

**AccuRay<sup>®</sup>**

**510 Added capabilities**

**Accuray 510,530,540**

**Welded Steel Tube Mill Control**

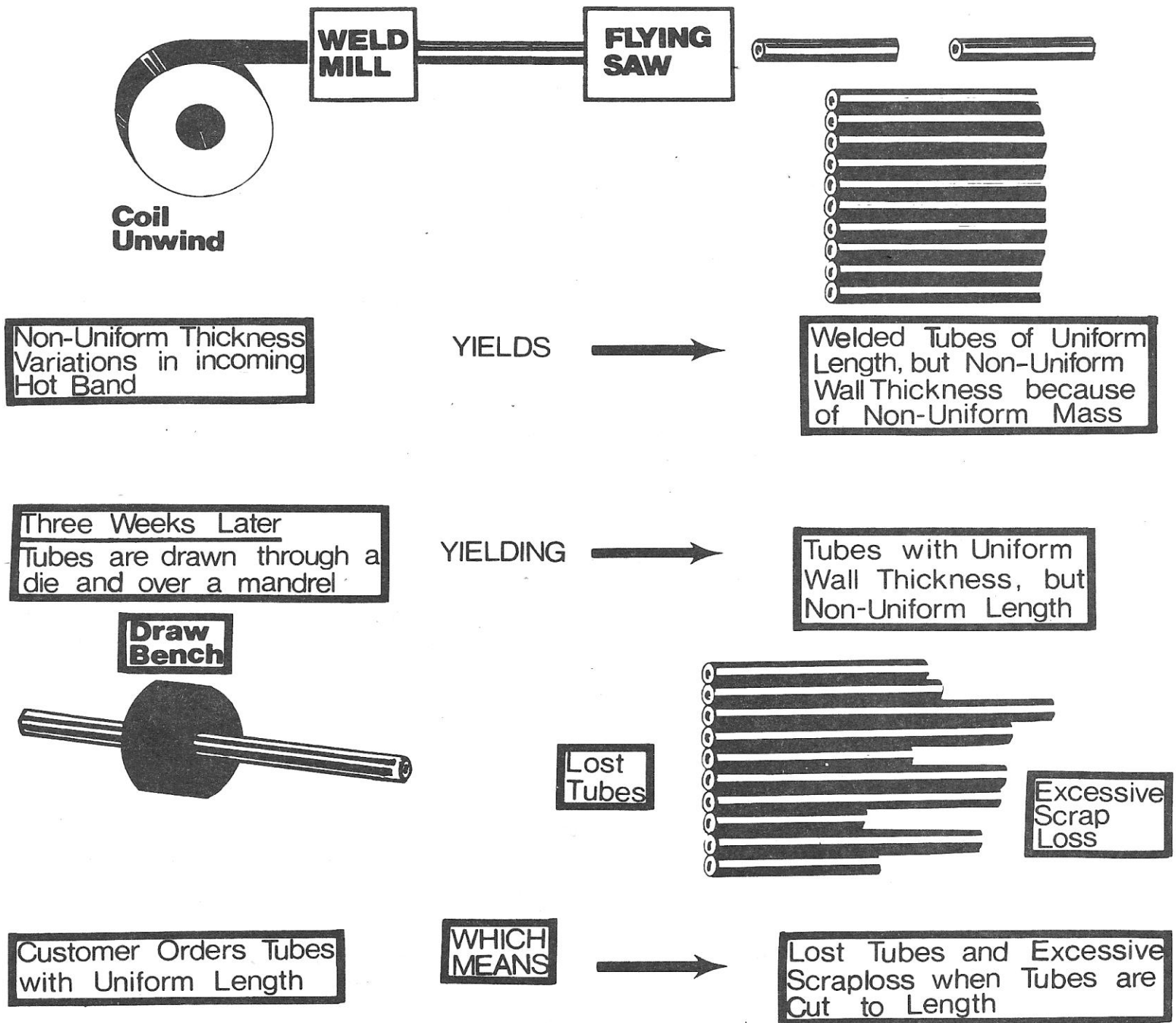
## **ACCURAY 510,530,540 WELDED STEEL TUBE SYSTEM (see data sheets)**

In 1977 I.N. started surveying the welded steel Tube application for the standard AccRay 510 non-contact thickness gauge and the 530 micro data collection system. These systems would be used in a quality control program that would reduce scrap in the final cold drawing process. After a successful 510/530 installation it was obvious that the process could be automated. A 530 was reprogrammed (now a 540) to control the tube cut-off process to produce uniform weight rather than uniform length. The 540 control system made a surprising reduction in variations at the cold drawing operation of 87%.

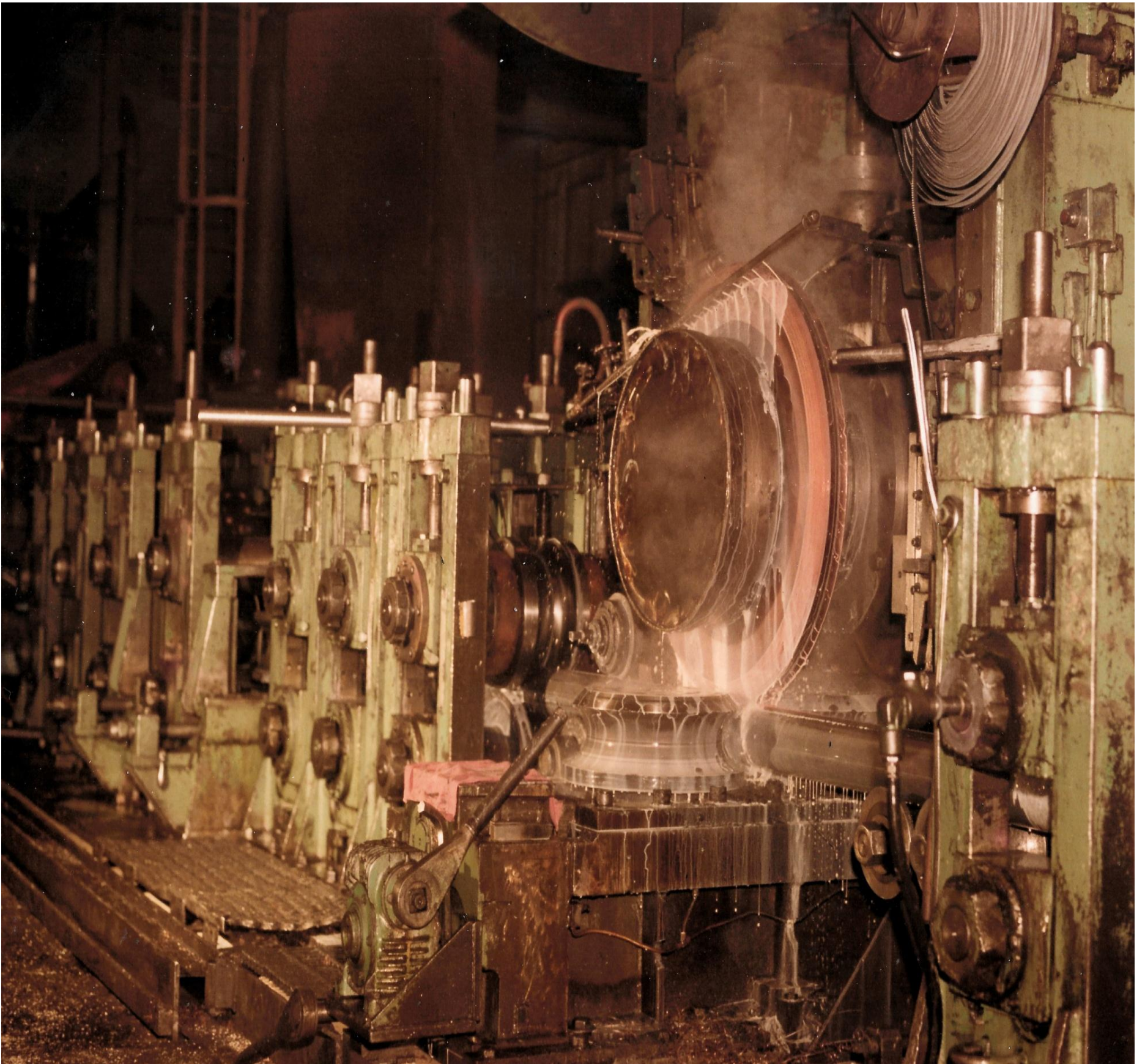
### **DESCRIPTION OF THE WELDED STEEL TUBE PROCESS ( Drawing attached)**

This continuous process starts with “skelp” which is hot rolled, flat sheet, low carbon, malleable steel that is formed into a tube by cold shaping on a closely coupled multi-stand cold mill. At the exit end of the multi-stand mill is a resistance welder that continuously welds the tube seam inside and out to form a complete tube. As the tube moves down the line, a saw clamps to the tube and starts making the cut. When the cut is complete the saw returns to the start position ready to cut the next tube section. In this way the welding process is not interrupted and the cut tube continues down the process line ready for the next operation. If the tube is to be used in a tight tolerance application, it goes to the “draw bench” where one end is swaged so it can be attached to the “draw buggy”. A lubricated mandrel sized to meet the inside spec of the tube, is inserted in the tube and the tube is cold drawn over the mandrel and through a die by the draw buggy. ( After the tube clears the die assembly, the mandrel is removed.) The steel wall is forced through the dies to obtain a near perfect wall thickness and internal /external finish. As the tube is pulled through the dies, any variations in the tube wall thickness will transform into undesirable length variations. The swaged end must be cut off and the tube measured again for the specified length. Since the tube length varies proportional to wall thickness changes, the target thickness is usually specified on the thick side to be sure the length meets the minimum length as ordered. Although this practice is necessary for quality control, it creates unwanted scrap. If the end use of the tube doesn't require tight tolerance for wall thickness, the cold draw process is bypassed and the tube is taken to the finishing department and made ready for shipment.

# WELDED STEEL TUBE PROCESS







Welded Tube Mill exit end prior to cooling and flaying saw





View of seam and welder

## **AccuRay 510,540 Welded Tube Control System**

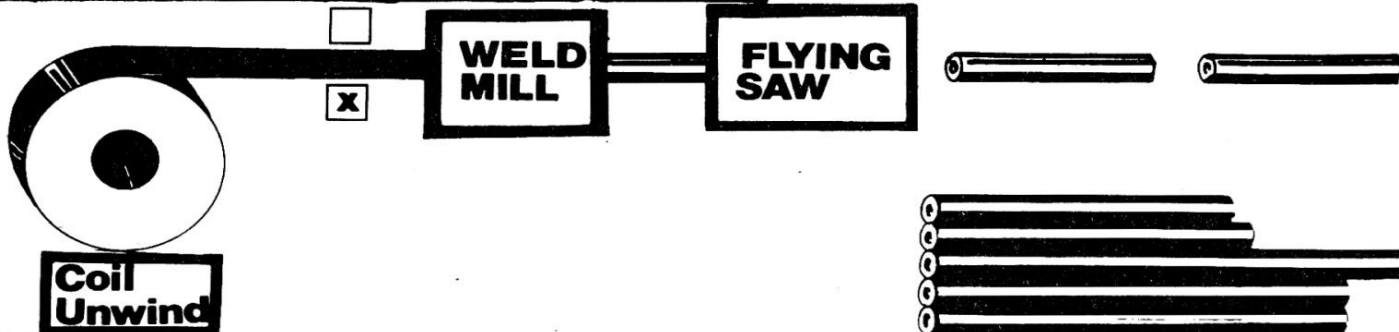
The AccuRay control system is designed to control the welded tube mill to produce tube lengths of a specified weight rather than length. This condition applies to tubes that will undergo a subsequent process where the tube will be cold drawn over a mandrel and through a die to create uniform wall thickness and a smooth finish. Since there are thickness variations in the incoming hot rolled product these variations cause variations in length when drawn over a mandrel and through a die. For the system to provide an accurate weight for each tube some product data must be entered into the system. Production information must also be entered into the system to facilitate the hard copy production report generated by the AccuRay 530. The data to be entered are: user number, incoming coil number, current order number, quantity, target weight of the individual finished tube, current width (this is an accurate value since the strip edges are skived to the specified width). The same data is entered for the next order. The system is started in the manual mode when the line starts up or when the weld of a new coil is moving through the mill. Once the mill is started and the seam welder has settled into operation, the system is turned on and from that point the control stays in automatic.

The AccuRay 510 thickness sensor is mounted in a heavy duty "C" frame and installed at the entry end of the multi-stand cold shaping mill. It detects the mass variations of the incoming hot rolled product called "skelp". (See photo) The measured signal is sent to the AccuRay 510 where the signal is turned in to digital units and sent to the AccuRay 540 control system. A delay vector containing 4096 words is used to represent the 80ft. distance from the AccuRay 510 measure system to the cut off saw. A tach signal representing line footage is used to increment the vector. This provides a resolution of 0.23 inches of strip for the thickness readings sent to each vector segment. The 540 uses the thickness signal, entered width, density and length (.23 inch) and calculates the average weight for each segment. The weight readings are loaded into a buffer where they accumulate until the total weight is equal to the target weight entered into the system by the operator. At this time the system initiates the saw cut and the cut tube moves down the line for more processing.

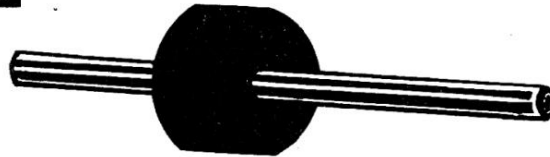


# AccuRay 510/540 Solves the Scrap Problem by:

Measures the Thickness of the Input  
Sheet and Computes the Mass out of Weld Mill

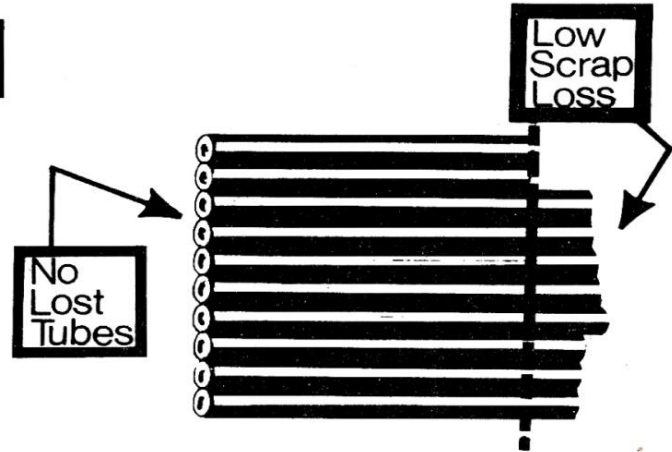


And Activating the Saw to  
give Tubes of Uniform Mass,  
but Non-Uniform Wall Thickness  
which means Non-Uniform Length



**Draw  
Bench**

Which produces Tubes of Uniform  
Length and Uniform Wall Thickness  
Off the Draw Bench



Customer Orders Tubes  
With Uniform Length

Which  
Means

No Lost Tubes and  
Low Scrap Loss when Tubes  
are Cut to Length

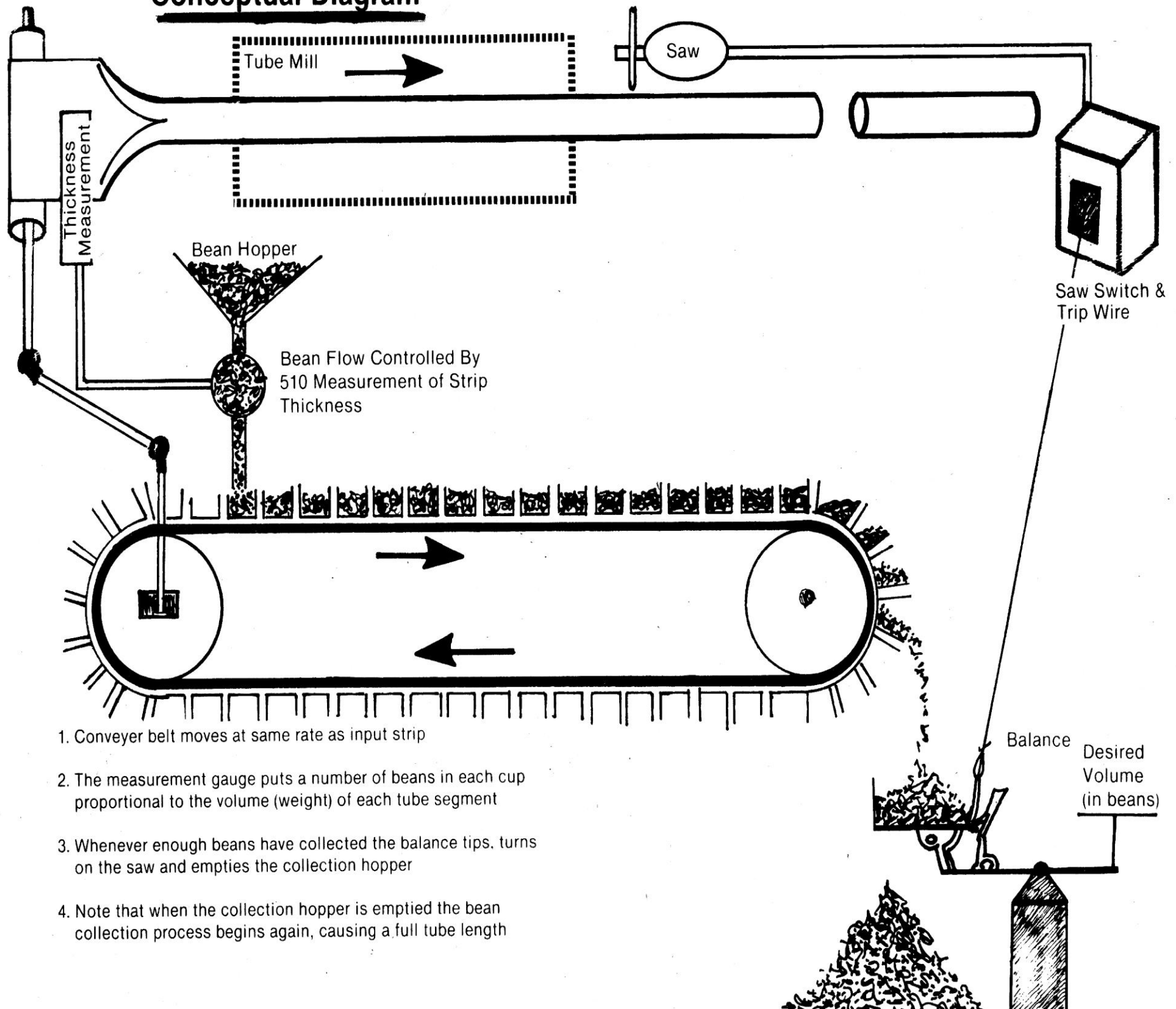
**SCRAP LOSS REDUCTIONS  
OF 2% to 4% WILL RESULT  
FROM ACCURAY 510/540**

**AND**

**ON A TYPICAL  
PROCESS A 1%  
SCRAP REDUCTION  
IS WORTH \$100,000/YR.**

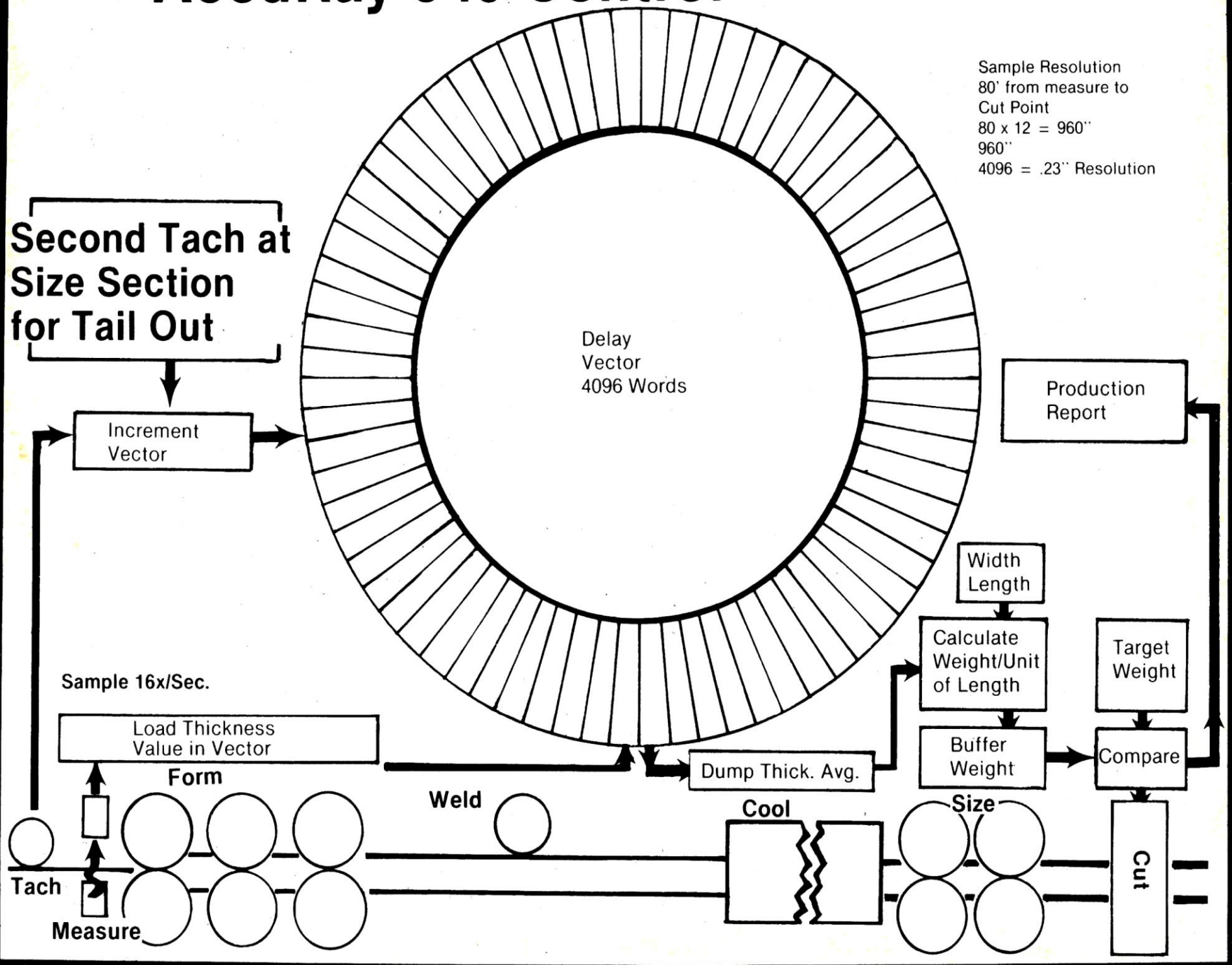


## 530 Tube Mill Data Tracking Conceptual Diagram



1. Conveyer belt moves at same rate as input strip
2. The measurement gauge puts a number of beans in each cup proportional to the volume (weight) of each tube segment
3. Whenever enough beans have collected the balance tips, turns on the saw and empties the collection hopper
4. Note that when the collection hopper is emptied the bean collection process begins again, causing a full tube length

# AccuRay 540 Control





**SCRAP LOSS REDUCTIONS  
OF 2% to 4% WILL RESULT  
FROM ACCURAY 510/540**

**AND**

**ON A TYPICAL  
PROCESS A 1%  
SCRAP REDUCTION  
IS WORTH \$100,000/YR.**

*AccuRay*

	USER NUMBER <input type="radio"/>
COIL NUMBER	COIL NUMBER <input type="radio"/>
CURRENT ORDER NUMBER	NEXT ORDER NUMBER <input type="radio"/>
CURRENT ORDER QUANTITY	NEXT ORDER QUANTITY <input type="radio"/>
CURRENT TARGET WEIGHT	NEXT TARGET WEIGHT <input type="radio"/>
CURRENT WIDTH	NEXT WIDTH <input type="radio"/>
INVALID ENTRY	CHANNEL <input type="radio"/>

+ 1.2345

(5 DIGIT DISPLAY)

1	2	3
4	5	6
7	8	9
-	0	.

(DATA ENTRY PAD)

MANUAL

AUTO

ADD  
TUBE

NEXT  
ORDER

TIME

ENTER

PRINTER  
OFF

ANNUNCIATOR

FUNCTION  
SELECT

DIGITAL DISPLAY/ENTRY

OPERATOR CONTROL  
PUSHBUTTONS

ACCURAY 540 TUBE CONTROL OPERATOR PANEL

FIGURE I



# AccuRay®

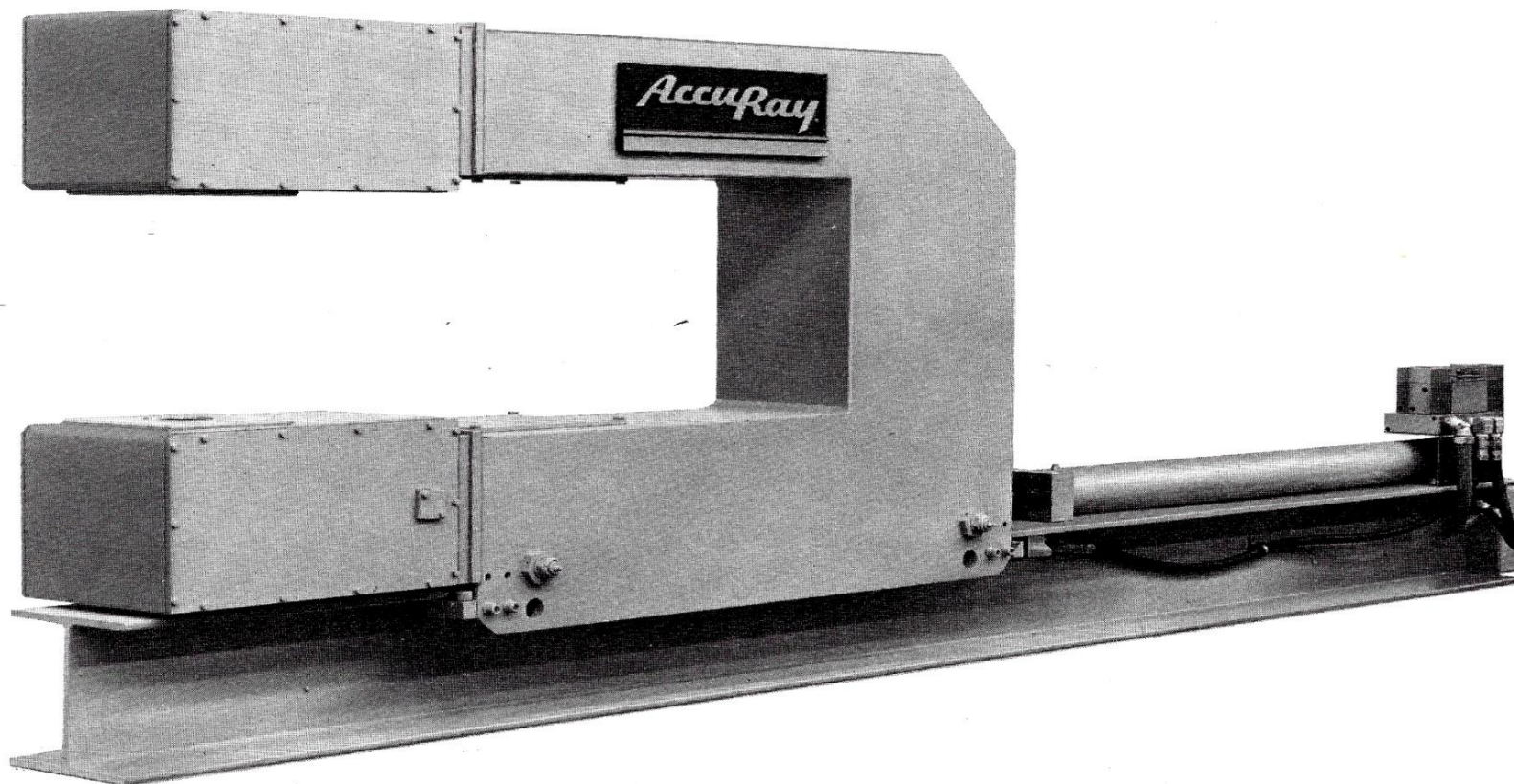
## 510 Heavy-duty "C" frame

The "C" frame is built to withstand continual use on the metal rolling mill or processing line.

Construction is extremely rugged. The frame, which supports and positions the thickness gauge, is fabricated from steel. The rail is an "I" beam. The carriage is plate—up to a half inch thick, welded into a sturdy "C"

configuration. Source and detector housings of the gauge are also plate.

This type of construction, coupled with protective coating of exposed surfaces of the frame, enables the structure to stand up in a severe industrial environment over an extended period of time.



**Positioning** of the strip thickness gauge, at any point on sheet for measurement or off sheet, is accomplished automatically by heavy-duty pneumatic or electrical equipment.



# AccuRay®

## 510 Easy-to-use operator panel

The operator panel provides a simple, direct means of communicating with the AccuRay measurement system.

Controls arrayed on the panel are easy to use.

Only three steps are necessary for operator set up of the gauge. The alloy is dialed, through four-digit thumbwheels, by its customary designation. Target thickness of the strip is entered, again through four-digit thumbwheels, in appropriate units such as mils. Then the "target enter" pushbutton is pressed.

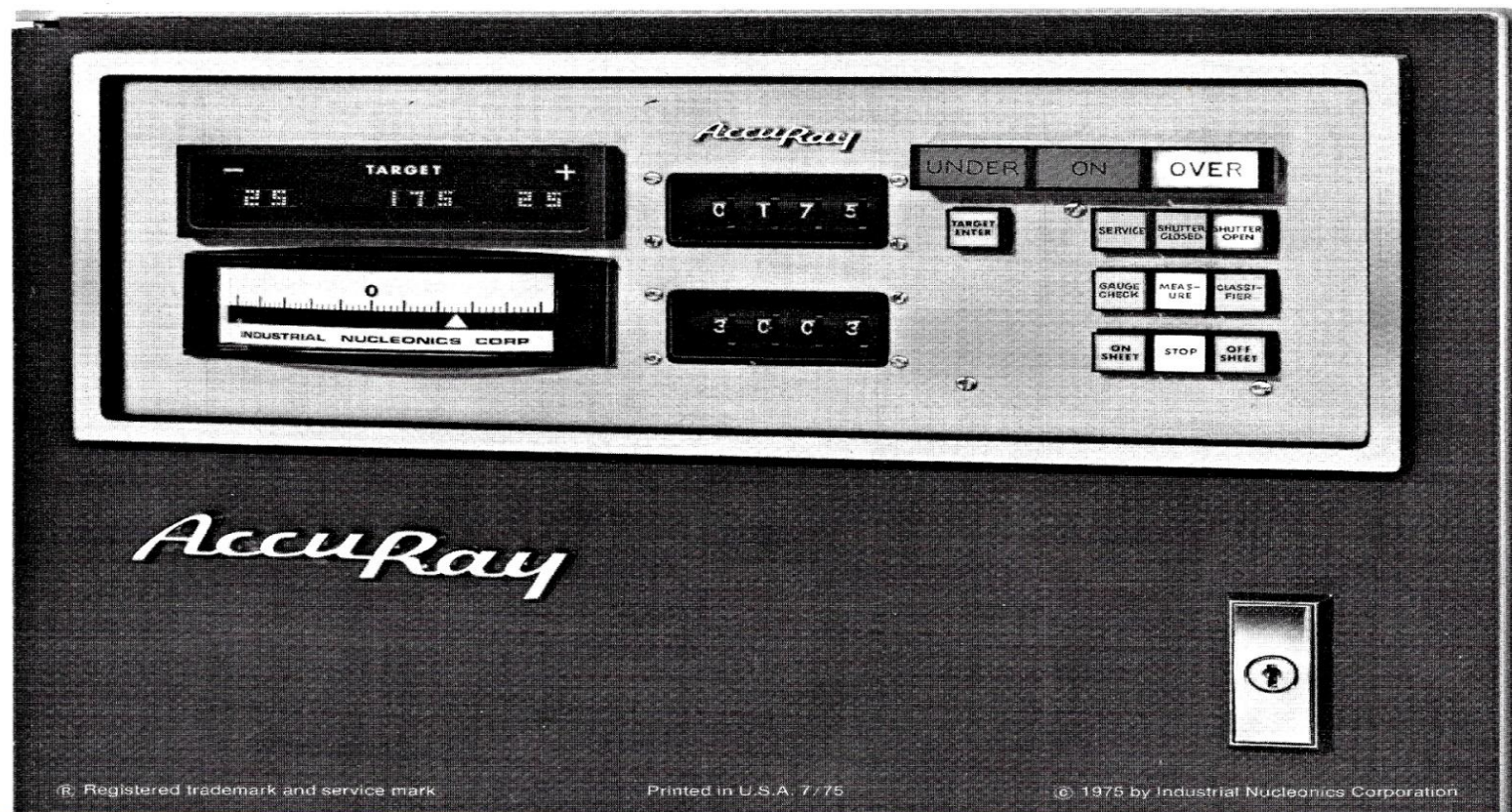
This automatically calibrates the gauge for the alloy to be processed. (Calibration data for up to 63 alloys can be stored in system memory for call up by the operator.) This also calibrates

the deviation meter for readout of measured strip thickness. (Absolute values of target and span are displayed above the meter.)

To move the gauge on strip and make the thickness measurement, the operator simply presses the "on sheet" pushbutton.

Information displayed on the panel is easy to understand and see.

By backlighting, pushbuttons indicate the mode of gauge operation. Additional indications of system status are provided by shutter and "service" lights. Classifier lights, visible at 50 or more feet, show whether or not the strip being processed is within preset limits for thickness.



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# AccuRay®

## 510 High-reliability electronics

Electronics employed in the AccuRay system are designed and built for superior performance and in-use reliability.

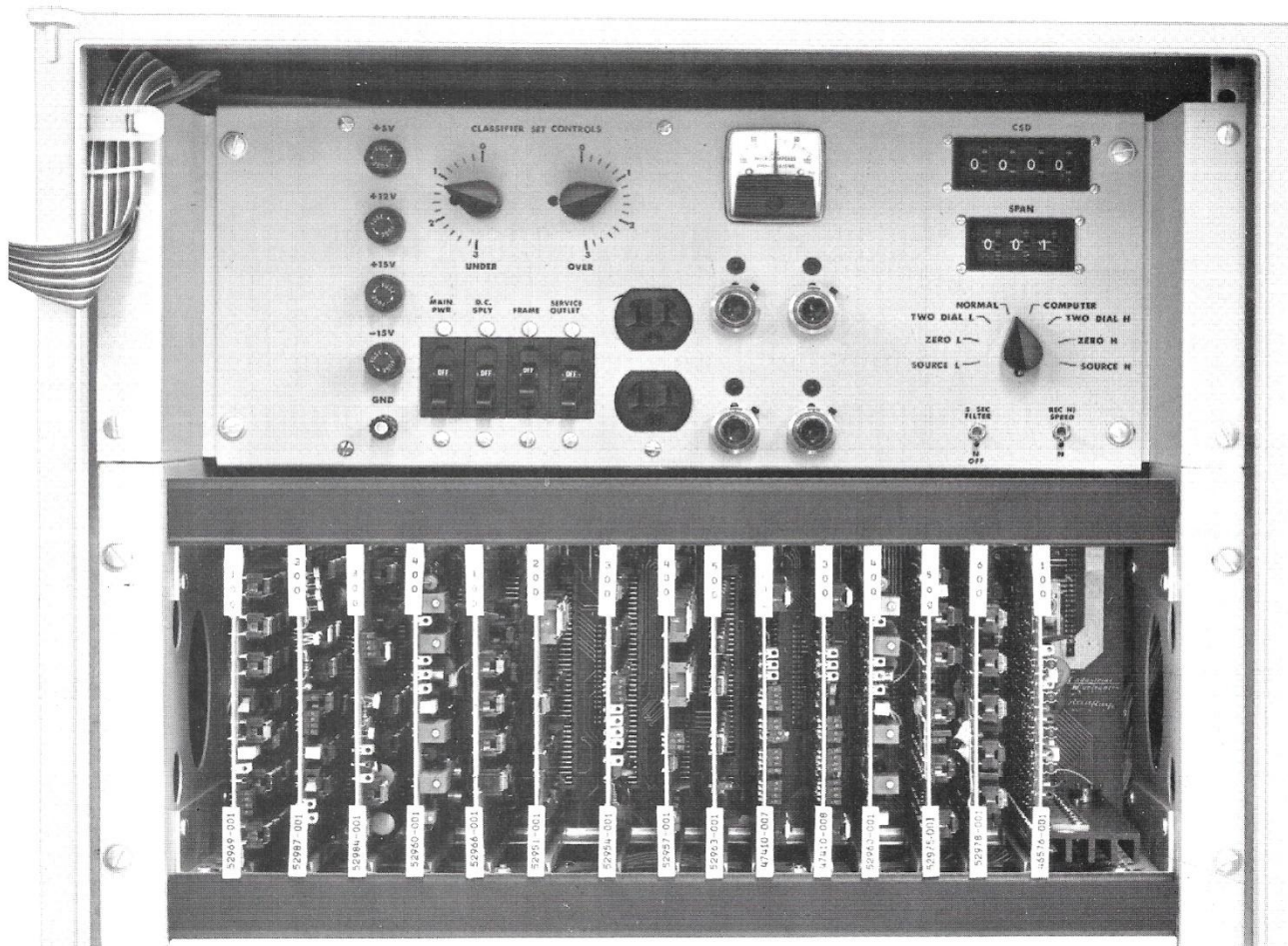
Integrated circuits perform two unique functions in addition to such routine functions as gauge positioning and measurement-signal conditioning.

One of the unique functions is target automated set up. This simplifies gauge set up for measurement to operator entry of alloy, entry of thickness target, and pushing a button. The gauge is automatically calibrated for the alloy and thickness of strip to be processed. Also, the deviation meter is automatically

calibrated for readout of the measurement.

The other unique function is electronic verification of gauging accuracy. The check is performed automatically each time the gauge moves off strip. A flashing red "service" light warns the operator if and when accuracy drops. The system cannot be used for measurement until accuracy is restored.

System electronics are fourth generation. Use of solid-state components reduces heat buildup, greatly increasing the mean time between failure and assuring performance which does not degrade with time.





The 530 data module is easily added to the AccuRay 500 system, which is finding widespread application among metalmakers for measurement and control of flat-rolled products. It utilizes the newest microprocessor technology, an interactive operator panel, and an alphanumeric printer for reporting information needed to improve production. And the information is reported in real time at a fraction of the cost of systems employing minicomputers.

Data issued by the 530 is derived from strip thickness measurement, target value, and alloy designation fed from the 510 measurement module—and from other inputs such as those from the line speed transducer and those entered by the operator. Operator entries range from coil number to strip width. Other informational capabilities of the module include previewing of strip thickness parameters before a coil reaches the rolling mill and computation of theoretical coil weight.

Results of module use are faster identification and correction of off-gauge conditions, the ability to roll metal closer to minimum ordered thickness, and a flow of data useful in improving other aspects of operations.

COIL NO.	TARGET	ALLOY	MIN ORD GAGE	AVERAGE	RANGE	LENGTH
11435	20.5	1018	20.0	20.5	.26	7690
11436	20.5	1018	20.0	20.5	.26	7690

### AUTOMATIC

Key information for mill management is issued automatically by the alphanumeric printer of the 530.

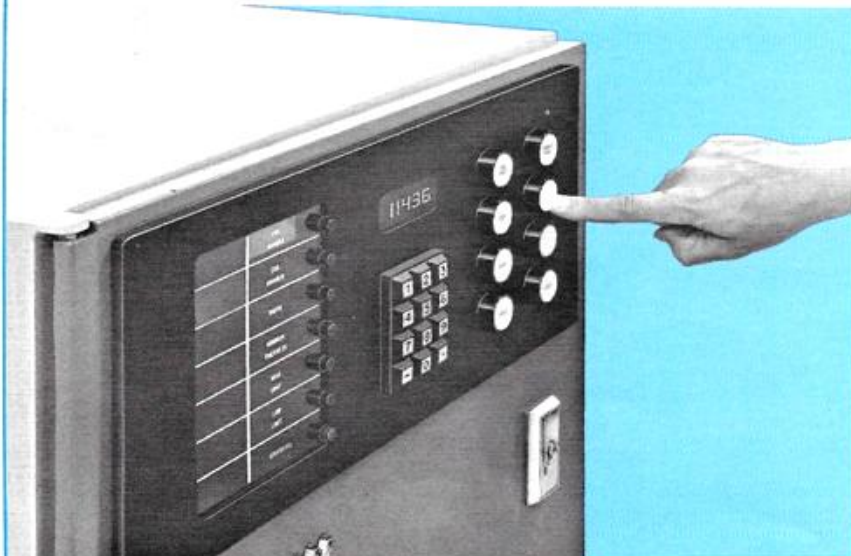
A coil summary which gives order and alloy numbers, target thickness, average gauge and approximate length, and other data is issued at the end of rolling each coil.

Similarly, a shift summary containing pertinent information is automatically printed out at the end of each shift.

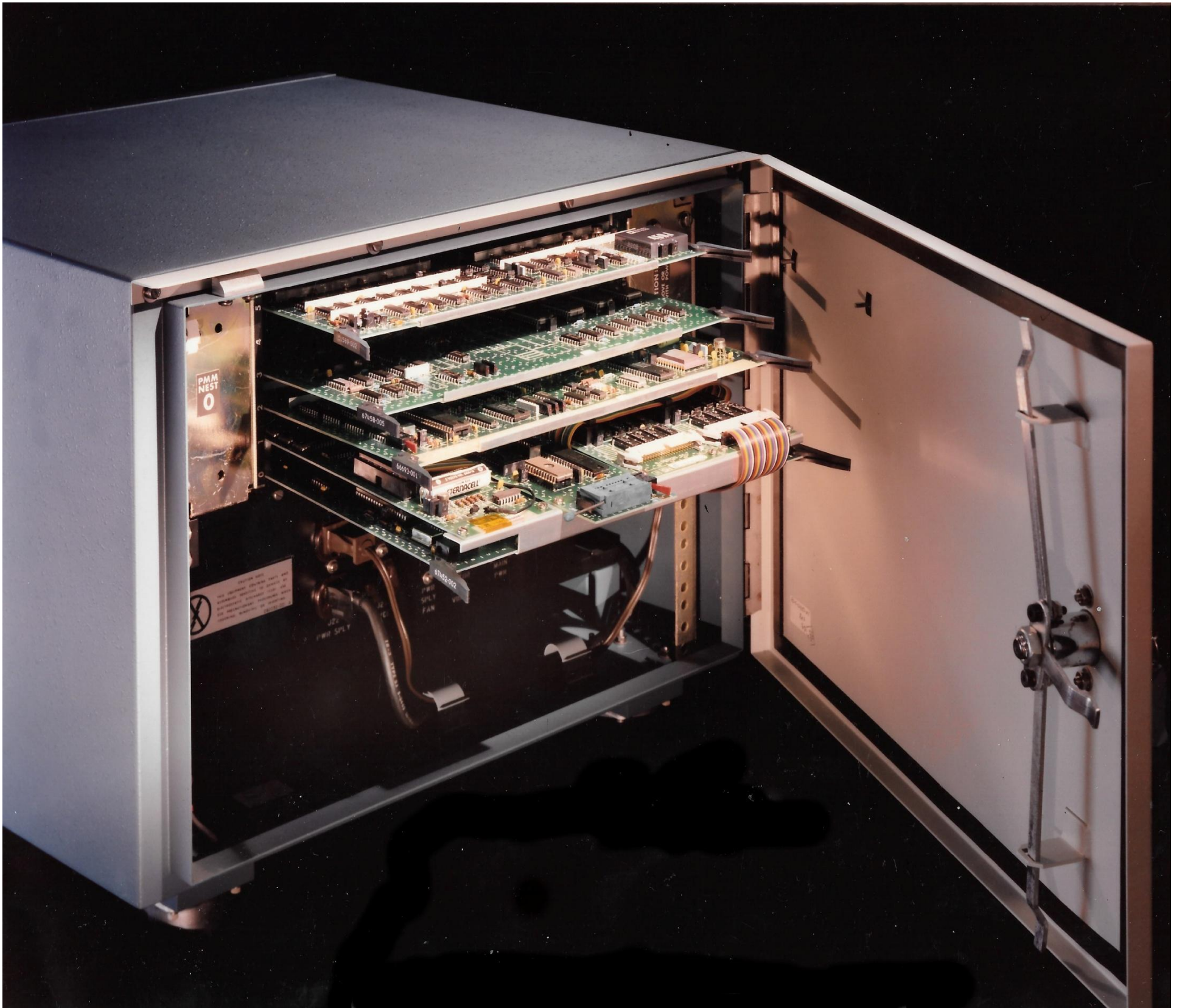
### UPON COMMAND

The interactive operator panel with annunciators, dedicated pushbuttons, telephone-type numeric keyboard, and digital display requires minimal training for effective use.

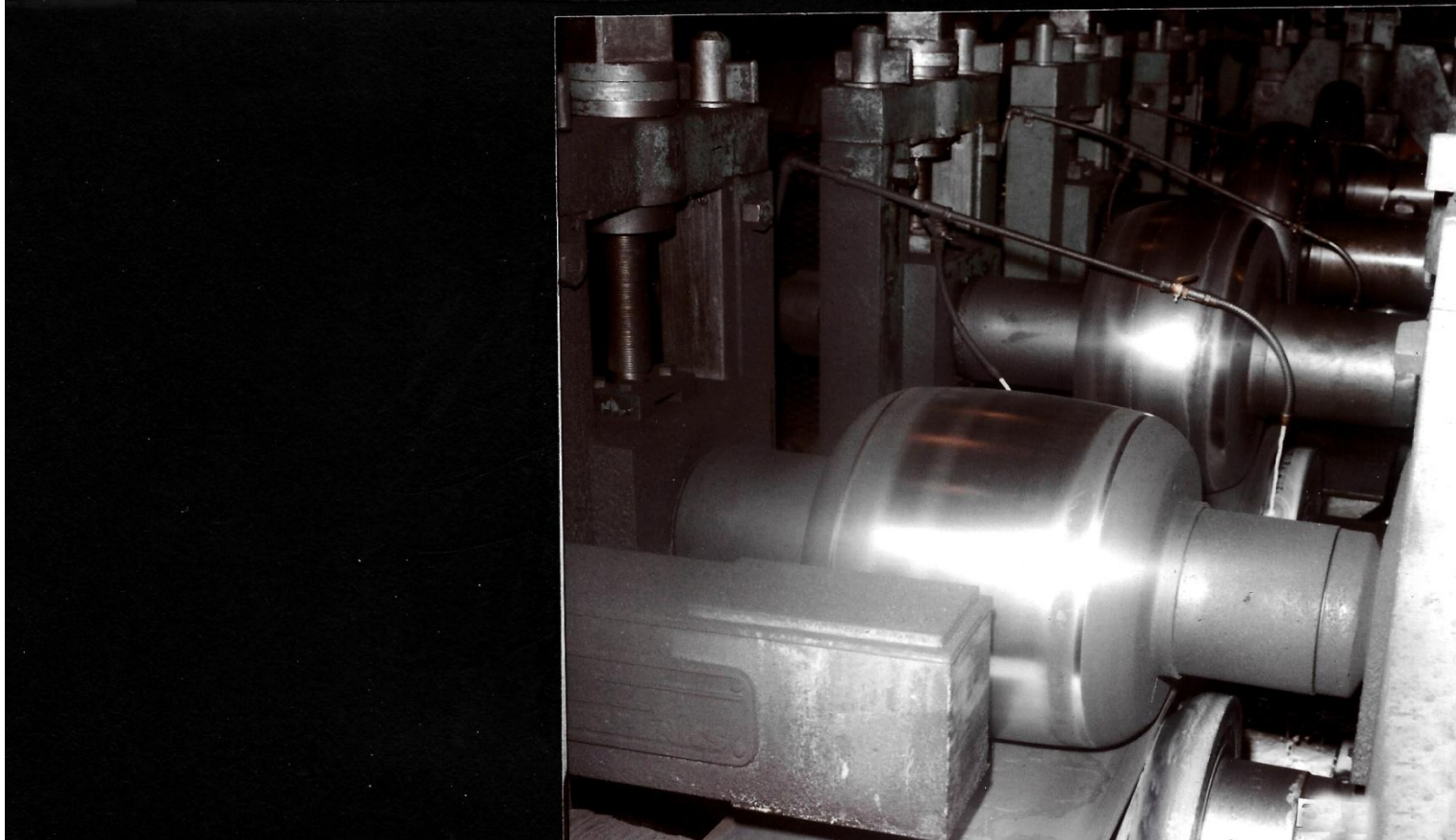
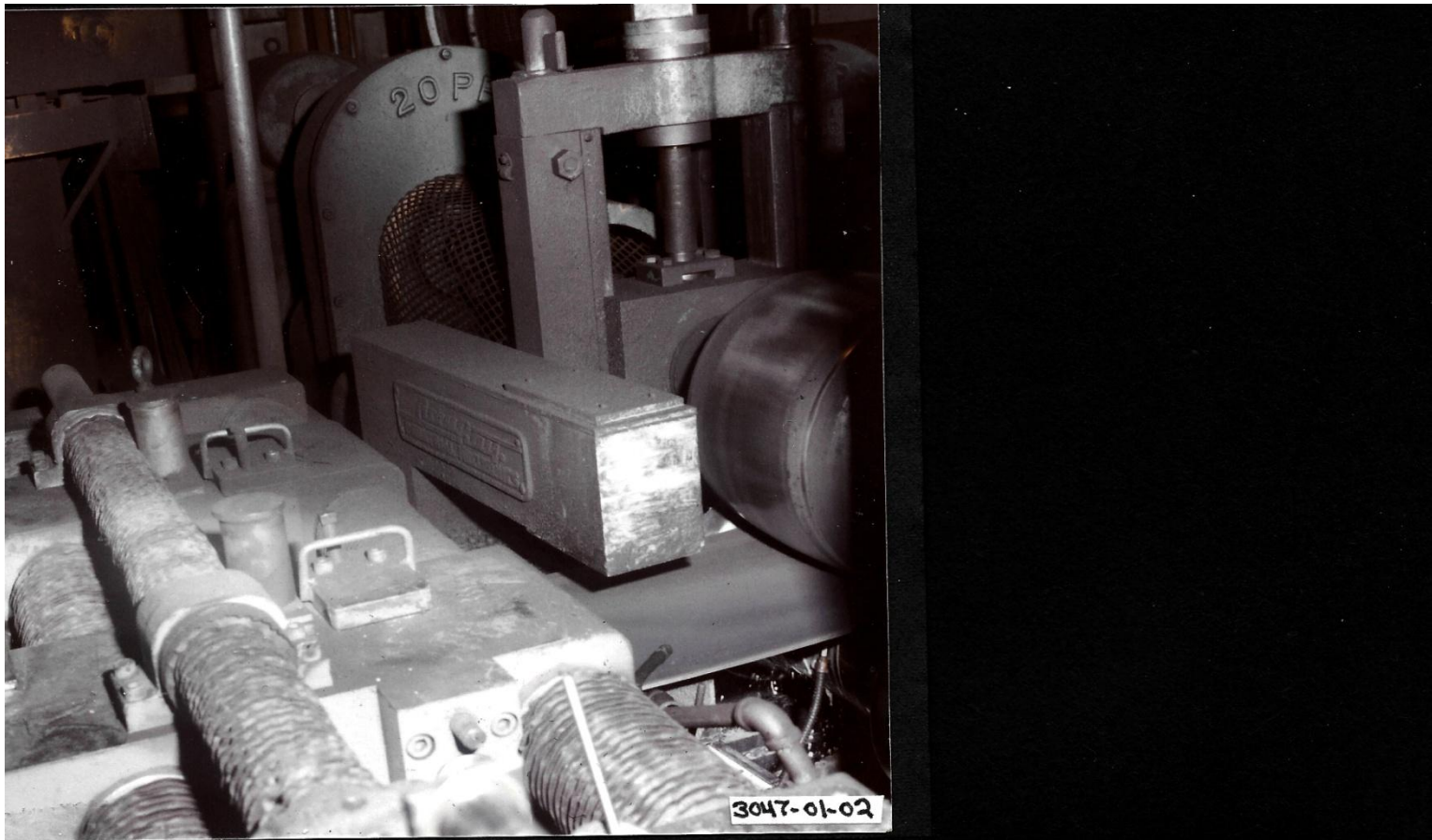
The panel allows operator entry of values into the module or call-up of memory-stored and microprocessor-calculated information. Upon command, the digital display presents such data as average coil thickness, thickness standard deviation within a given coil, or coil length.











page 18 **Welded tube mill entry, AccuRay heavy duty thickness sensor**





**Operator's desk-TOP-530, Data CENTER 540-Auto-Control, Bottom-510 Gauge**



