CMVA 60 ULS (Ultra Low Speed) SKF Microlog – Where Can It Be Used?

By Dr. Bob Jones • SKF

There are laws of electronics and electronic processing that cannot be changed. Any time you are manipulating electrons, there are going to be trade-offs. And if there are not electronic limits to what you want, then there are economic limitations. With the standard model CMVA 60, and the standard 100 mV/Eng accelerometer, there are limitations on the low-end frequency response.

Accelerometer roll off combined with the normal internal electronic noise will produce the often mentioned "ski slope" so that velocity measurements below 100 CPM or so are usually masked. When the accelerometer is changed for a 500 mV/Eng unit, the low-end is improved, but the user wanting to balance a rotor at 20 r/min, for example, is going to have a problem.

The CMVA 60 ULS (Ultra Low Speed) will allow the user to obtain useful velocity information on rotors turning at 12 r/min. The author has stretched this a bit and has collected some data on 6 r/min mixers and, although the 1x signal has a broad base, the signal is usable. The trade-off is a slight increase in data collection time in response to the low frequency signal enhancements made in the CMVA 60 ULS.

We have identified a number of applications where the new data collector should provide results not obtainable from any source outside the laboratory in the past, unless of course you did not have any economic limitations. Without a doubt, as the ULS moves into the field, other applications will come to light and we look forward to hearing from users who have found these additional applications.

Fig. 1. SKF Microlog CMVA 60 ULS data collector.

Suggested applications for the CMVA 60 ULS

Steel industry

- Ladle bearing
- Turret bearings
- Continuous caster bearings
- Roll-out table bearings
- Traveling cranes

In the steel industry we have been successful in analyzing bearing condition using enveloped acceleration with vessel rotation speeds of 0.5 r/min. This required the use of time waveform analysis and measuring the time between energy pulses. This time span was converted to a frequency that was equal to the BPFO. Tear down of the bearing revealed damaged in the outer race, as predicted by the analysis (→ **fig. 2**).

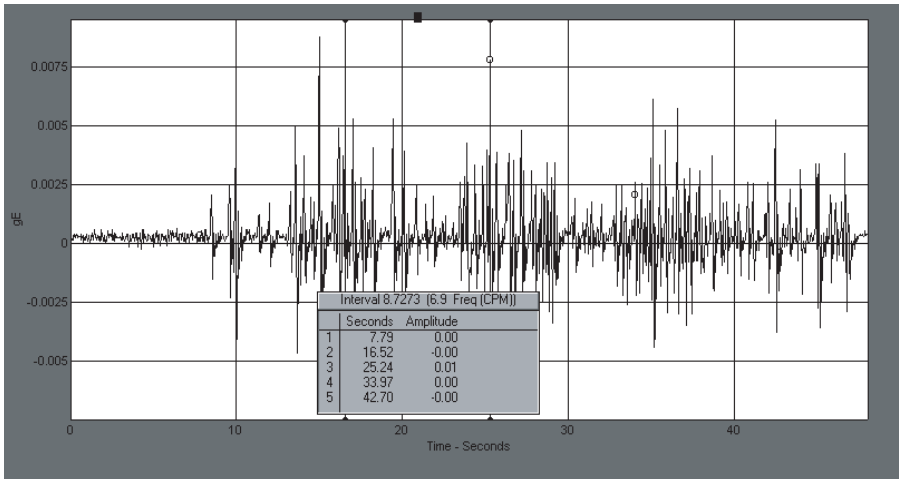

Fig. 2. Steel industry.

Automotive industry

- Conveyor drive gearboxes
- Conveyor bearings
- Overhead cranes
- Robots

The automotive industry is one group that is filled with robots; they do not take breaks, do not take vacations and do not complain. But they run on bearings, and if mistreated, bearings will fail. A downed auto assembly line cost is not measured per hour, it is measured per minute, and depending on the model on the line, the cost can be in the thousands. We were asked to evaluate the bearings in a series of robots. Again, using the time domain as in the previous example, we collected the waveform and looked for pulses of energy that would be generated as rolling elements passed over flaws in the rings or cages (→ **fig. 3**). Since none was found, we could assure the owner that the bearings were in good condition. It is better information to know that the bearings are in good condition than to find out there is a problem as there was in the steel mill.

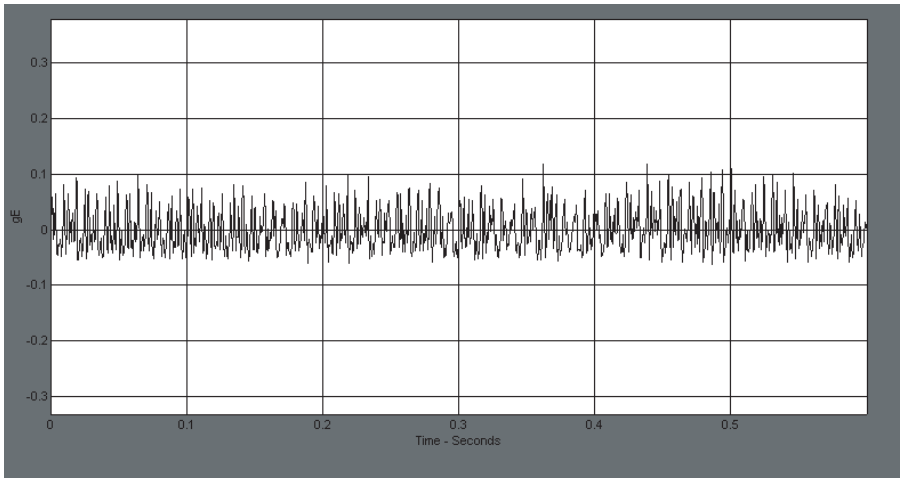

Fig. 3. Automotive industry.

General industry

- Cement kiln bearings
- Conveyors and drives
- Computer chip oven fans
- Satellite and radar azimuth bearings
- Radar antenna bearings
- Radio telescopes
- Dock-side slew bearings
- Wenches and crane lifting bearings
- Printing press rolls
- Coin punch press
- Railroad locomotives wheel and motor
- Railroad wheel truck repair

The railroad industry provides us with a unique situation. Their rules and regulations allow them to operate with bearings that are damaged within certain limits. Above those limits the bearing is repaired by grinding out the flaw, again within certain limits for the grinding. They were able to save considerable money after we were able to establish amplitude limits that were linear with the amount of damage in the bearing. By knowing prior to tear down what to expect, a number of wheel sets now bypass the repair station and are returned to service as is. The following spectrum shows indications of some damage; note the harmonics, but the overall amplitude 0.068 gE at 55 r/min was within the acceptable limits, therefore no repairs were necessary.

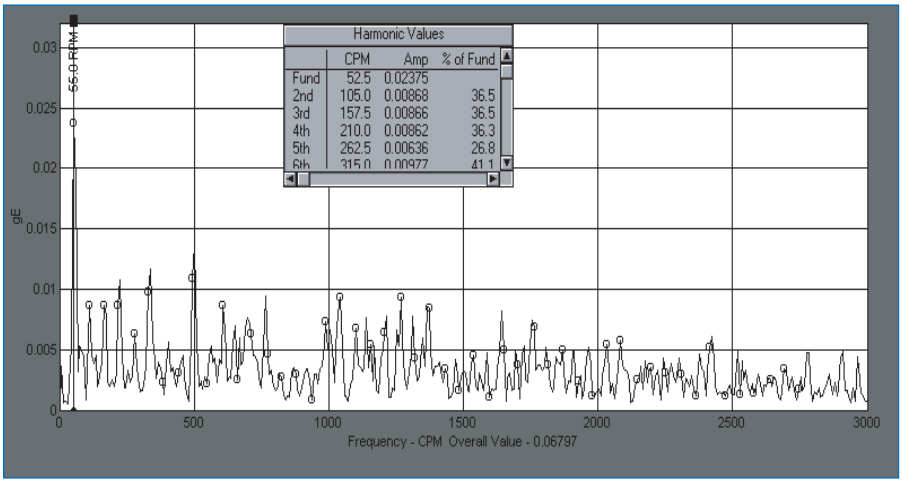

Fig. 4. General industry.

Power industry

- Turbine cranes
- Ball mills
- Filter screens
- Conveyors
- Wind turbines

Companies that use fossil fuel usually move the material with conveyor belts. Quarries and the mining industry are also users of slow speed belts. The owner of this tail stock bearing was concerned because it was made in Europe and the lead time for replacement was measured in months. On top of that, he did not know what kind of bearing was installed and the manufacturer was not being cooperative in supplying the information. A catastrophic bearing failure could put him out of business for several months. Measured at 110 r/min (**→ fig. 5**), the resulting spectrum with the energy at 5.85 orders of shaft speed and harmonics with some apparent unidentified sidebands led us to declare that the bearing was damaged and should be replaced as soon as possible. Since a catastrophic failure is generally 10 times more costly than a scheduled shutdown for repair, he proceeded to plan the replacement and to use a locally supplied bearing as a replacement.

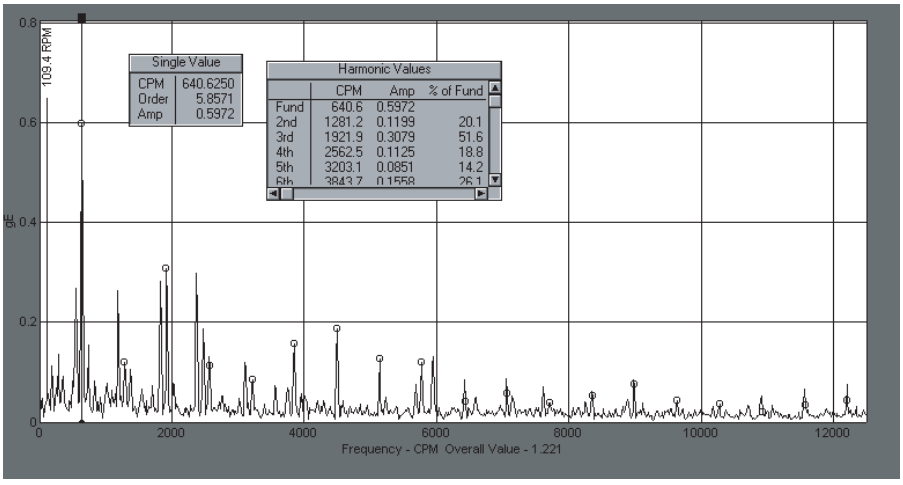

Fig. 5. Power industry.

Paper industry

- Production rolls and press
- Conveyors
- Mixers

The paper industry is probably going to be the largest user of the CMVA 60 ULS. On a paper machine there are numerous rotating elements that require analysis and balancing. The CMVA 60 ULS should be able to meet all of the requirements of this industry.

This customer had been using standard velocity measurements and had found that his amplitudes were trending up on this bearing. Suspecting bearing damage on his 30 year old paper machine, he asked us for confirmation. Much to his surprise, when we used enveloped acceleration we found the signal to be 33 orders of roll speed with sidebands of 202 CPM (**→ fig. 6**). It turned out that one of the drive gears had 33 teeth and the shaft speed was 202 r/min and we told him he probably had a damaged drive gear on the drive side. A damaged gear was found during the next inspection.

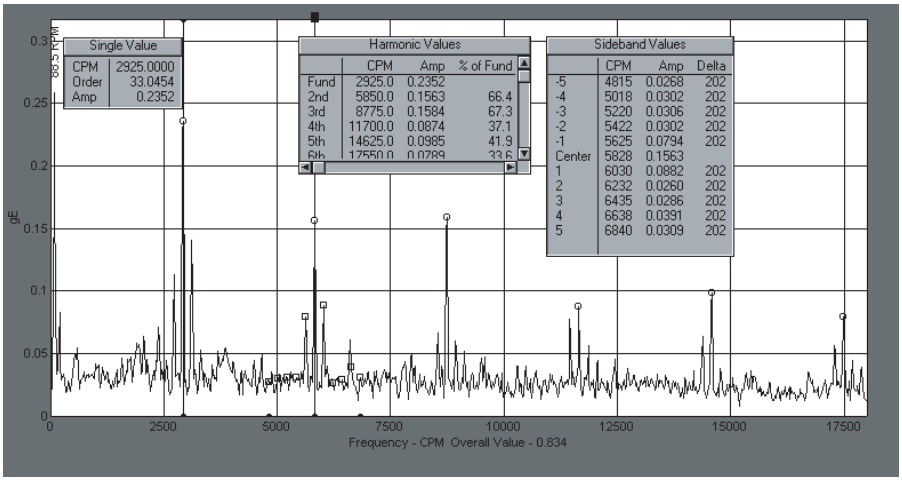

Fig. 6. Paper industry.

Chemical and Plastics industry

- Screw mixers/compressors
- Plastic thickness rolls
- Batch mixers
- Cranes

A new customer was receiving training for his vibration group and the following spectrum (**→ fig. 7**) was collected during the training. This was a brand new rebuilt motor on a critical air compressor. Loss of this unit when the motor had failed amounted to thousands of dollars until a portable compressor could be brought on site. The speed is not in the low range, but it is a good example to show that just because it is new does not mean it is good. We were not even troubleshooting, but when we saw a fundamental frequency at 4.31 orders of shaft speed and an amplitude of 1.7 gE, we expressed our concern that there was bearing damage. The motor shop did not like it one bit, but on the insistence of the owner, returned the portable compressor, removed the bearing and found the race to be damaged, probably on installation.

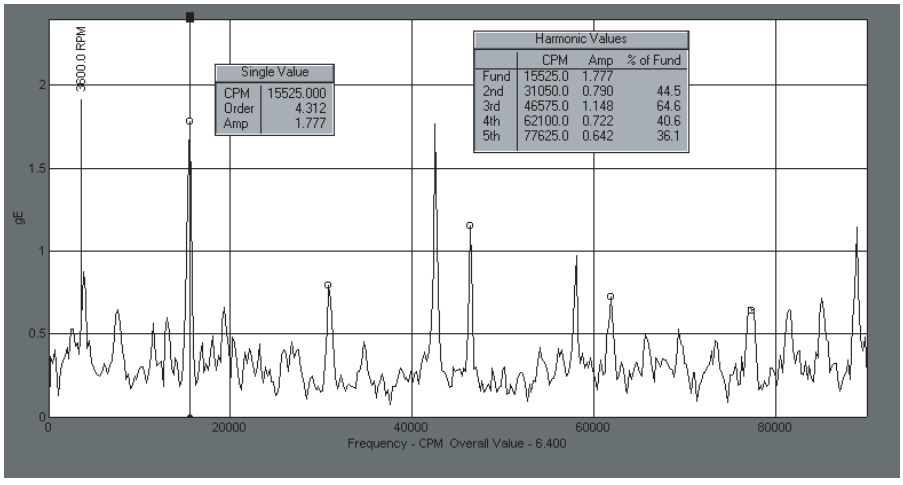

Fig. 7. Chemicals and Plastics industry.

Mining industry

- Tunnel boring machine
- Coal face grinders
- Conveyors/gearboxes

As stated in the beginning, one of the largest users of conveyors is the mining industry and their customers who transport the product at their sites. The mining environment is generally very hard on bearings, dusty, damp and not enough lubrication. The following enveloped spectrum (**→ fig. 8**) raised concern for this conveyor bearing because of the energy shown at 15.89 orders of the 70 r/min shaft speed in conjunction with 70 CPM sidebands. Because of the running speed sidebands and high number of orders, we felt it was probably a damaged inner race. A damaged inner race will nearly always generate sidebands because of the modulation occurring when the damaged area goes in and out of the load zone. So we informed the customer and he said thank you, but he did not want to shut it down. It may still be running, but sooner or later it is going to let go.

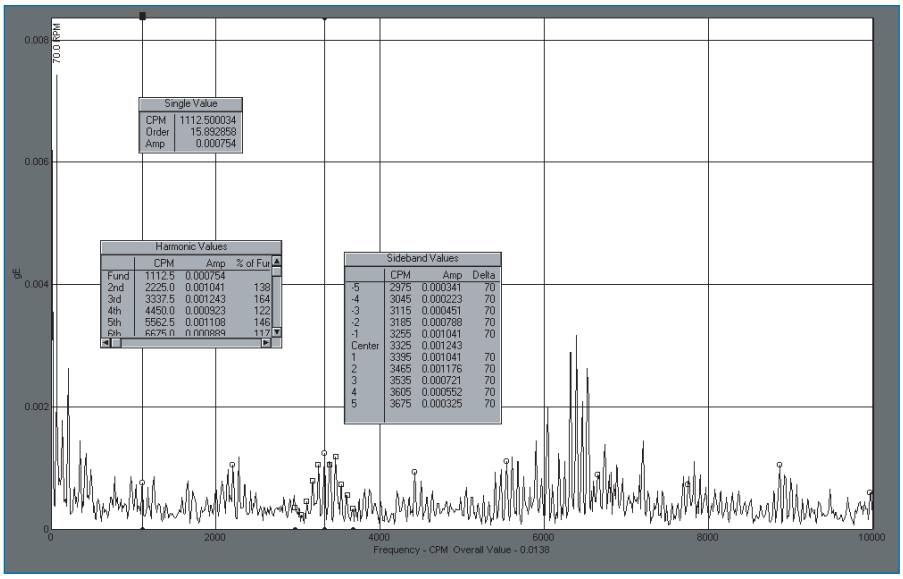

Fig. 8. Mining industry.

So here are some of the places where we have used the CMVA 60 ULS with success. Not all of these examples used the CMVA 60 ULS, generations of the SKF Microlog have excelled in low speed analysis, but the low frequency signal quality improvements in the CMVA 60 ULS takes this capability to a new level.

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