Subject: Commissioning procedure for forced draft heat exchangers with VFD operated motors.

Air cooled heat exchangers are constructed of many different structural members bolted or welded together. Each of these members has multiple natural frequencies in different directions. The fan blades also have a 1st mode natural frequency (simple bending mode) that must be avoided during operation. To adequately protect against possible resonance conditions at fans speeds from 10% to 100%, the following procedure will need to be performed.

Using a vibration analyzer with a velocity probe or accelerometer, take overall vibration readings in inches/sec peak units in the X, Y & Z directions (per following page) during a step wise increase in motor speed. Readings should start with VFD set at 10 Hz. Record overall vibration, and then increase motor speed in steps of 5 Hz. See sample table below.

VFD Setting	Overall Vibration (in/sec Pk) X	Y	Z
10 Hz			
15 Hz			
20 Hz			
25 Hz			
30 Hz			
35 Hz			
40 Hz			
45 Hz			
50 Hz			
55 Hz			
60 Hz			

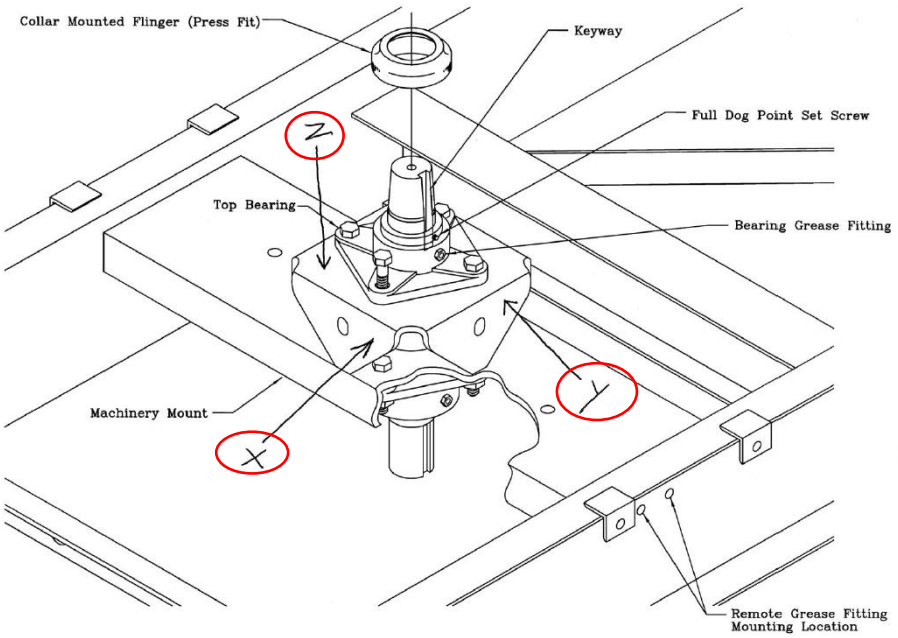

FIG. C2 – TOP BEARING

After all the vibration readings are taken, the next step is to lock-out the frequency bands that result in vibration over 0.350"/s peak to peak. More vibration readings can be taken with smaller step changes in the motor speed to determine exactly where the elevated vibration abruptly starts and dissipates. Another frequency range that may need to be locked out is when the 1rst mode of the fan blades get in resonance with blade passing frequency. Most of this can be found in the fan manufactures software. For example the "Campbell Diagram". API states to design the fan with a 10% delta minimum but some end-users specify 20%. If the fan is set up correctly often this is never an issue. Reference vibration paper by Norgren-Agius for more information on the proper set up for fixed wing fans at www.thefanguy.ca or www.thefanguy.com