

Marley Cooling Tower Company

P. W. Hink July 12, 1994

GEAREDUCER[®] MINIMUM SPEED

Minimum speeds of Marley Geareducers as documented in our Engineering Specifications and tower manuals are those speeds necessary to maintain a flow of oil to the upper bearings through our oil slinger splash lubrication system.

This flow of oil serves primarily to carry away the heat generated in the bearings due to the friction of the rolling surfaces, which is proportional to the power being transmitted through the system. While it only takes a very small oil film to adequately lubricate the bearings themselves, the heat generated will destroy the lubricating properties of that thin film very quickly.

The minimum speed requirement is based on the self-preservation (for Marley) assumption that the Geareducer could be applied up to its rated capacity. The rated capacity varies linearly with speed from the full speed rating. This means that at half speed the box is rated for half of its full speed power. This is based on the fact that the torque capacity is constant.

A fan pitched to draw the rated Geareducer power at full speed draws significantly less power than the Geareducer capacity at any lower speed because the power of a fan at a specific pitch is proportional to the speed ratio cubed. This means that at half speed the fan is only drawing one eighth of full speed power, which is 25% of the Geareducer's capacity at half speed. This also means that the heat generated from the bearing loads is significantly reduced. This difference becomes even more pronounced at lower speeds. At 25% of full speed, the fan power is 1/64 of full speed power, or about 6% of the Geareducer's capacity at 25% speed.

Marley has, to our knowledge, never experienced a lubrication related bearing failure because a fan windmilled for an extended period of time. We do recommend that our Geareducers be operated at half speed or above at least once a month to drive off any moisture that may accumulate in a box that is not seeing warm enough oil temperatures to keep it driven off. This has a secondary benefit of renewing the lubricant film on the bearings.

Consequently, Marley does not specify a minimum speed for our Geareducers that operate on a variable speed fixed pitch fan system because of concern for inadequate lubrication. This does not mean that there are no other possible problems associated with variable frequency drive systems operating at low speeds. It is the responsibility of whoever is designing or applying the variable frequency drive system to apply them in such a manner so as to not shorten the life of any of the rotating equipment because of excessive motor winding heating, harsh vibration, etc.