous gearless technology when modernizing buildings in pre-fabricated slab construction in a large city in eastern Germany. The architects apparently did not have the experience which is absolutely necessary to reach such a decision. The modernization strategy was selected simply on the basis of what was "up-to-date" at the moment. Gearless technology is not always the most sensible and/or the most economical solution. In the case of these slab structures unexpected EMC problems appeared later since the old electrical system was not suitable for synchronous gearless drives and their peculiarities. A gearless motor (and in particular the asynchronous versions) will naturally exhibit high winding capacitance in relationship to the case (ground), this being due to its great physical size. This is normally not a problem – provided that one uses suitable motor filters – in the usual situation when dealing with modern electrical networks and wiring or where the machine rooms are located at the foot of the shaft. Old buildings for which the electrical drawings are either not clear or not complete (often there are unexpected junctions between the neutral wire and the ground conductor) always present difficulties. The comparison between the winding capacitance for gearless drives and for a normal worm-gear drive (Figure 30) shows why this is. The factor is about 10!



 -for Liftreport and our customers-	Technical Customerinformation	KI0107e0
	Peculiarities in commissioning and maintaining gearless drives	2001-2008
	Advantages and drawbacks of gearless drives: which system is ideal?	page 5 von 5

The capacitance of the asynchronous gearless motor with its large number of poles – greater by a factor of about 10 – induces relatively high currents against ground. If the grounding potential is not directly identical with the foundation ground conductor, then capacitive currents may be propagated throughout the building. Often four- and five-conductor systems are mixed, the result being that the interference is carried away by the neutral wire instead of the protective ground PE (and that is undesirable). This interference lies in the range of the IF carrier frequencies for radio equipment and then become audible. In the first chapter we made note of the effect of inductance in longer feed cables (in particular where machinery is located overhead) in our discussion of the AddOn motor filter.

This example shows how important it is to examine in detail the environment in which the lift system will be operating before suggesting any particular lift to the owner. A word of comfort here: In new construction the problem described above should normally not appear.or

Which type of system is then correct?

Based on previous experience with individual projects we can – from the purely technical viewpoint – put forth the following suggestions.

You have sufficient space in the elevator room, great ascent height, high speed and/or high payloads and the building`s wiring complies with current practice? The asynchronous gearless system is the right concept here. In addition it runs especially quietly, has a long service life and is favourably priced. Emergency evacuation using batteries or an UPS is not, however, possible without great effort (an emergency diesel generator should be provided).

You have a lift which executes a large number of trips but a rather lower payloads and no space for a machine room? Then the synchronous gearless concept is the one to be used. Upward of 1 m/s it operates at very good efficiency and emergency rescue can be effected with a USP or battery system. Its low energy consumption is its primary advantage.

You are dealing with high payloads at low speed? Space is available and the number of trips is normal? Use the worm-gear transmission with asynchronous motor. The advantages are simpler commissioning and trouble-free emergency evacuation.

You are designing small lifts of short to medium ascent heights, have hardly any space available and have to observe cost constraints? Use machinery with compact gearing (3-turn worm gears with or without pinion gear stage;, hypoid gearing or planetary gear) with asynchronous motors.

You are dealing with a modern lift running at medium speeds, without a machine room, and more stringent requirements as to emergency rescue? Use the planetary gear with synchronous motor. The advantage here is that when constructing a glass-enclosed lift you can also show the optically appealing mechanical equipment.