



**TOOL MONITORING ADAPTIVE CONTROL**



## PROTECT YOUR CNC MACHINE

Caron Engineering's Tool Monitor Adaptive Control (TMAC) system protects your CNC machine while providing valuable information about your cutting process. The system reduces the high cost of replacement tools, lost production, and rejected parts by effectively measuring tool wear in real time. It operates on the principle that the horsepower required to cut a part increases as the tool's cutting edges deteriorate.

The "Adaptive" control feature of TMAC reduces cycle time and optimizes cutting conditions to improve tool life.



stop this



from becoming this

**PROTECT YOUR  
MACHINE TOOLS  
AND REDUCE  
OPERATING COSTS**

**LEARN:** TMAC learns the tools and their respective horsepower in "Learn Mode"

**SET LIMITS:** You program the horsepower limits (extreme, wear, and undercut) and enable adaptive control if required

**MONITOR:** TMAC Monitors and recommends corrective action

- Feed Hold
- Job/Cutting interruption
- Tool retraction
- Adaptively control the feedrate
- Other custom actions based on your needs



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## **TMAC Viewer - Horsepower Chart (Data) Recorder**

All TMAC Systems come packaged with TMAC Viewer, a program that runs on your PC under Microsoft Windows to record the Monitoring and Adaptive Control process. TMAC Viewer records and stores cutting horsepower, start/stop signals, alarms, spindle speed, and coolant data during machining operations. This data can be saved to a file and printed. TMAC Viewer provides the tools to diagnose cutting conditions and problems. In addition to the standard data elements recorded by TMAC Viewer, a variety of user-defined data elements can also be recorded and charted.

## **SPINDLE MAINTENANCE**

Spindle horsepower data can be used to track spindle life and predict spindle failure. The TMAC system's new spindle maintenance feature simplifies the task of collecting this data. Maintenance technicians can send a command to TMAC to record horsepower at a given RPM. This will generate a record in the spindle maintenance log on the TMAC PC that is monitoring the idle horsepower. By comparing these values over time, the condition of the spindle can be assessed.

## **LiveView – Remote Monitoring**

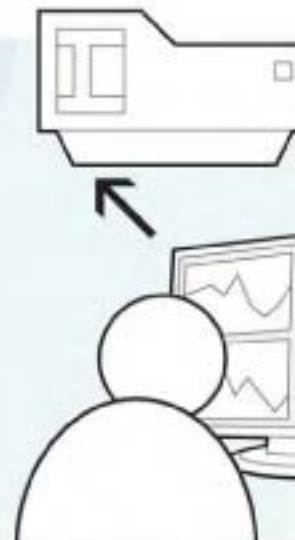
LiveView is a separate software application included with TMAC. LiveView runs on any PC and displays a real-time view of any networked PC running TMAC 7.12+.

- LiveView can be used to determine the run status of a machine without a trip to the shop floor.
- The TMAC "search" feature in LiveView allows quick identification of networked TMAC systems.
- Data collection can be initiated from a remote PC without interrupting the machine operator.

**Slope Monitoring  
provides the solution  
for lathe applications  
using Constant  
Surface Speed**

## **SLOPE MONITORING**

During constant surface speed cuts the spindle RPM can change based on the cutting diameter. When the speed changes, the horsepower also changes and can mask the effect the tool has on horsepower. This is where slope monitoring takes over. Instead of a level horsepower limit, the limits are applied at the slope of the horsepower increase or decrease. So, on a cut such as a facing operation on a lathe, as the spindle RPM increases and the corresponding horsepower increases the effect of the cutting tool can be extracted.







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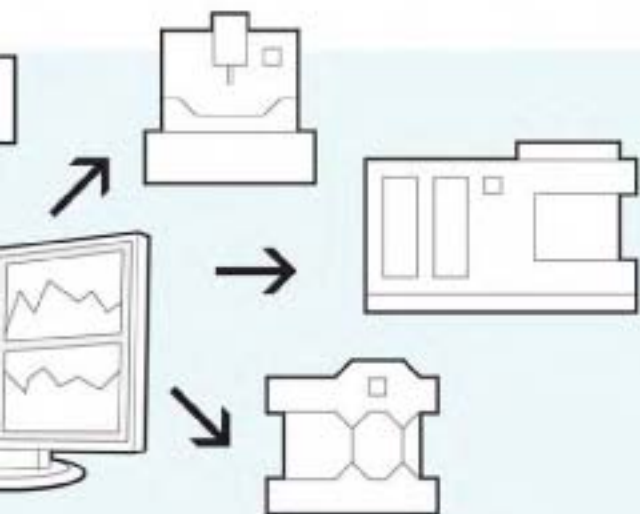
## ENHANCED COOLANT MONITORING

TMAC can be configured to monitor 4 separate channels of coolant flow and pressure information. Coolant flow and pressure limits can be set for each tool for precise monitoring of both "flood" and "through-the-tool" coolant sources. TMAC can learn coolant flow and/or pressure for each tool and apply these limits. When coolant flow or pressure drops below the limit, the system will issue a coolant alarm.

TMAC reads coolant flow data and pressure data dynamically from an external source, and graphs this data in real-time. Limits can be set in TMAC to generate an alarm on the machine if the coolant flow or pressure drops below an acceptable level. TMAC Viewer can be used to view the coolant flow and pressure data.

## ADAPTIVE CONTROL - Save Time and Money

Adaptive Control allows TMAC to regulate your machine's feedrate override, maintaining a constant spindle motor horsepower during cutting. This feature optimizes cycle times, and includes Adaptive Extreme Limit checking. Adaptive Control reduces cycle time by optimizing feedrates, reducing feedrates in hard spots, and increasing them in soft areas or voids. Tool life is extended when a tool continually cuts at its optimum horsepower. This feature optimizes cycle times and still provides limits to protect the machine and tool. A new built-in feature of Adaptive Control is the ability to control Approach and Exit feedrates with a fixed value.



## TMAC - Basics

Easy to install, program, and integrate with your CNC Machines

- Fine resolution of horsepower monitoring (down to .001hp)
- Fast response time (less than 10 milliseconds)
- Parallel, serial and Ethernet machine interface
- Simple calls added to the part program to start and stop the monitoring
- Real-time graphing
- Extreme, wear, and undercut limits for every tool and section
- All tool limits stored in job files on PC or networked hard drives
- Event log showing date and time of all TMAC actions

**"TMAC is a necessity for any unattended machining. The ease of use allows anyone to quickly apply it and immediately see the benefits."**

- Rob Caron, PE - President



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## **AUTOMATIC TIME INCREMENTED LIMITS**

This feature provides the ability to change the monitored cut limits based on a timer rather than specific directions from the CNC program. A start command from the CNC starts a timer. A job operation can be programmed to invoke different cut limits based on the timer. This can be useful for monitoring "canned cycles" where start and stop commands can not be inserted directly into the CNC program. This feature is most useful for monitoring taps where constant spindle reversals make standard tool monitoring impossible.

## **NEW TAP OUTPUT**

TMAC can supply a separate signal to a CNC machine that is sent only when a tool is designated as a "tap". For a tapping operation on controls such as the Okuma THINC control, TMAC can send a signal directly to the control on an alarm that will reverse a tap out of the part before stopping the machine.



## **TMAC - Standard Features**

- Adaptive Control
- Automatic Time Increments
- Coolant Monitoring
- Slope Monitoring
- Tap Control
- TMAC Viewer
- TMAC LiveView
- Spindle Maintenance

## **TMAC - Optional Features**

- Adaptive Control Integration
- Spindle Speed Monitoring
- Coolant Flow and Pressure Monitoring
- Additional transducers based on your needs (e.g. main spindle and live tooling on lathes)
- P11TF12 Capabilities
- Connection to external Coolant Flow/Pressure monitoring