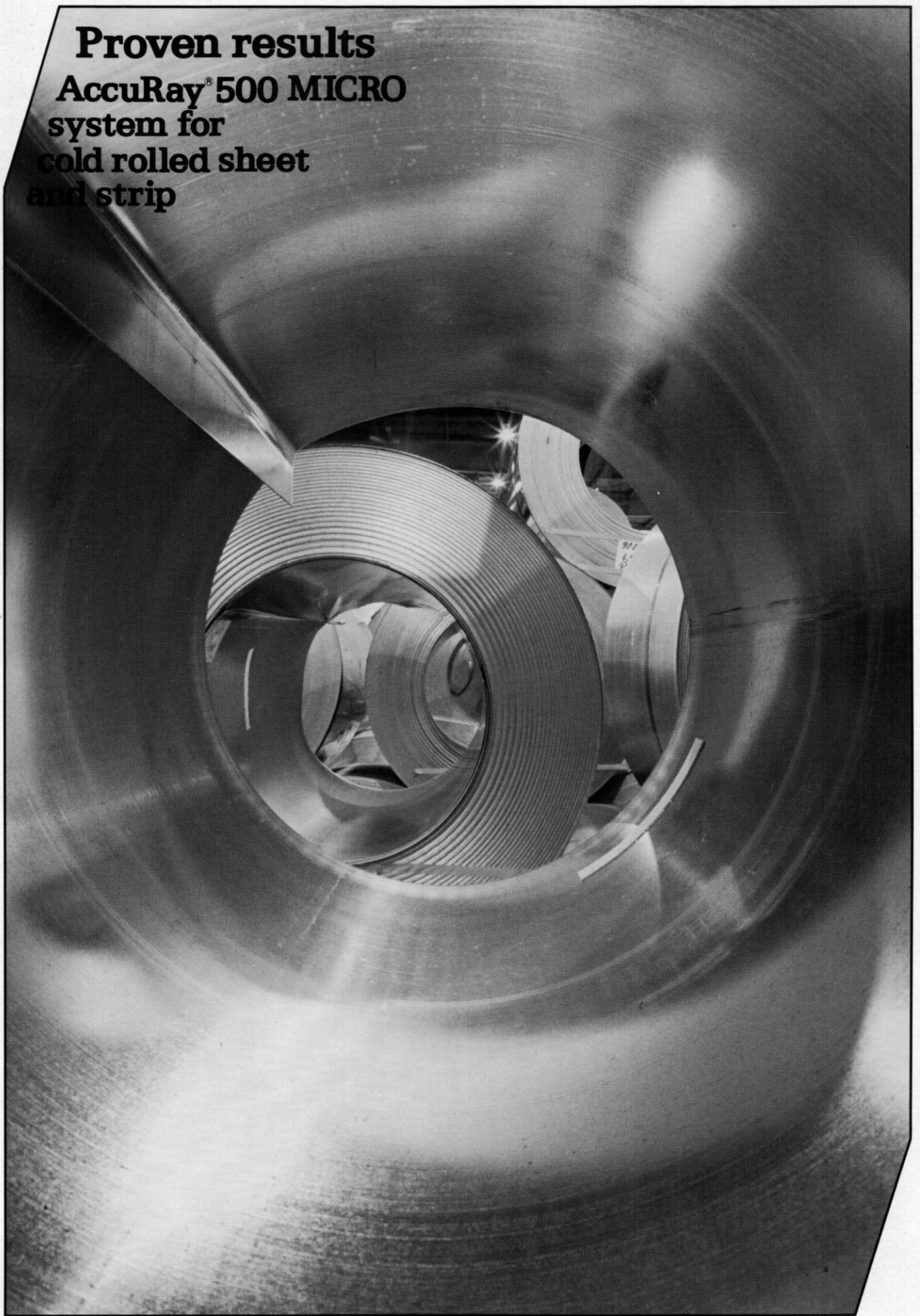
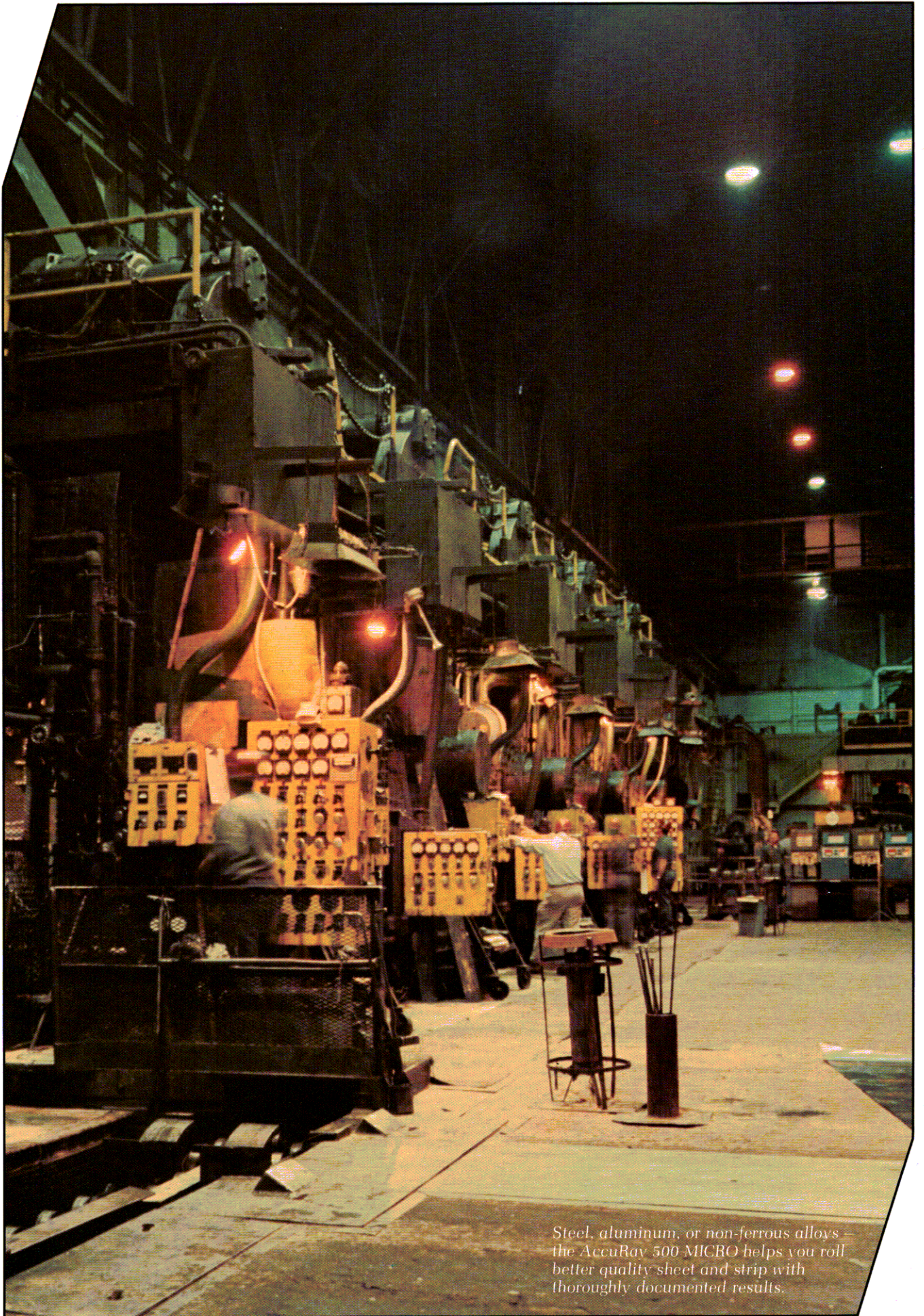


Proven results
AccuRay[®] 500 MICRO
system for
cold rolled sheet
and strip





Steel, aluminum, or non-ferrous alloys – the AccuRay 500 MICRO helps you roll better quality sheet and strip with thoroughly documented results.

Focus: on Results

The AccuRay[®] 500 MICRO Means Quality Product, Higher Profit

Your costs are rising. Customers demand tighter tolerances and better quality control. Now more than ever, you need to be able to control exactly what is happening to each coil you roll and just how closely each coil comes to target gauge. That means accurate measurement, tight control, and comprehensive documentation, more than just a mike or a gauge can provide. You need the full capabilities of the AccuRay 500 MICRO system.

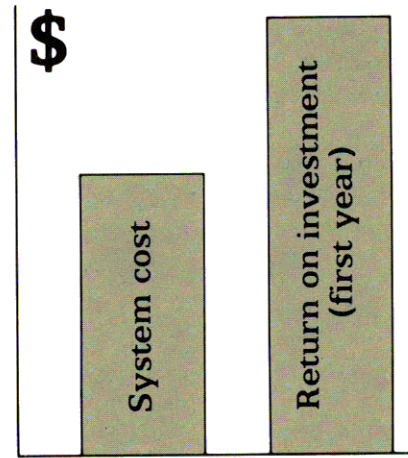
The AccuRay 500 MICRO combines advanced electronics and superior sensor technology with over a quarter century of AccuRay experience in process measurement and control in the metals industry. In well over a hundred installations worldwide, the AccuRay 500 MICRO has established its track record for accurately measuring sheet and strip thickness, recording comprehensive data on each coil, and, when used on rolling mills, controlling the mill to gauge. More than half of the sales of the AccuRay 500 MICRO are repeat orders.

The AccuRay 500 MICRO can mean results like these on your rolling mills —

AccuRay 500 MICRO Typical Results

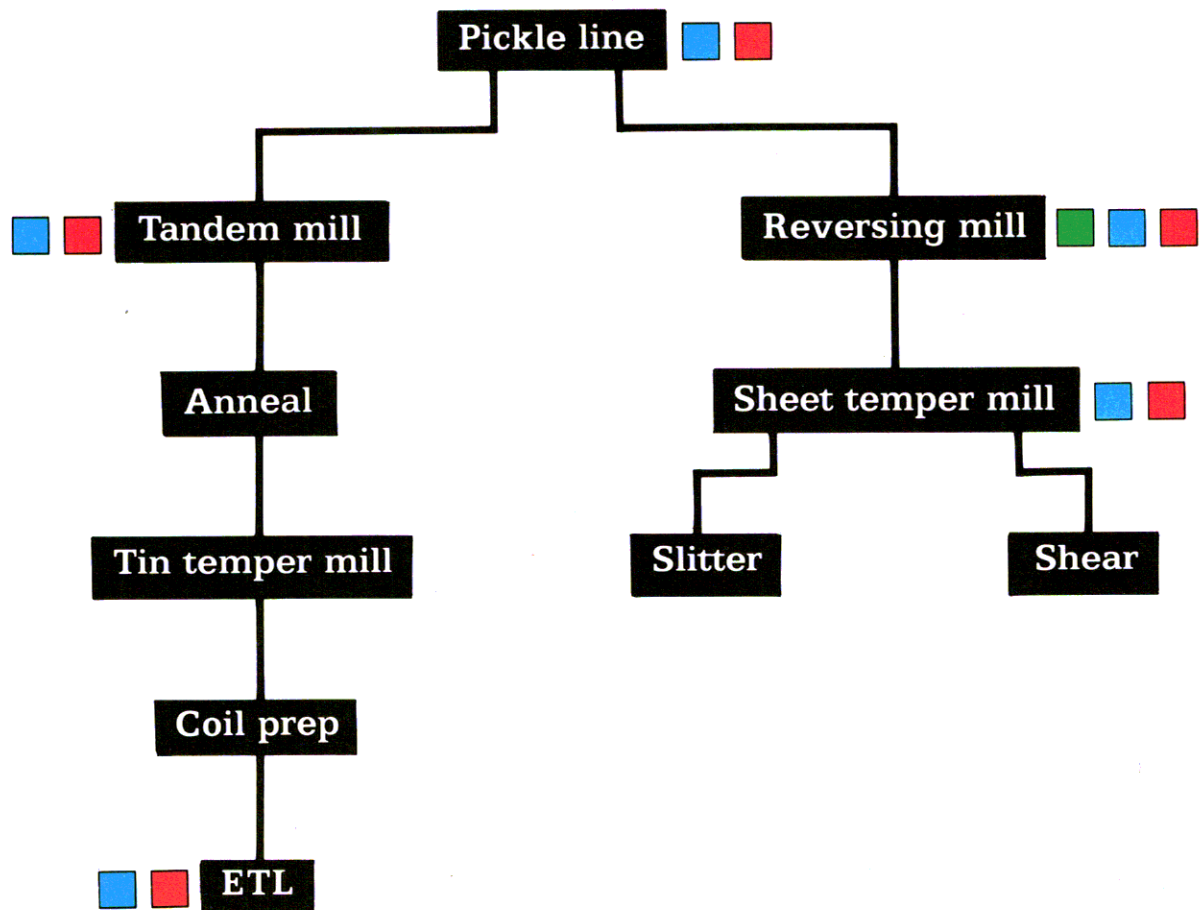
- 0.5-1% increases in yield (25-50% reductions in TMW giveaway).
- 70-85% reductions in coil-to-coil thickness variations.
- 50% reductions in within-coil thickness variations.
- Fewer sheet breaks.
- Less scrap.

While results like these are impressive in themselves, the system's return on investment for rolling mills is even more impressive. The average payback is less than one year, and that includes installation costs.



First-year savings are invariably greater than the capital cost of the AccuRay 500.

The measurement and documentation capabilities of the AccuRay 500 MICRO also pay for themselves on other processing lines — pickling lines, slitters and temper mills, and inspection lines — wherever accurate measurement and quality control records can mean dollars saved. One company saved 100 feet of finished strip per coil by cropping to gauge instead of using standard crops. Another company qualified its sheet with important buyers using quality control records generated by the AccuRay 500 MICRO.



■ measurement

■ documentation

■ control

The AccuRay 500 MICRO pays off in many locations in a rolling mill, wherever accurate measurement and quality control can mean dollars saved.

Wherever decisions that affect profits are made – that’s where the AccuRay 500 MICRO belongs. At the pickle line, the AccuRay 500 MICRO System is used to inspect hot bands, calculate more accurate billing weights, and provide gauge variation data to improve rolling. On the tandem mill, the system provides accurate gauge information (both exit and interstand) for better control. On reversing mills, the 500 MICRO puts computer control in the hands of operators at a fraction of the cost of previous systems. Sheet temper mills with 500 MICRO capability mean TMW information and accurate weight for immediate billing data. And an AccuRay 500 MICRO at the ETL exit allows final inspection and documentation of canstock gauge quality.

Focus: on Measurement, Control, Documentation

Here's How the AccuRay 500 MICRO Helps You Roll Better Product

The ideal objective for every rolling mill is to turn out uniform sheet and strip on target. The AccuRay 500 MICRO can bring your mill closer to that ideal than any other system on the market today.

The AccuRay 500 MICRO Fits into Your Mill

The AccuRay 500 MICRO system consists of three discrete modules — for measurement, control, and report functions. This allows complete flexibility of placement to accommodate the layout of your mill. AccuRay 500 MICRO control panels can be placed with existing operator stations along the length of a tandem mill, or they can be conveniently grouped together on an inspection line.

On reduction mills, all three modules are generally used. However, the control module may be omitted, and the measurement and report modules interfaced with an existing AGC system using simple, plug-in hardware.

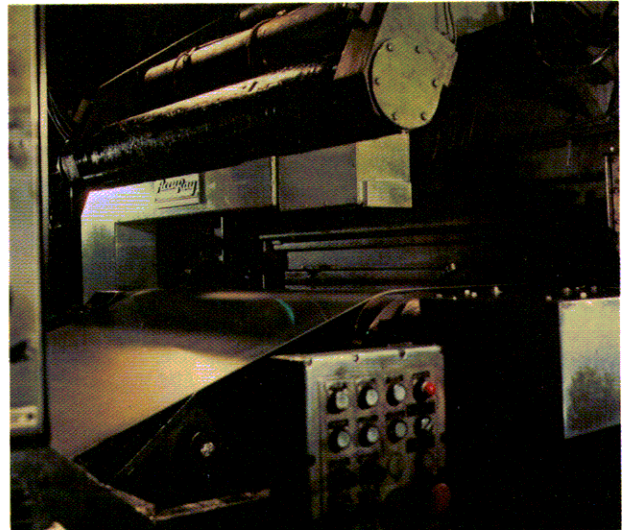
Elsewhere in the plant, the measurement and report modules are used to aid tracking and to inspect prior to making disposition decisions.

Accurate Measurement Basic to Quality Control

Good quality control begins with accurate measurement. It's the basis for automatic gauge control that can reduce coil-to-coil thickness variations by up to 85% and reduce within-coil variations by as much as 50%. These improvements can result in yield increases of up to 1% (up to 50% reductions in TMW giveaway). And there are corollary benefits — less scrap, fewer sheet breaks, and higher throughput.

The measurement module of the AccuRay 500 MICRO is comprised of a radioisotope sensor and supporting frame, microelectronics for signal processing, and an operator station at which data can be entered and measurement readouts displayed.

Field-proven measurement sensors are available in any of several application-matched geometries for the greatest accuracy over a wide range of metals (steel, aluminum, or non-ferrous alloys) and product thickness. All sensors are permanently calibrated at the factory and provide a dynamic accuracy of $\pm 0.5\%$. Total electronic drift over a 24 hour period, without standardization, will not exceed 0.1% of the measurement signal.



The AccuRay 500 MICRO measures strip thickness more accurately, more reliably than x-ray or contact devices. Patented source encapsulation for Americium-241 prevents thickness measurement noise or step-outs due to vibration or shock.

The sensor may be positioned by the operator at any point across the sheet, on-sheet for measurement or off-sheet for easier threading and servicing. One frame option allows the operator to call for a demand scan, a single scan of the full sheet width, at the push of a button.

The operator panel displays real-time coil thickness along with highly visible, color-coded alarms that indicate off-gauge conditions. An optional strip chart recorder display may also be used.



The excellent history of acceptance by mill personnel indicates the ease with which the AccuRay 500 MICRO fits into the normal routine of the rolling mill. All operator stations feature dedicated pushbuttons in a simplified panel layout. Digital readouts and deviation meters provide real-time information, and the mode of operation is shown by backlighted indicators.

Precise Control to Target Gauge

The goal of any AGC system is to reduce variations in coil thickness, but the real challenge is to design a system flexible enough to do an optimum job on the complete range of products that the mill rolls. And that's just what the control module of the AccuRay 500 MICRO does.

The microcomputer-based control module receives signals from the measurement module and processes them into correction signals at the rate of 30 per second. The unique AccuRay adaptive gain concept optimizes the correction signal according to alloy or grade to assure the best response from the reduction mill. The control module is readily adapted to one-way mills or reversing mills.

The control module memory stores data on up to 63 pre-selected alloys and grades. When the operator enters the desired reduction and the coil width, the microprocessor calculates the optimum adaptive control gain for that coil.



The AccuRay 500 MICRO records thickness, calculates weight, provides data for the most economical cropping, and classifies coils for billing. Comprehensive quality control documentation provides a decisive marketing tool.

Control is accomplished through the use of pay-off reel tension, screwdown control, or a cascaded combination of both. The AccuRay 500 MICRO also compensates for screwdown backlash. While the coil is being run, the system monitors key variables and inhibits control if mill or product limits are reached.

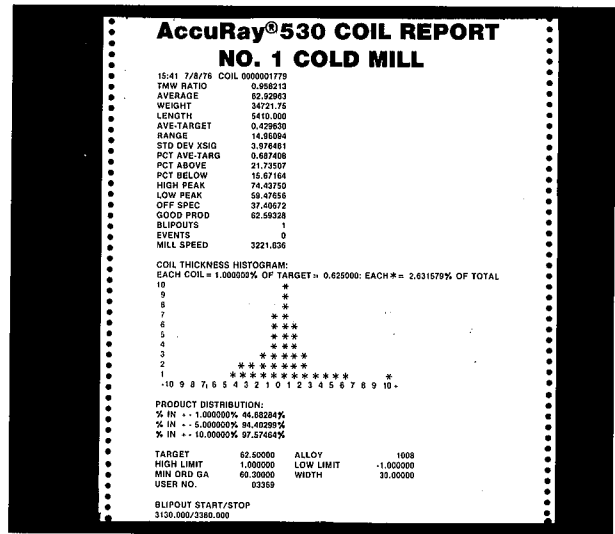
Full Quality Control Documentation

Printed records from the AccuRay 500 MICRO mean faster identification and correction of the source of off-gauge conditions, more accurate product classification, improved billing, and an organized flow of critical data that can provide the basis for management decisions involving operational improvements, capital expenditures, renovation, and maintenance schedules.

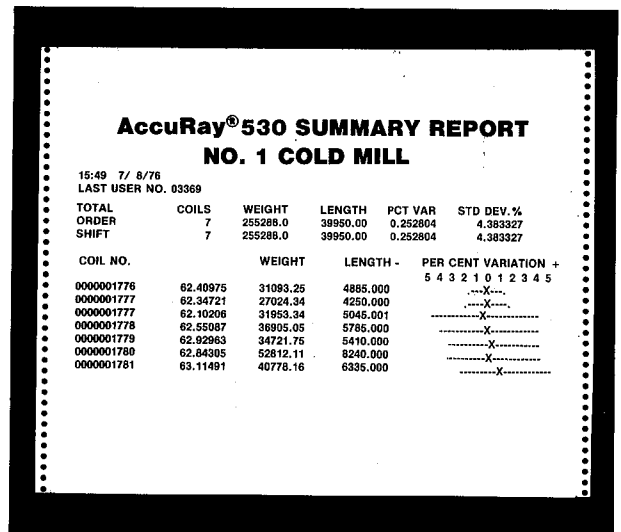
After each coil is run, the AccuRay 500 MICRO prints out a coil report, including coil number, target gauge, average gauge, percentages of off-grade and on-grade product, coil length, and start/stop footage readings of blipouts. It also calculates the total weight of the coil so accurately that some clients have eliminated weighing operations.

At the end of each turn, the AccuRay 500 MICRO generates a summary report showing total production by coil and the deviations from target gauge in a graphical format for quick review of turn performance.

The 500 system's report module has two output ports. The primary port drives the system printer for mill operation use. The secondary port permits a direct computer link, or a link to a remote computer peripheral such as a tape deck, or an optional remote printer for management use.



The coil report provides full documentation of all the critical variables that affect quality.



The summary report provides a quick analysis of performance and production of mill and crew for each turn.

Focus: on AccuRay

Here's Why the AccuRay 500 MICRO Delivers 99% Uptime

Twenty-five years of experience ensure that the AccuRay 500 MICRO is designed and built to operate in the hot, abrasive environment of the rolling mill. From the "C" frame and the sensor to the corrosion-resistant electronics cabinets, the AccuRay 500 MICRO needs no special cooling provisions, no air-conditioned enclosures.

The long-lived radioisotope source in the sensor is encased in a high-integrity, hermetically sealed container. Employing a fail-safe shutter, the sensor is fully shielded and meets or exceeds all government safety standards.

Designed for Long-term Reliability

Microtechnology employed in the AccuRay 500 MICRO system, combined with the exclusive use of a Datatrac™ bus for reliable communication between system memory components, has allowed an 80% reduction in the number of hard-wired interconnects, a major cause of failure in electronics systems. Permanent computer programs now replace thousands of discrete hardware components.

The measurement sensor of the AccuRay 500 MICRO is supported by microelectronics. They permanently store all of the calibration data for accurate signal processing for real-time display and trouble-free communications to the other two system modules.

Computations performed by the AccuRay 500 MICRO are carried out in the distributed intelligence modules. Microcomputers have the same basic flexibility as minicomputers, but are less expensive and can be more readily serviced by in-plant personnel. Based on large-scale integrated circuits, the microcomputer memory utilizes random access (RAM) and programmable-read-only-memory (PROM) devices. Current instructions and information related to thickness

control are held in RAM for instantaneous access by the microprocessors. Programming and file data are stored in PROM — a feature that allows retention of basic memory if plant power is interrupted and a self-initiated cold start by the system when power is restored.

Every one of the solid-state electronic components used in the AccuRay 500 MICRO is tested rigorously and "burned in" before use to eliminate infant mortality inherent in all solid-state devices. Those components that pass the screening are permanently built into printed circuit boards using reliable flow-soldering techniques.

Subsystems of the AccuRay 500 MICRO — printed circuit boards, for example — are also thoroughly tested to verify the component screening and to make sure they perform flawlessly.

AccuRay has dedicated several man-years to the development of a large scale engineering computer (Multics) used for system programming, diagnostics, and engineering studies.



The relative simplicity of the AccuRay 500 MICRO modules contribute to the system's overall reliability.

All sensors are factory-calibrated using Multics. A model of sensor performance is used by Multics to generate the calibration constants required for the accurate performance of each sensor. Because of the sophistication of the model, the calibration is more accurate than could be achieved by using a minicomputer and/or actual samples on the mill floor as part of the installation procedures.

The final stage of initial commissioning is a thorough diagnostic check of the complete AccuRay 500 MICRO system. Computerized testing devices take every component through a rigorous routine designed to reveal any electronics flaws, ranging from a poor connection to a malfunctioning subsystem. In a sense, each AccuRay 500 MICRO has already passed performance trials even before it is shipped to your mill.

The last job of the Multics computer is to print out complete wiring documentation for the AccuRay 500 MICRO. An accurate wire list is delivered to the customer for fast service and maintenance.

Easy Installation, Service, and Repair

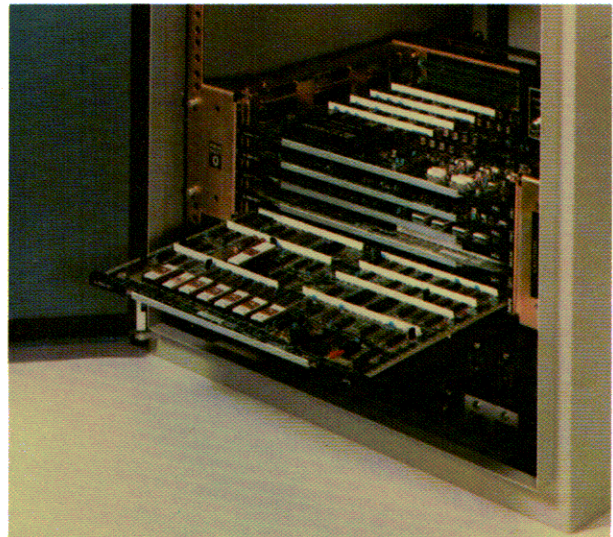
Even installation is fast and simple. Electronics and operator panels are compact and can be conveniently placed near existing control boards. The "C" frame and sensor can be installed during regularly scheduled downtime, and hookups between modules and between the mill and the system can be complete in a matter of hours. Checkout procedures are usually completed in less than a day, and AccuRay systems engineers are then available for fine tuning and operator training.

A primary design criterion of the AccuRay 500 MICRO system was serviceability. Servicing can be performed by mill personnel following a formal training

course conducted by AccuRay. Self-diagnostics and thorough systems documentation simplify the job.

The measurement module of the system runs through an automatic check cycle at the end of each coil. Self-diagnostic routines exercise the electronics to verify their performance. If, for any reason, the accuracy of the sensor is below standard, an alarm signal on the operator panel lights up, and the sensor cannot be used until accuracy has been restored.

Microprocessors in the control and report modules have similar diagnostic routines that are automatically initiated at startup. Any trouble is specifically identified down to the circuit board level through light-emitting diodes.



All-solid-state electronics, minimal interconnects, thorough testing, and self-diagnostics contribute to an uptime of better than 99% for the AccuRay 500 MICRO.

All of the component parts of the AccuRay 500 MICRO have been grouped into Optimum Replacement Units for easy replacement from on-site inventory. Most of the electronics, for example, are on plug-in circuit boards.

Focus: on Action

Proven AccuRay 500 MICRO Results For Your Mill

You can achieve substantial results in your mill with the AccuRay 500 MICRO system — the same kind of results that are being achieved daily in over a hundred installations throughout the world. On reduction mills, on pickling and annealing lines, on slitters and temper mills, and on inspection lines, the AccuRay 500 MICRO measures, controls, and documents to help you roll better sheet at higher yields with less scrap.

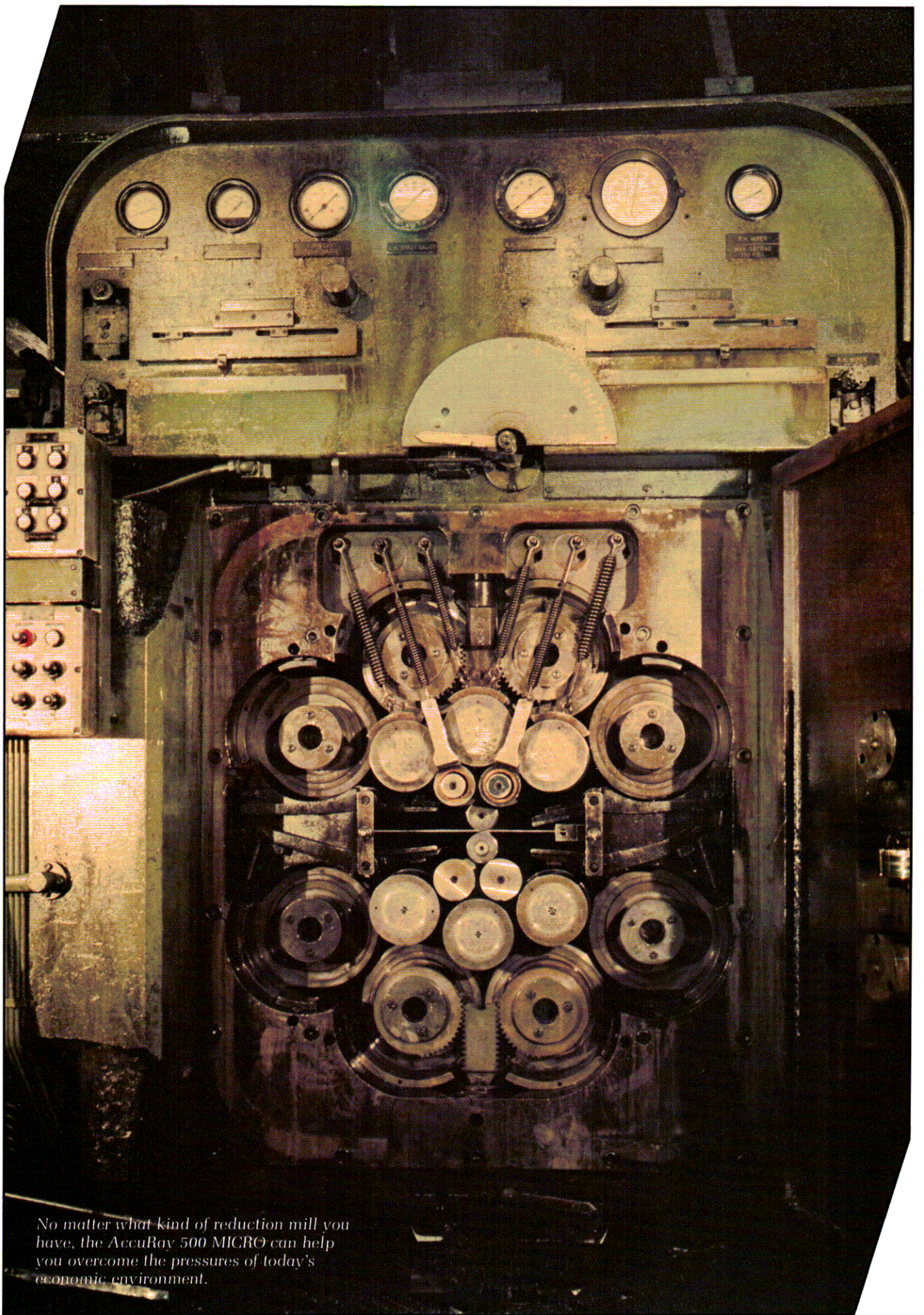
The AccuRay 500 MICRO represents a relatively inexpensive answer to some traditionally expensive problems. The system has extended the life of apparently obsolete equipment, allowing companies to produce tighter tolerance strip for a highly competitive market without investing in new reduction mills. Companies have been able to improve quality and yield through operational changes at the hot mill based on coil quality documentation from the AccuRay

500 MICRO. And in other cases, replacement of inaccurate sensors with an AccuRay 500 sensor module improved AGC sufficiently enough to reverse initial assessments calling for new AGC systems.

Your AccuRay account manager can consult with you on any quality control problem in your rolling mill to determine the value of an AccuRay 500 MICRO system in a solution. And he can survey your total facility to advise on the best installation plan for multiple AccuRay 500 MICRO systems — an installation plan that will yield the highest return on investment.

Write us.

AccuRay is a registered trademark of Industrial Nucleonics Corporation, 650 Ackerman Road, Columbus, Ohio 43202.



No matter what kind of reduction mill you have, the AccuRay 500 MICRO can help you overcome the pressures of today's economic environment.

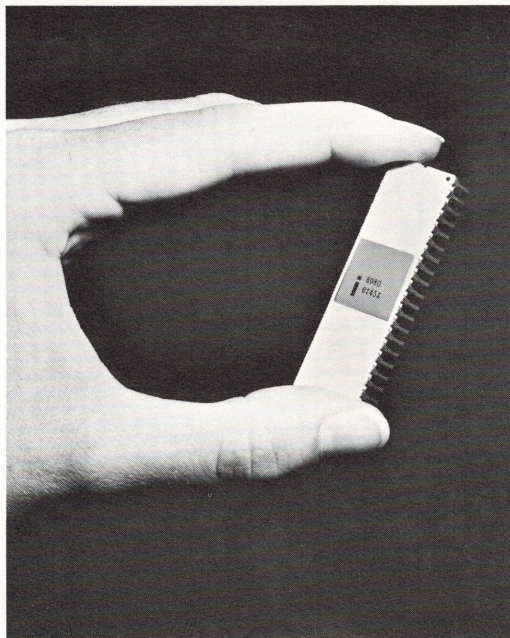
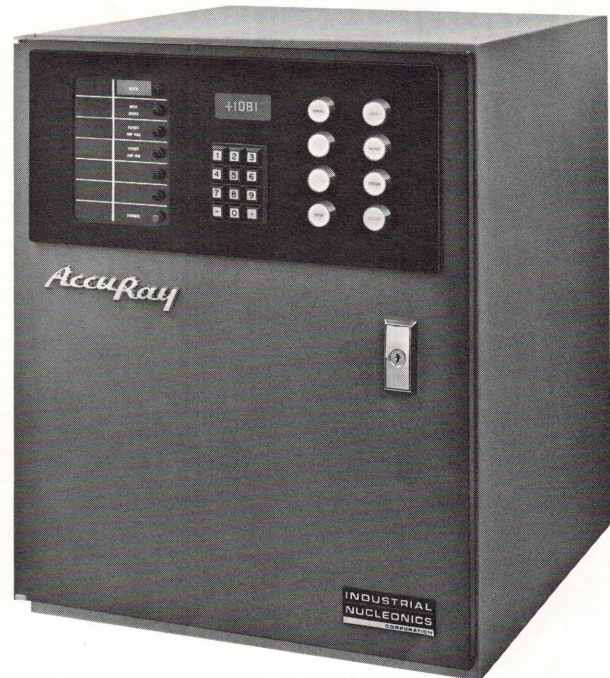
The 520 automatic gauge control module holds thickness of flat-rolled products much closer to target. The reduction in variations generally ranges from 25% to 50%. Also realized are corollary benefits—a drop in amount of “overweight” strip produced, less scrap, fewer sheet breaks to interrupt rolling, and higher throughput.

Two factors contribute substantially to this performance.

The first is that control is based on extremely accurate determination of deviation of actual strip thickness from target.

The gauge deviation signal is fed to the 520 by the 510, the measurement module which is basic in the AccuRay 500 system. The 510 continuously measures strip thickness, compares the measurement to target or aim gauge, and outputs deviation as a signal proportional to the thickness error.

The second factor is use of a microprocessor—a large-scale integrated chip of silicon which can perform arithmetic and logic functions from instructions and information stored in memory.



MICROPROCESSOR TECHNOLOGY

In the 520, this computer on a chip is used with up to 9,000 eight-bit words of random access memory and up to 23,000 words of programmable read-only memory. Transient instructions and information related to strip thickness control are held in RAM. Most programming and data, however, are stored in PROM—a feature which allows retention of memory if plant power is interrupted and a self-initialized cold start by the module when power is restored.

Use of the new technology gives the 520 the arithmetic, logic, and memory capabilities to respond to product and process changes and to execute the advanced control algorithms necessary to improve rolling.

In addition to the gauge deviation signal, the module accepts grade or alloy designator and thickness target from the 510. These numbers allow automatic selection of algorithm parameters most suitable for control of the product being rolled.

CHOICE OF MODE

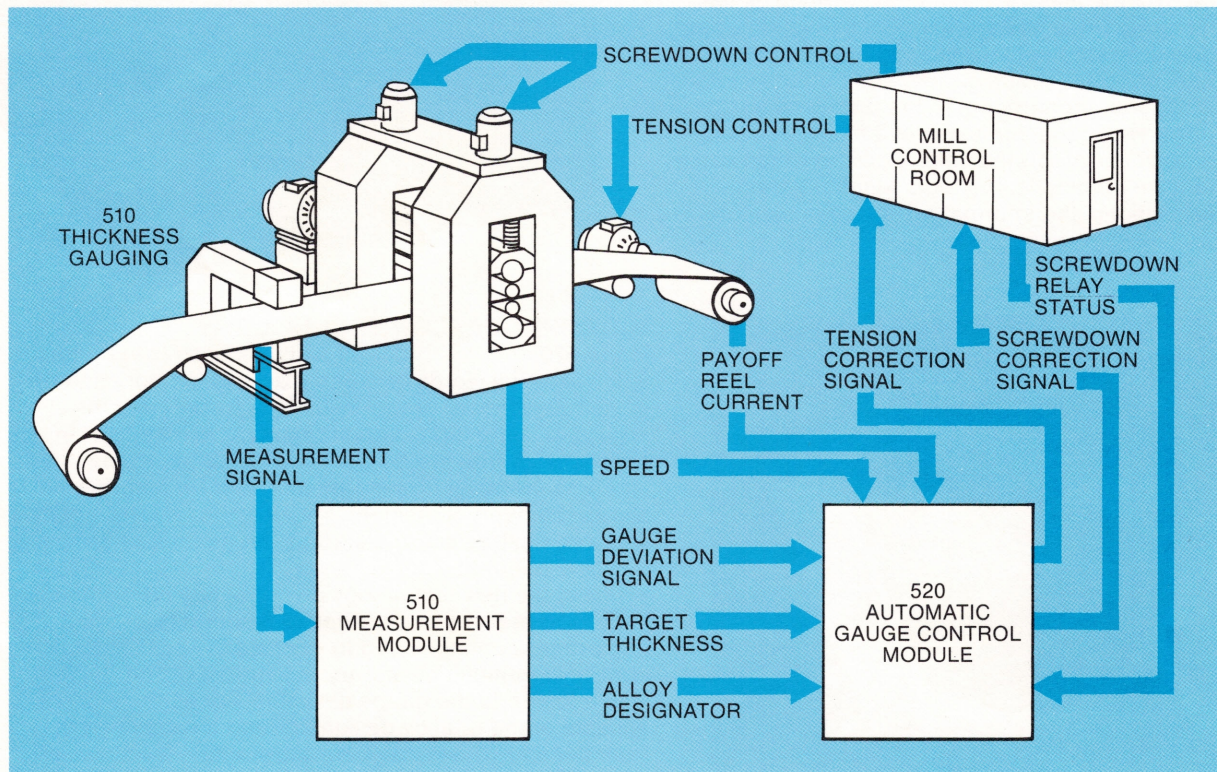
The 520 operates in any of three modes of automatic gauge control—screwdown when large adjustments are needed, payoff reel tension for fine control, or a cascaded combination of both. Module outputs for control purposes are on-off contact signals for relays in screwdown motor circuits and a continuous current reference signal for tension regulators.

The proper mode is selectable by dedicated pushbutton.

The dedicated buttons—along with a numeric keyboard for entry or call-up of data, a digital display, and annunciators which backlight to warn or report on status—are functionally grouped to simplify module use.

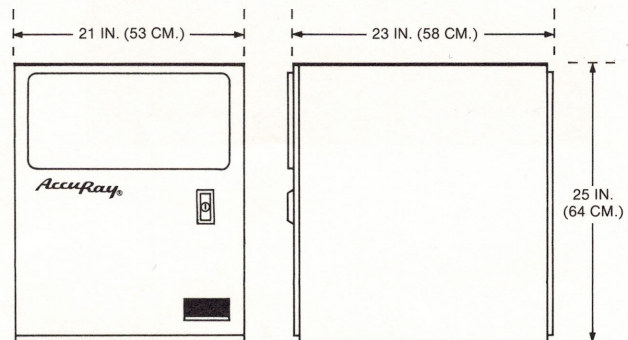
FEATURES

- Computes best setup for control of each product entering mill on basis of grade or alloy, cross-section, and percent reduction.
- Allows selection of most suitable mode of control—screwdown, tension, or cascade—for product being rolled.
- Tailors outputs, both screwdown and tension correction signals, to fit characteristics of mill control hardware such as relays, motors, and gearing.
- Compensates for simple backlash so that automatic screwdown is of sufficient magnitude for desired thickness correction, for differential backlash so that shape correction made by manual "tilt" adjustment is maintained.
- Provides non-interactive cascade control so that introduction of a thickness error, as in the case of some controllers, is unnecessary to keep primary control within its range.
- Monitors key variables to protect mill equipment by inhibiting control output and alarming when required.
- Permits two-way communication through an easy-to-use operator panel and, to eliminate guesswork associated with adjusting analog pots or reading meters, in a digital format.



SUITABLE FOR PRODUCTION FLOOR USE

Use of the microprocessor, coupled with protective housing of components and circuitry in a heavy-gauge steel cabinet, gives the module computer capabilities which can be employed on the production floor. The microprocessor, for example, will function dependably in an ambient temperature of 110° F (43°C) while a minicomputer requires an office-like environment for reliability. Solid-state components and printed circuit boards of sturdy epoxy-fiberglass are employed exclusively in the module. Cabinet surfaces are epoxy-enamelled to resist corrosion.

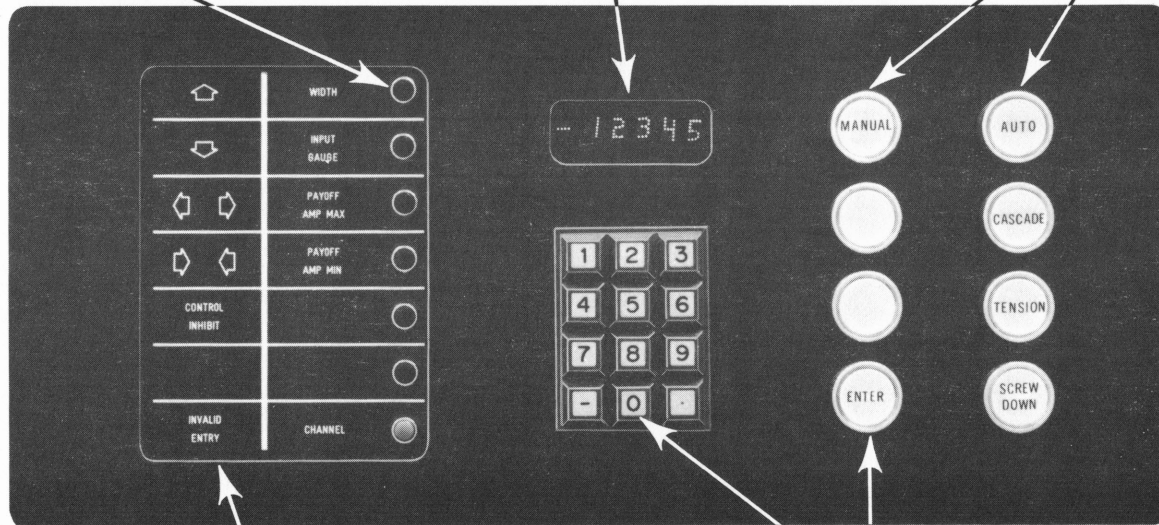


AccuRay® 520 OPERATOR CONTROL PANEL

- **FUNCTION SELECT PUSHBUTTONS**
for selection of product and mill values to be presented on the Data Display. Also used for easy entering of product and mill values for the next product.

- **DATA DISPLAY**
presents product and mill values for easy operator verification. Also displays data being entered at the Keyboard.

- **CONTROL MODE PUSHBUTTONS**
activate any control mode with the push of a single button.



- **ANNUNCIATOR LIGHTS**
identify control actions when mill screws move up or down, or reel tension increases or decreases. Also alerts operator to conditions which inhibit automatic control actions.

- **DATA INPUT KEYBOARD**
for fingertip entry of values for mill control. The "enter" pushbutton illuminates to acknowledge a valid entry.