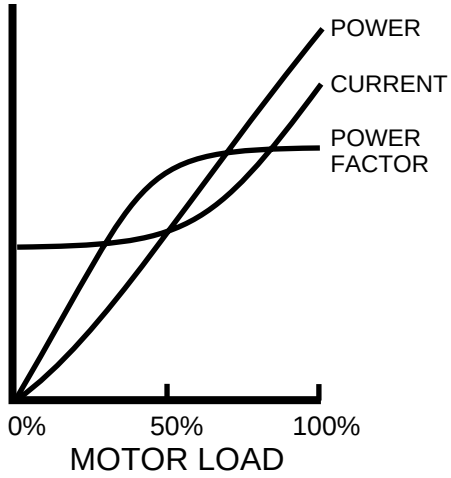
A HIGH-SENSITIVITY SELF-ADJUSTING DULL/BROKEN TOOL MONITOR

The COMPENSATOR Motor Load Control has proven to be a very effective unit for tool monitoring. It senses the spindle horsepower and has set points that are used to indicate dull tools and broken tools.

- By sensing power, rather than amps, it is sensitive enough to work with a wide range of tool sizes including small tools.
- By zeroing out the inherent machine drift with the COMPENSATOR, the control is quite precise.
- A special filtering scheme is used to insure fast response.
- It is easy to install since it requires no machine modifications.
- It is inexpensive.



SENSING POWER

The power input to a motor as measured in watts or horsepower is essentially linear for all motor loads and is the best indicator of the work that is being done by a motor. For a lightly loaded motor, the difference between measuring power and measuring current is dramatic. A 3% change in current is equal to a 30% change in power. In this situation, a power-measuring control is 10 times as sensitive.

CONTROL READJUSTMENT

The energy going into any process can be divided into two parts. The most important portion is the part that actually goes into doing the work. The second part of the energy goes into just keeping the machine turning. This is the idling or "baseline" power. This baseline power changes significantly as temperatures change, coolant and the lubricant viscosities change and the mechanical clearances change.

The curve shows two power cycle curves for an automatic machining process. One was at 7:00 in the morning and the other at 12:00 noon. Throughout the morning, the power required to do the actual work remained relatively constant with small cycle-to-cycle variations. However, the baseline or idling power dropped a dramatic 38%. This drop meant a change in the total power requirements of 17%. Without making some adjustment, a dull tool or machine overload trip setting would have a 17% error. Worse yet, if the load control were used to determine when the tool had touched the workpiece, there would be a 38% error.

To eliminate the need for adjustments as the machine characteristics change, the idling power or baseline power should be zeroed out for each machine cycle. By doing so, you are able to monitor and control only the amount of actual work that goes into the process.

THE COMPENSATOR LOAD CONTROL

The COMPENSATOR Load Control is a fast response control. A unique filtering system reduces the response time to 35 milliseconds or less including the relay response time. This compares with 250-500 milliseconds for a typical power transducer. The control also has a compensating feature which will zero out the baseline power. During each machine cycle when the process is in its baseline or idling position, a contact closure is sent to the control from a limit switch or from a programmable controller. This value is retained in memory during the next machine cycle. The control then looks for an increase above this baseline value.

DULL TOOL DETECTION

Dull tool detection is straightforward since the load increases as a tool gets dull. Just run a tool until it gets dull, watch the load on the load meter, and using the set read button, adjust the dull tool set point.

BROKEN TOOL DETECTION

Our studies have shown that it takes a large increase in power to actually break a tool. So, the dull tool set point will normally catch a tool as it is breaking. But, this is not foolproof, so you need to have an additional provision.

The first reaction is to think that the load decreases when a tool is broken, which is true. However, the load only decreases to the idle power, so you need to establish a timing window to look at the trip condition when you know that you are supposed to be doing work. For short cycle times, this gets tough to do.

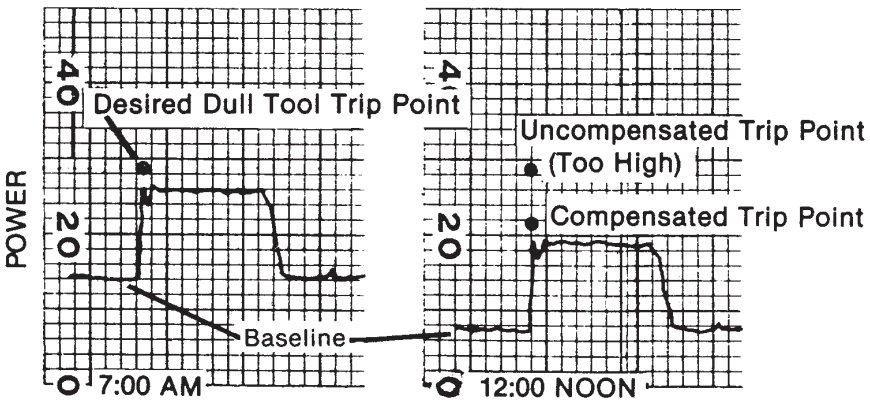
A simpler way to monitor for a broken tool is to make sure that work is done during each machine cycle. (If there is no increase in power, the tool is broken or no workpiece is present). Adjust the Set Point so that it trips for each cycle (you can probably just turn it to minimum since it is a Compensated set point that looks for an increase over the no-load level). If you have a cycle where you don't get a trip, don't start the next cycle.

MULTIPLE TOOLS

Although we have satisfied customers who are using the COMPENSATOR to monitor multiple tools running on a single spindle, we usually don't recommend it. A great deal of care is needed to set the trip points so that you can detect trouble with one tool out of many.

But, for monitoring a single tool on a single spindle, the COMPENSATOR performs just as well as the more sophisticated systems, which can be quite expensive.

BASELINE POWER CHANGE



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