

The attached document was distributed by NDC Systems, Inc. during a NRC Pre-Decisional Enforcement Conference held on October 23, 1996, at the NRC Region IV Office in Arlington, Texas.

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Kent Prendergast*

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NRC Pre-Decisional Enforcement Conference

October 23, 1996

I. Introduction

- Longtime Family Run and Employee owned Company
- CA License 1966: NRC License 1986
- On-line Measurement & Control Systems for the continuous web process industries
- Quality & Safety Benefits of NDC Activities

Background

- Brief History and Idea for Company
- 1970's Introduction of NDC Gamma Gauge and Company Experiences
- 1978 Dan Fishman and Bruce Kramer Join the Company
- 1980's - Modern Period of Growth Begins
 - 1983 20 employees
Dave Carlson joins as VP Sales & Marketing
NDC begins international distribution
 - 1986 45 employees
Yudie Fishman joins the company

Background continued

- Nov. 29, 1989 - Bert Fishman company founder, President and RSO suddenly becomes incapacitated with no meaningful opportunity for orderly transition.
- 1990's Continued Growth and Exemplary Safety Record

II. Radiation Safety Program and Safety Record

- 1966 - 1990 Bert Fishman President - RSO
- 1991 - Present Dan Fishman President - RSO
- Dan Fishman institutes a formal, written safety policy and program
- Extensive Personnel & Site Monitoring
 - Committed to personnel and site monitoring in excess of regulatory requirements, i.e. film badges and ring badges, TLD's (when expected exposures are less than 10% of 10 CFR Part 20 max. levels)
 - Extremely Low Exposure History

140 people
40 in the field

1995 Annual Exposure Data

	TLD & Film Whole Body	Ring Badge Extremity
Number of Individuals Total	99	29
Number of Individuals w/Background Exposure	74	20
Individual Max Exposure	180 mrem/yr	290 mrem/yr
Avg. Annual Exposure	7.1 mrem/yr	36.5 mrem/yr

III. Description of Violation

- Violation: 10 CFR 110.50(a) Delivery of gauge device containing 150 mCi of Am-241 sources in excepted packages in violation of DOT regulations.
- Intent: Violation was due to lack of oversight - not any deliberate or intentional act.



- Original sources 25 mCi
 < 4 mr/hr at 30 cm shutter open
- 1970s early 80s obtain foreign approval of devices. Very few exports.
- 1983,84 Amersham changes to point source labeled 150 mCi
 < 4 mr/hr at 30 cm. shutter open
- Foreign distributors object to new 150 mCi change

- Company determines that distributors must change registrations. 25 mCi sources are used for those countries.
- 1989 written directive to use 25 mCi sources for specific countries
- Company labels 150 mCi sources as 25 mCi to the affected countries until distributors change registrations
- Rationale was source had same output and radiation field as registered devices

- Distributors start to change registrations
- Shipping department initiates shipping confirmation sheet.
- Dan Fishman becomes aware of practice
- 1990 Dave Carlson Memo
- Employees Raise Concerns

IV. Corrective Action

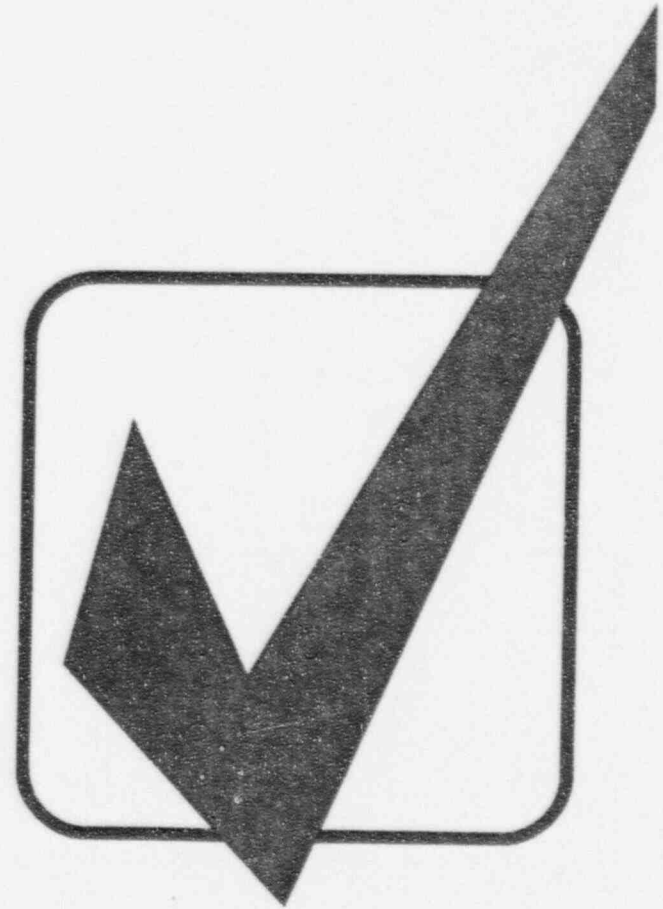
- Identification of Violation
 - June 25 - 27 Inspection/Investigation Reveals Violation
- Immediate Corrective Action to Stop the Practice
 - June 28 Written Notification to all NDC personnel
 - see slides
 - Affected Departmental Meetings

Corrective Action continued

- Immediate Corrective Action to Stop the Practice (cont.)
 - Internal Investigation and Review
 - Physical tours and inspection of all areas involved
 - Interviews with all personnel involved
 - Commencement of audit of shipping documentation
 - Review of applicable NRC and DOT regulations

Compliance Issues

- ◆ Sources must be traceable
- ◆ Keep proper records
- ◆ All sensors must be labeled all the time
- ◆ Wear monitoring badges



Important !

- ◆ It is everyone's responsibility to bring ANY safety or compliance concern to my attention.
- ◆ If you are not sure about doing a procedure
DO NOT DO IT !

Corrective Action continued

- Subsequent Corrective Actions
 - Company-wide Meeting
 - Discussed source labeling, safety and regulatory compliance
 - Full and Complete Internal Audit of the Radiation Safety Program
 - Identifies Transportation and Shipping as a deficient aspect of the RS program and its root causes

Corrective Action continued

- Root Cause 1: Lack of Oversight and Control by RSO
- Root Cause 2: Lack of Knowledge and Understanding of DOT regulations

Corrective Action continued

- Response to Root Cause 1
 - Designation of New RSO
 - Individual whose primary responsibility is to be RSO
 - Highly qualified individual
 - License amendment pending
 - Increased emphasis on RSO activities

Corrective Action continued

- Response to Root Cause 2
 - Contracted with an independent technical expert to review all company activities related to shipment and transportation of hazardous materials

V. Enforcement Factors

- The Significance of Regulatory Concern
 - Although occurring over time, the regulatory violation was not known to the company until NRC inspection/investigation;
 - Company president was unaware of any written guidance concerning NDC export practices; he did not knowingly direct employees to violate a regulation;
 - Some NDC employees questioned NDC's labeling practices; no employee ever discussed or questioned DOT regulation.

Enforcement Factors continued

- Enforcement Policy Section VI.B.2: Civil Penalty Assessment
 - No previous escalated enforcement actions
 - Violation was not licensee-identified

Enforcement Factors continued

- Enforcement Policy Section VI.B.2: Civil Penalty Assessment continued
 - Thorough, comprehensive, and responsible immediate and long-term corrective action, consistent with NRC IN 96-28
 - immediate action to restore regulatory compliance
 - written direction to NDC employees
 - affected departmental meetings
 - internal investigation and review
 - physical tours and inspection of all area involved
 - commencement of internal audit of shipping department
 - review of applicable NRC and DOT regulations

Enforcement Factors continued

- Thorough, comprehensive, and responsible immediate and long-term corrective action, consistent with NRC IN 96-28 cont.
 - **development and implementation of long-term corrective measures to address root causes and ensure future compliance**
 - Company-wide meeting
 - Full and complete internal audit
 - Designation of new RSO and increased emphasis on position
 - Contract for independent technical expert to review all company activities relating to shipping and transportation of hazardous materials

Enforcement Factors continued

- Licensee's history, safety record, and response to identification of violation support imposing no civil penalty.

Enforcement Factors continued

- Exercise of Discretion Under Section VII
 - Significance of the circumstances understood by licensee; regulatory message already sent and understood
 - No safety consequences to violation
 - Excellent licensee performance history and safety record
 - No increased risk as a result of violation

Enforcement Factors continued

- Exercise of Discretion Under Section VII cont.
 - No conscious decision to be in noncompliance; no significant economic benefit; no intentional or deliberate act
 - Special circumstances under B6 exist:
 - no safety significance
 - good overall performance
 - action no longer constitute a DOT violation
 - company always complied with IATA regulations
 - Immediate and Comprehensive Corrective Action

To: All Department Managers
From: Dan Fishman
Date: June 28, 1996
Subject: Shipment of Radioactive Material
CC:

Distribution:

Dave Carlson - Europe
Jean Maes - Europe
Yudie Fishman - International
Rick Whiteman - North America
Bruce Kramer - Operations
Jonni Swrdlow - Service
Ian Rule - Finance

An inspection by the NRC has revealed several serious problems and potential violations related to our existing export shipping procedures. Effective immediately, the following changes will be implemented to bring us into full compliance with all relevant regulations.

1. All devices, labels and associated paperwork shall reflect the actual source activity as reported by the source manufacturer.
2. No change to this information may be made for any reason. This includes requests from international agents, customers, sales department personnel, or foreign regulatory bodies. Any such request should be reported immediately to me.
3. All required shipping documentation must be fully and accurately prepared for every shipment without exception. Any request to deviate from this policy must be reported to me immediately.
4. Registrations and licenses that exist with authorities of countries where we sell our devices must be updated to include the activity levels of our sensors as reported by the source manufacturer, even though the output of our sensors may not have changed. This may require re-certification by individual countries of our devices. This process should begin immediately.

The above are several immediate steps that we are taking. A more detailed and comprehensive program of corrective action will be communicated to you after I have

completed an internal investigation of our program and procedures. This is an extremely serious matter and any deviation from this policy will not be tolerated.

I ask that you distribute this memo to all personnel, international agents, and direct offices that report to you. Please confirm directly with me that you have communicated this information to these people.

I would like to take this opportunity to reiterate our policy of requiring each and every NDC employee to report any concern or suspicion of the existence of any safety or regulatory violation that you may be aware of. I ask that you also communicate this existing policy to all employees reporting to you. This policy of communication of concerns and suspicions of this nature to upper management is necessary to allow us to take corrective action and avoid potential future violations.

I look forward to receiving confirmation from you that you have received this memo and are taking steps to implement its terms immediately.

A handwritten signature in dark ink, appearing to be "D. H.", followed by a long horizontal flourish.

To: George Estevez Shipping Manager
From: Dan Fishman
Date: June 28, 1996
Subject: Shipment of Radioactive Material
CC: Bruce Kramer

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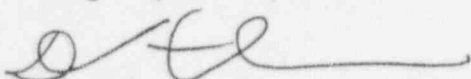
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I look forward to receiving confirmation from you that you have received this memo and are taking steps to implement its terms immediately.



July 1971 - June 1974: Executive Administrator and Medical Radiation Physicist, Mary Bird Perkins Radiation Treatment Center, Baton Rouge.

July 1971 - Certificate: University of Texas Graduate School of Biomedical Sciences at Houston

1. External Beam, Interstitial and Intracavity Dosimetry - Applications
2. External Beam, Interstitial and Intracavity Dosimetry - Computer Methods

June 1970 - May 1975: Directed doctoral research of L. Hall Bohlinger, D.Sc., Tulane University.
Dissertation: "A Study of the Surface Dose Effects in Materials Irradiated with Multi-Curie Sealed Gamma Sources and Related Occupational Exposure Assessments."

February 1965 - June 1971: Director, Louisiana Division of Radiation Control

February 1964 - February 1965: Health Physics Consultant

July 1964: Guest Lecturer - LSU Neutron Activation Analysis Symposium

June 1964 - August 1964: Instructor - AEC-NSF Summer Institute in Isotope Technology for College Teachers at LSU

September 1963 - January 1965: Louisiana State University

1. LSU Health Physicist
2. Administrative Assistant - Department of Physics and Astronomy
3. 1965-67 General Catalogue - Assistant Professor of Nuclear Science; Assistant Professor of Physics

September 1959 - August 1963: Graduate Research Assistant - LSU Beta and Gamma-Ray Spectroscopy Laboratory

June 1962 - August 1962: Instructor - AEC-NSF Summer Institute in Isotope Technology for College Teachers at LSU

September 1957 - August 1959: Graduate Teaching Assistant - Elementary Physics and Advanced Physics Laboratories, Louisiana State University

April 1957 - August 1957: Graduate Research Assistant - Double focusing, iron free, beta-ray spectrometer project, Vanderbilt University

June 1956 - August 1956: Oak Ridge National Laboratory -
AEC Radiological Physics Fellowship Program

September 1955 - March 1957: AEC Radiological Physics
Fellow at Vanderbilt University

September 1951 - May 1955: Millsaps College
Student Assistant - Chemistry (One Year)
Student Assistant - Mathematics (one Year)

PROFESSIONAL ORGANIZATIONS, COMMITTEES, HONORS AND AWARDS:

Conference of Radiation Control Program Directors - Affiliate
Member

Louisiana Department of Environmental Quality
Division of Radiation Protection - Naturally Occurring
Radioactive Materials (NORM) Disposal Advisory Group (1992-
1993)

Nuclear Energy Division- Naturally Occurring Radioactive
Materials (NORM) Regulation Working Group (1989)

Technical Electronic Product Radiation Safety Standards Committee
- U.S. Department of Health, Education and Welfare (1969-
1972)

National Advisory Radiological Health Council - U.S. Public
Health Service (1969)

Cancer, Radiation and Research Foundation, Inc. of Baton Rouge -
Board of Directors (1968-1973)

Environmental Health Committee of the Louisiana State Health
Planning Advisory Council (1979)

Health Physics Society - Charter Member: Past President (1965)
Deep South Chapter; Committee on Evaluation of Medical
Diagnostic X-Ray Facilities (AAPM Joint Committee)(1971-
1972); Standards Committee (1973-1975)

Conference on Radiological Health - Past Chairman (1967-1968)

American Association of Physicist in Medicine Secretary-Treasurer
(1969-1971) Southwestern Chapter; Committee on Evaluation
of Medical Diagnostic X-Ray Facilities (HPS Joint
Committee)(1971-1972)

Radiological Society of Louisiana (1968-1990)

Who's Who in the South and Southwest

American Men of Science

Society of Nuclear Medicine - Second Vice President (1970-1972)
Southwestern Chapter

American Physical Society (1957-1963)

Conference of Radiation Control Program Directors (1968-1971) -
Charter Member

Sigma Xi - National Science Research Honor Society

Sigma Pi Sigma - National Physics Honor Society

Omicron Delta Kappa - National Leadership Society

Theta Nu Sigma - Science Honor Society, Millsaps College

Theta Nu Sigma Award for Outstanding Science Student at Millsaps
College, 1955

Bausch and Lomb Science Award for Outstanding Science Student -
1951

PUBLICATIONS:

Parker, Roy A., Peacock, Charles L., Jr. and Goodrich, Max.
Bulletin of the American Physical Society, Ser. II 6, 459
(1961)

Parker, Roy A., Peacock, Charles L., Jr. and Goodrich, Max.
Bulletin of the American Physical Society, Ser. II 8, 116
(1963)

Parker, Roy A., Peacock, Charles L., Jr. and Goodrich, Max. A
Report on the Computer Activities of the Beta and Gamma-Ray
Spectroscopy Group at Louisiana State University, Baton
Rouge, Louisiana: Department of Physics, Louisiana State
University, 1963

Meckstroth, George R. and Parker, Roy A. "Radiation Hazards and
Public Health," Journal of the Louisiana State Medical
Society, 119, 121-6 (1967)

Weiler, John H., Porter, B. Jim and Parker, Roy A. "Use Factors
for Medical X-Ray Shielding," presented at Health Physics
Society Annual Meeting, Pittsburgh, Pennsylvania, June 11,
1969

ACKNOWLEDGEMENTS:

Hunter, J., "Pipelines Weld, Make Repairs Under 58 Feet of Water," Ocean Industry, December 1967.

Lambert, G. "An Application of Underwater Radiography," Materials Evaluation, March 1968.

Maxfield, W. S. and Porter, G. H., "Accidental Radiation Exposure from Iridium-192 Camera," presented at the International Atomic Energy Agency Symposium on Management of Accidental Radiation Exposures in Vienna, Austria, May 1969.

ROY A. PARKER, Ph.D.

Consulting Radiation Physicist

EDUCATION: B.S. 1955, Millsaps College:
Majors: Chemistry and Mathematics

M.S. 1960, Vanderbilt University:
Major - Physics (Nuclear)
Minor - Mathematics

Ph.D. 1964, Louisiana State University
Major - Physics (Nuclear)
Minor - Mathematics

Dissertation: The Beta Decay of La-140 and a
Fermi Plot Computer Analysis

EXPERIENCE AND EDUCATIONAL TRAINING:

July 1993 - Present: Instructor for Transportation of
Radioactive Material Seminars for Federal Express
Corporation at locations throughout U. S.

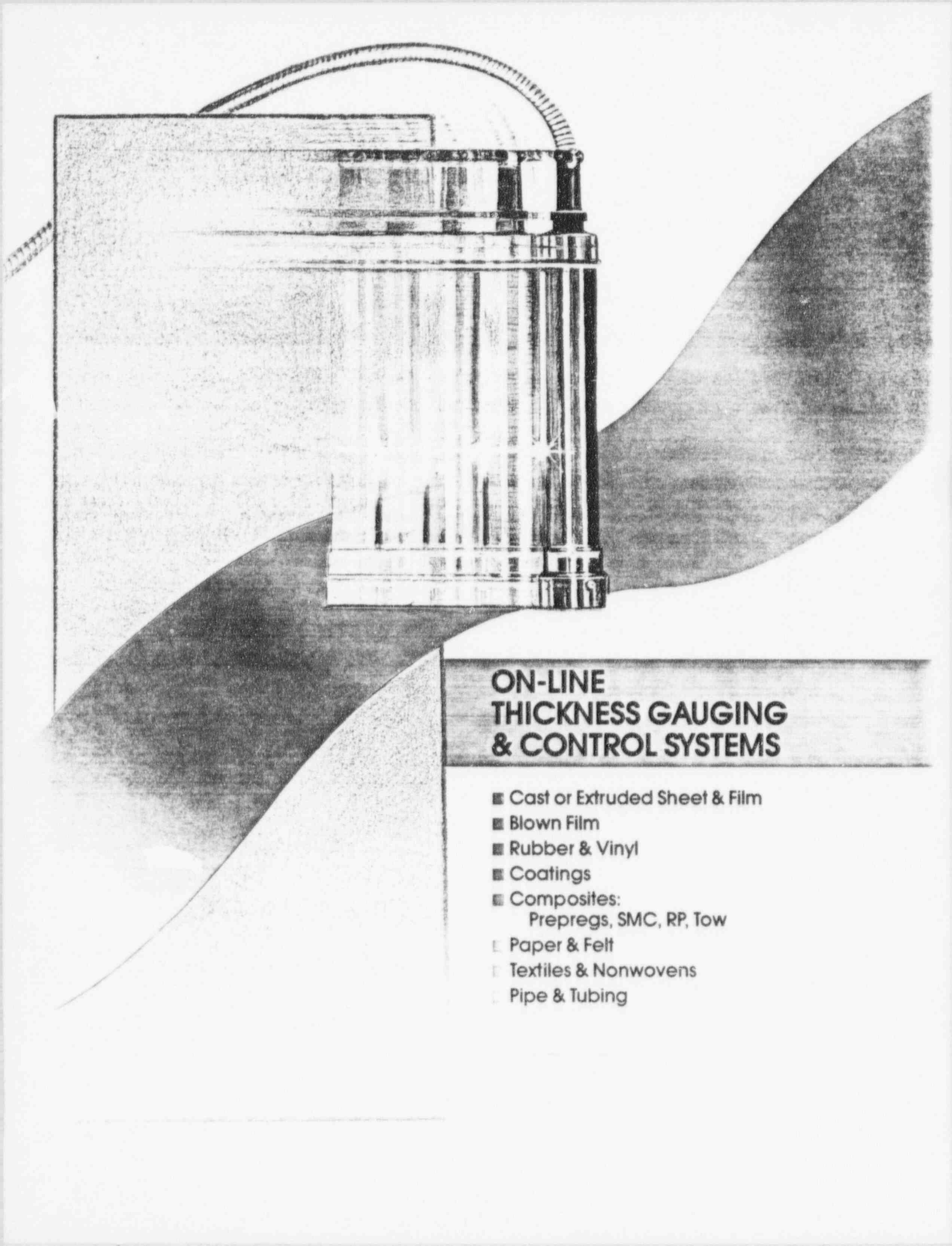
Radiation Safety Programs, Training and Audits:
Participated in industrial radiography radiation safety
training since the 1960's. Presented numerous
radiation safety programs to qualify industrial
radiographers, oil-well loggers, and industrial nuclear
gauge users in accordance with regulatory requirements.
Instructor in numerous industrial radiography training
programs for NRC and agreement state inspectors.
Conducted radiation safety audits of radiography,
industrial and medical facilities. Prepared and
established formalized radiation safety programs for
radiography, industrial, medical and academic
facilities.

May 1978 - Present: Consulting Radiation and Health
Physicist

June 1974 - April 1978: Physicist and Corporate Radiation
Safety Officer, Gamma Industries (Nuclear Systems),
Inc.

November 1971 - Present: Clinical Assistant Professor of
Radiology (Honorary), Louisiana State University
Medical School - New Orleans.

July 1971 - April 1978: Health Physics Consultant (Part
Time)



ON-LINE THICKNESS GAUGING & CONTROL SYSTEMS

- Cast or Extruded Sheet & Film
- Blown Film
- Rubber & Vinyl
- Coatings
- Composites:
Prepregs, SMC, RP, Tow
- Paper & Felt
- Textiles & Nonwovens
- Pipe & Tubing

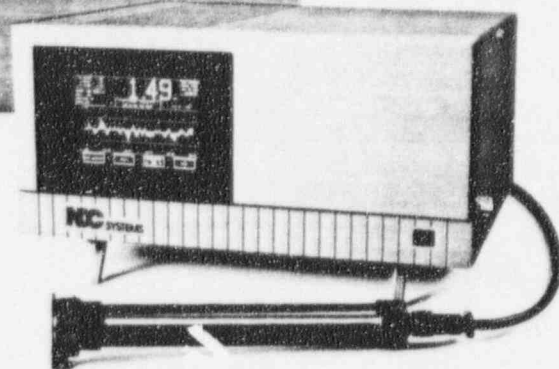
FROM BASIC SENSORS TO SOPHISTICATED SYSTEMS...

NDC offers a complete line of thickness gauging and control systems based upon proprietary sensors designed to solve specific application problems. These sensors are characterized by:

- Small size
- One-sided measurement
- Exceptional stability
- Low cost

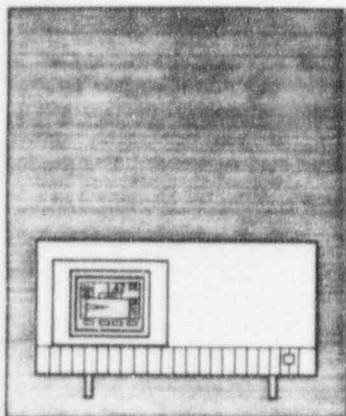
The small, one-sided probe is very easy to mount, especially when space is limited. If the probe is to scan the web, the unique NDC scanner is very small compared to traditional transmission type thickness gauges. A customer stated, "I don't have to torch my line to install your gauge."

MODULARITY NDC systems are modular in concept. It is possible to start with a small gauge and grow into a system with more capabilities. For example, a gauge with a



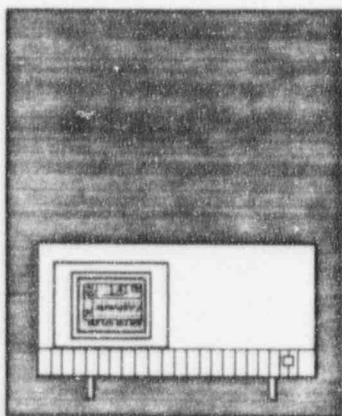
▲ Model 100T

fixed probe can be upgraded to a system with a probe that scans the web. All basic gauges feature a touch-screen interface that offers an ease of use and learning that is unmatched by systems using mechanical push-buttons, switches, etc. Upgrading to the NDC Model 8000 system with high-resolution color monitor and touch-screen controls adds more sophisticated displays, reports, and statistical analysis.



**Model 100T Series
Basic Fixed-Probe System**

The basic gauging system consisting of a sensor with appropriate mounting device, flexible armored cable, and electronics console. The console features a 7-inch, flat touchscreen for operator interface, and display of the measured variable in engineering units. Displays include machine direction trend and histogram. Options include a rotapulsar for line speed input and a printer that can simulate a chart recorder.



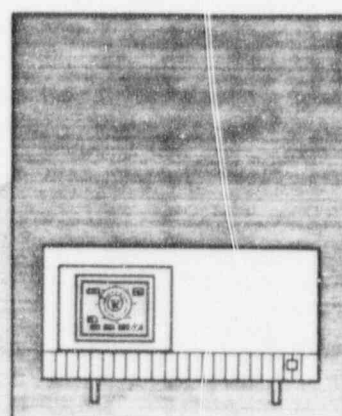
**Model 6100T Series
Basic Scanning System**

Adds scanning capability to the basic gauge. As with all NDC gauging systems, the 6100T features a touchscreen interface for ease of use. Displays include machine direction trend, cross direction profile, histogram, maximum/minimum/average of each scan, and much more, including several production reports. Control functions include speed control of screw, line or pump, and dual gap control for roll coaters, doctor blades, and the like.



**Model 8100 Series
Scanning System with
Color Graphics Interface**

The top-of-the-line scanning system. Besides the basic measurement, this system features a 19-inch high-resolution color monitor with split screen display and touchscreen controls. The NDC implementation of a touchscreen affords an ease of use, understanding, and versatility unparalleled by any other type of system or operator interface. The system provides composite profiles, trends, process statistics, management reports, and two-way communications with a host computer or CIM system.



**Model 5100T Series
Fixed-Probe System
with Control**

Similar to the 100T, but with the addition of a rotapulsar and control package that allows automatic speed control (speed of nip rolls) of a blown film line. Displays include flat or polar profile of the bubble. The system includes several useful reports, plus die bolt mapping for accurate display of the relation between thickness or weight, and an actual die bolt position.

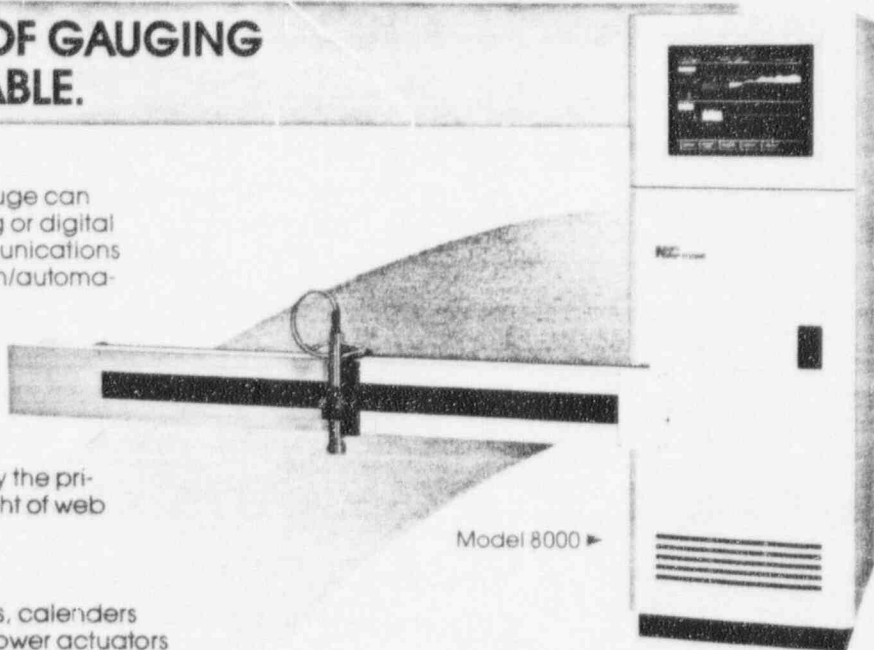
...A COMPLETE RANGE OF GAUGING AND CONTROL IS AVAILABLE.

COMMUNICATIONS Even the smallest NDC gauge can output data to a host computer in either analog or digital form. The larger systems feature two-way communications with a host computer or a plantwide information/automation system via point-to-point or network interface. NDC communications are designed to assure upward compatibility with developing plantwide automation or CIM.

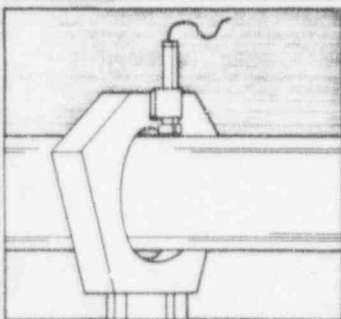
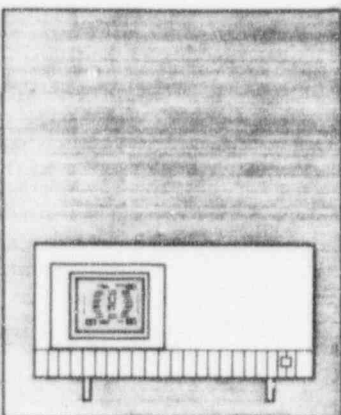
AUTOMATIC CONTROL NDC has chosen to limit the application of automatic control to only the primary measured variable, i.e., thickness or weight of web products.

NDC offers proven systems for control of:

- Speed—Line, pump, screw, etc.
- Gap Actuators—Roll coaters, doctor blades, calenders
- Auto Die—Dies with thermal bolts or other power actuators

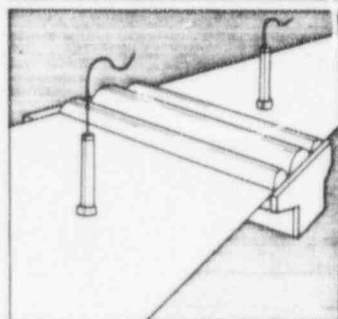
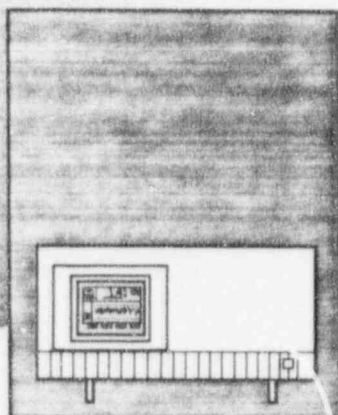


Model 8000 ▶



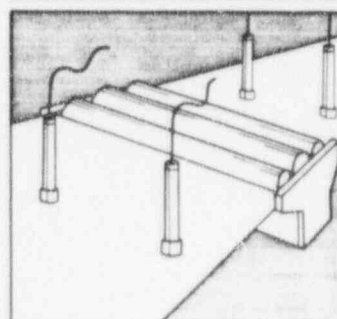
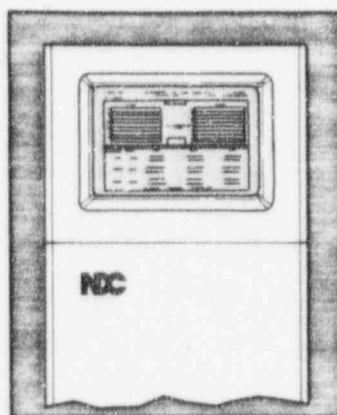
Model 4000T Series
Pipe and Tubing Wall Thickness
Gauging System

With a rotating (oscillating) scanner, it is possible to measure the circumferential thickness of plastic pipe. The touchscreen can display either a polar profile or a segmented screen that gives average thickness about each of a selected number of die bolts. Automatic control of hauloff speed keeps wall thickness at a constant average value, and a histogram or special report offers "proof of compliance."



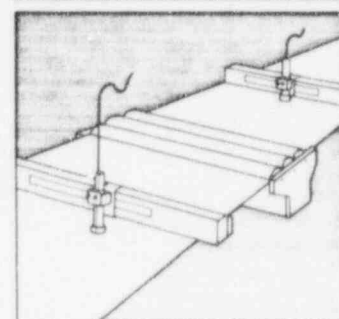
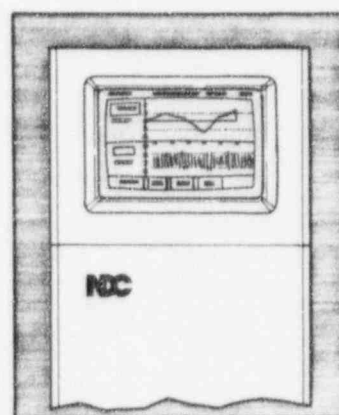
Model 5200T Series
Coating System with
Two Fixed Sensors

For coating applications. Measuring the thickness or weight before and after a coating station and then subtracting the two readings will yield the net coat weight. The NDC 5200/2, with fixed probes before and after a coating station, affords a low-cost solution to coating weight measurement. Typical applications include small or narrow coaters, and saturators where scanning (profile) measurement and control are not practical, or needed.



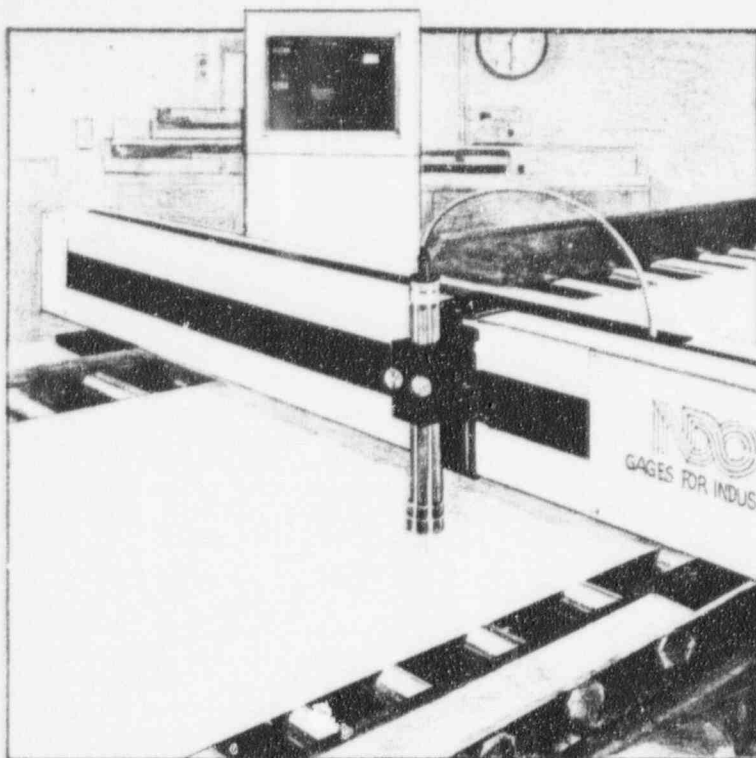
Model 8000 Series
Coating System with
Fixed Sensors

The Model 8000 can accommodate any practical number of fixed probes, depending upon the application. In one application, an 8000-8 has eight fixed probes, two left and two right, before and after three in-line coating stations. A very popular version has four probes, left and right, before and after a reverse roll coater. It should be noted that for certain very thin coating applications, NDC fixed-mount gauges can offer better response time and precision than any scanning system.



Model 8200 Series
Scanning Coating Weight
System

Scanning gauges develop a composite profile of the "net coat weight," which can be used to adjust (manually or automatically) the bolts on a die or left/center/right gap actuators. The 8000 system can control up to three scanners, and all units feature precise, same-spot measurement.

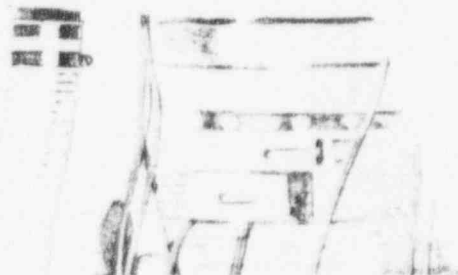
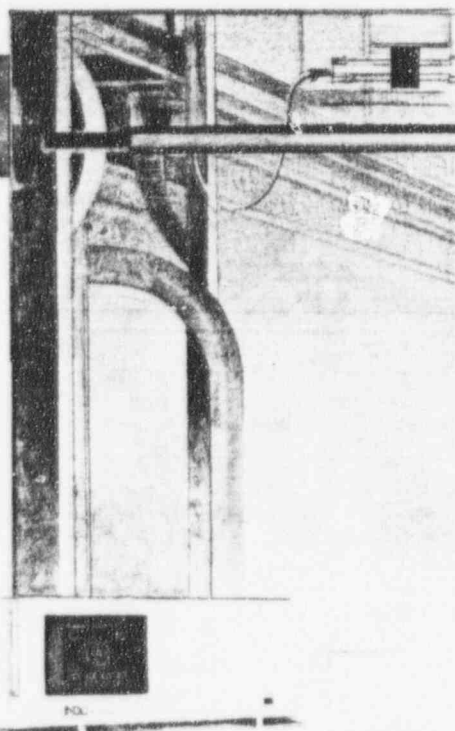


CAST OR EXTRUDED SHEET & FILM

Applications range from very thin films, on the order of 0.5 mil (12 microns), to sheet (including foamed sheet) as thick as 800 mils (20 mm) or more. With the NDC gamma probe, it is possible to measure sheet passing over a steel roll (for example, a chrome chill roll) which allows for faster response to thickness changes and installation on lines where large transmission gauges will not fit. Long time users include W.R. Grace, Impact Extrusions, Dixico, Amoco Fabrics & Fibers, and Goodyear.

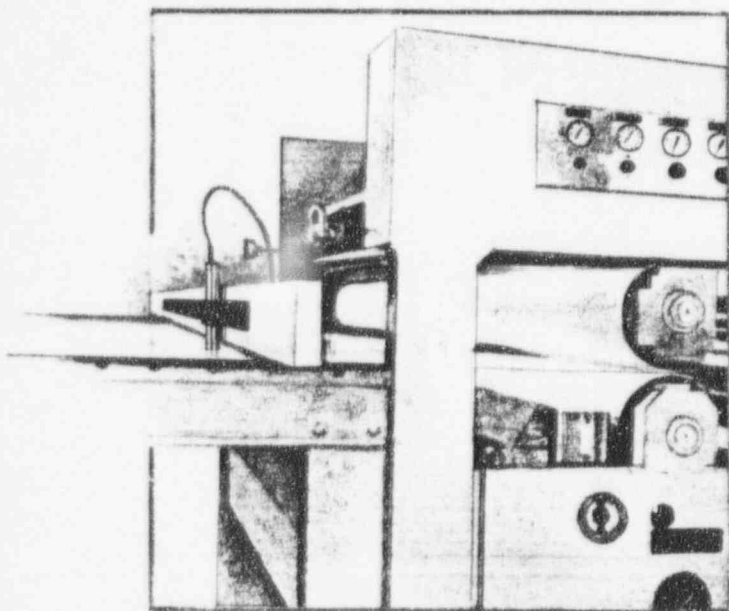
BLOWN FILM

Depending upon the application, the NDC gamma probe is mounted on the collapsing frame (because of the one-sided measurement) or on the edge of the layflat. Unlike other sensing techniques, the gamma measurement is not affected by changes in composition, opacity, color, or ambient variables (temperature and humidity). The touchscreen gives graphic indication of profile, average thickness at each die bolt position, machine direction variation, process spread (histogram), and much more. An optional control package automatically adjusts the speed of the nip rolls to maintain constant thickness. A printer option provides hard copy statistical information such as maximum, minimum, range, averages, standard deviation, footage, etc. A unique dynamic roll weight calibration feature provides the utmost accuracy of calibration. Over 400 NDC blown film systems are in use by companies such as Union Camp, Borden, Goodyear, American Can, Union Carbide, Crystal Print, First Brands, and Arrow.



RUBBER & VINYL

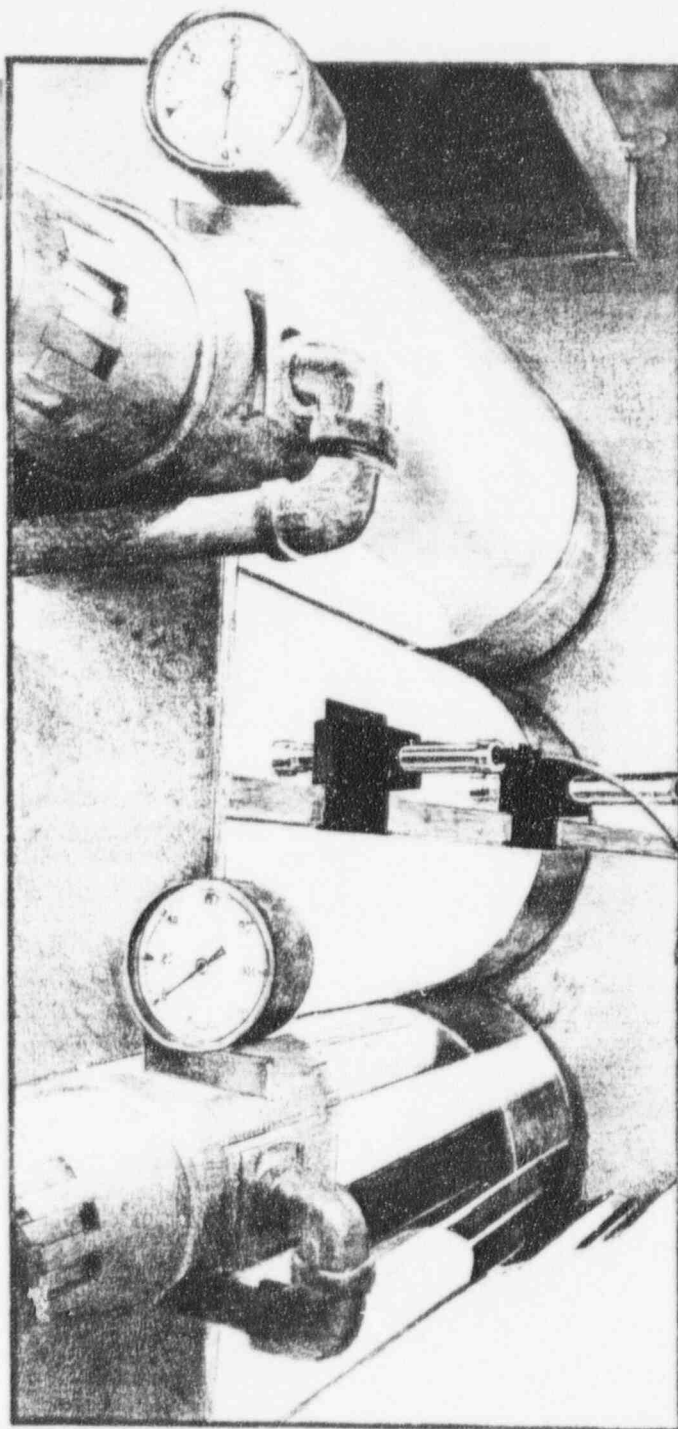
The NDC gamma probe can measure the thickness of material passing over a steel background, making it ideally suited for measuring rubber or vinyl as it passes over a calendaring roll. On certain configurations of calendaring rolls (for example, 'Z' calenders) there is no other place to make a thickness measurement except on the roll or on the total sandwich exiting the calendar. The probes can be fixed-mounted in a left/right configuration for left/right gap adjustment, or a single probe can be mounted on a scanner. Because the steel roll also produces some backscatter that may vary along the path of the scan, all scanning systems include software that automatically zeroes out the gauge reading for an uneven background. Uniroyal, Pirelli, Goodyear, Ford Vinyl and others take advantage of NDC's unique off-the-roll measurement.



COATINGS

One of the largest applications for the NDC gamma probe is ranging from adhesives on Avery Dennison labels, ink on IBM printer and typewriter ribbons, to extrusion coatings on packaging materials at Curwood Division of Bemis. Fixed-probe systems offer exceptional precision and speed of response on very thin coatings while scanning systems display a profile for adjustment of a coating roll or die.

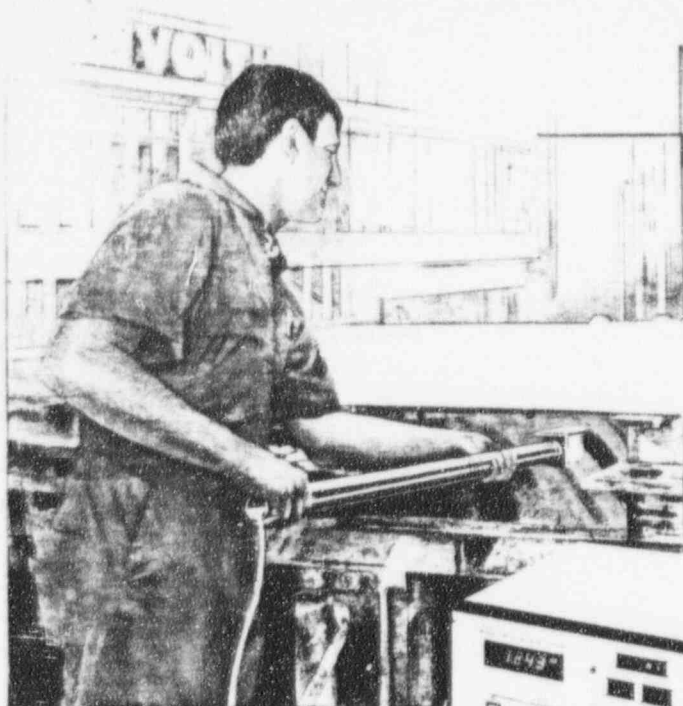
NDC x-ray fluorescence probes are used to measure very thin metallic coatings such as magnetic coatings for audio tape, computer tape, video tape, and floppy disk material. Also included are silver coatings for x-ray and photographic films, cadmium, zinc, lead, etc. Coating thickness is measured and controlled to 0.4 microinches (0.01 micron).



COMPOSITES

Measuring resin addition on paper, carbon fibers, fiberglass, varns, etc., is an easy job for the NDC gamma probe. There are dozens of NDC gauges on preregs, sheet molding compound (SMC), and reinforced plastics at Premix, Hexcel, McCann, Union Carbide, Amoco, Ferro, Narmco, Budd Co., and others. In one application, a narrow "tape" of carbon fibers is guided over the NDC probe by special teflon rollers, and the gauge reads the amount of resin addition in g/m (weight-per-unit length).

PAPER & FELT



Using a special sideways-looking configuration, the NDC probe can quickly measure the mass of cellulose and water on the wire (fabric) of a Fourdrinier paper machine. The gauge reads this mass in lbs/1000 ft. or kg/m². From these mass readings, plus basis weight at the reel, flow to the headbox, white water samples, and other factors, it is possible to calculate consistency along the wire and plot a drainage profile. This helps optimize the operation of the wet end of the Fourdrinier with the benefits of better paper quality, reduced wear on the fabric, and reduced energy costs. All major manufacturers of

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A variation on the drainage profiler gauge is used in the press section to measure the weight of the felts before and after the nips in order to determine degree of water transfer from paper to felt or vice versa. The basic gauge is also used by Appleton Mills, Porritts & Spencer, Fehr, and others in the manufacture of felts.

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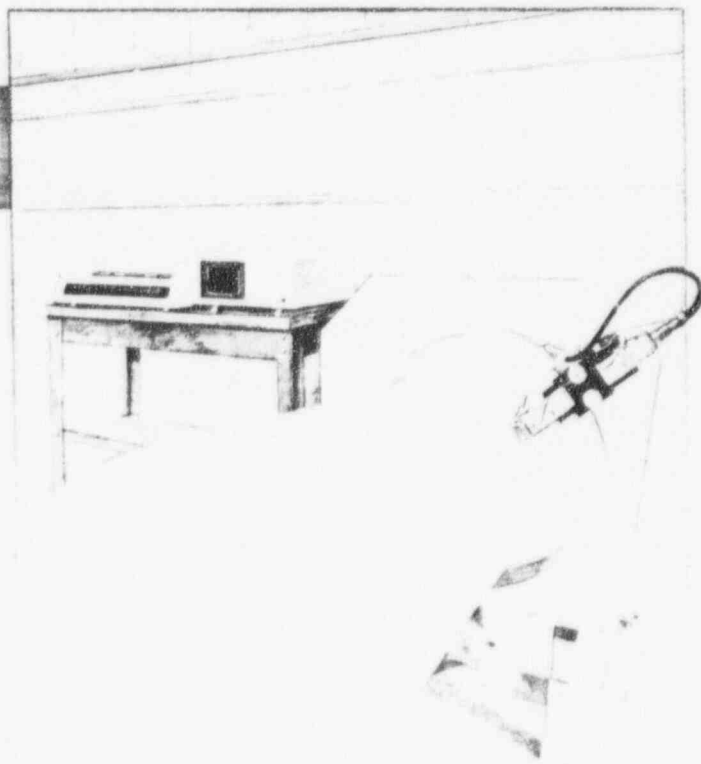
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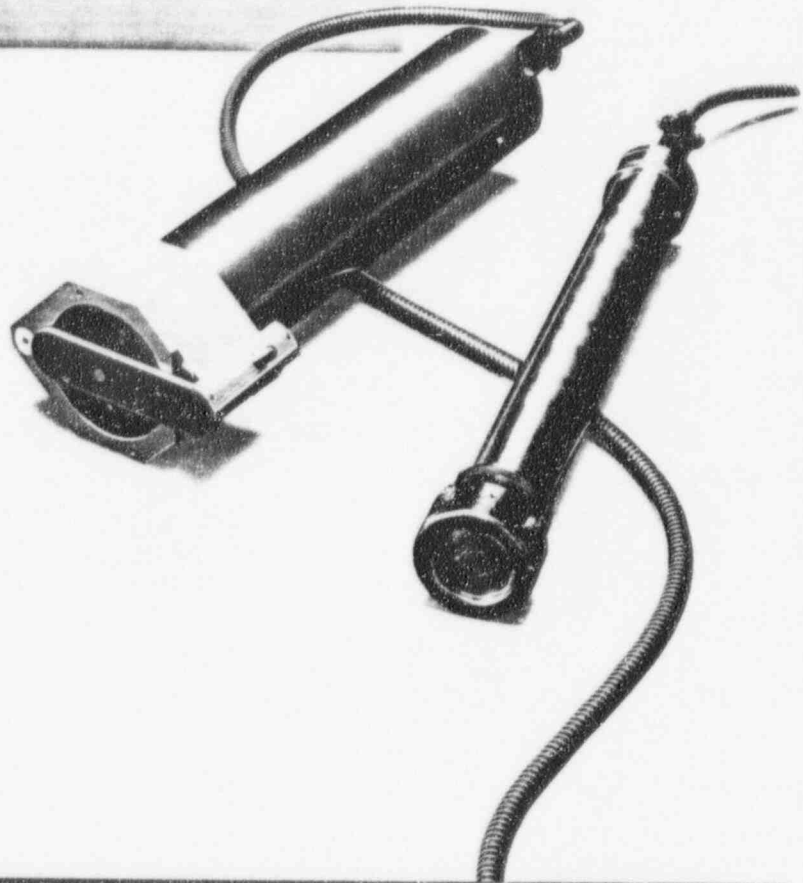
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GAMMA BACKSCATTER PROBES The principle of operation is Compton Photon Backscatter, commonly known as gamma backscatter. Photons from a very small radioactive isotope are backscattered in direct proportion to the mass (or weight-per-unit area) of material in front of the probe. A scintillation detector and electronics convert the photon count to a readout in engineering units such as g/m^2 , lbs/ream, mils, microns, or other.

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MANAGEMENT INFORMATION & COMMUNICATIONS



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NDC SYSTEMS



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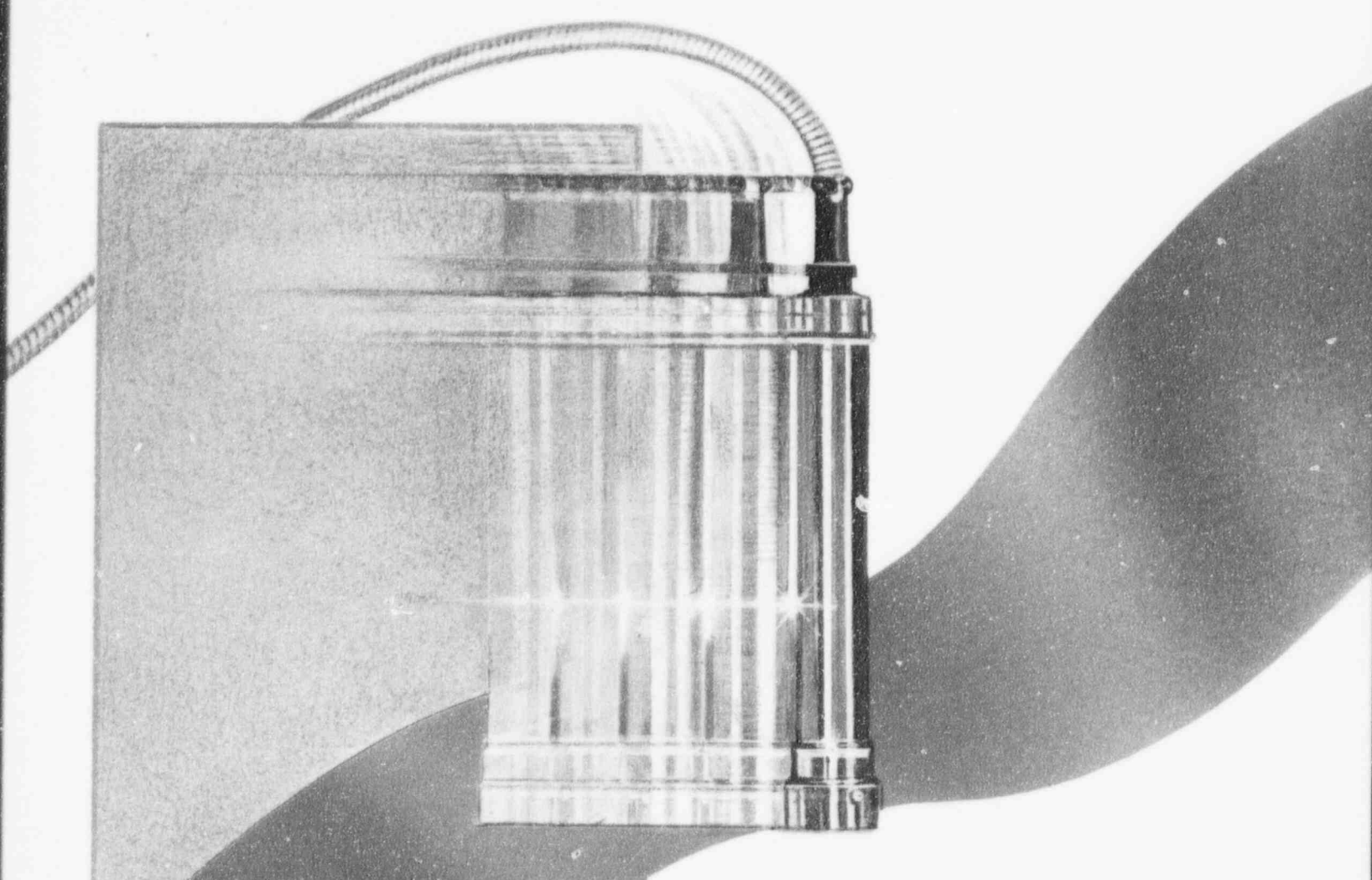
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NDC is proud to have served the needs of the many fine customers mentioned in this brochure. Mention of these names in no way constitutes an endorsement by any of these companies.

Data Brochure
107-051G
January 1992
Printed in U.S.A.



ON-LINE THICKNESS GAUGING & CONTROL SYSTEMS

- Cast or Extruded Sheet & Film
- Blown Film
- Rubber & Vinyl
- Coatings
- Composites:
Prepregs, SMC, RP, Tow
- Paper & Felt
- Textiles & Nonwovens
- Pipe & Tubing

NDC SYSTEMS

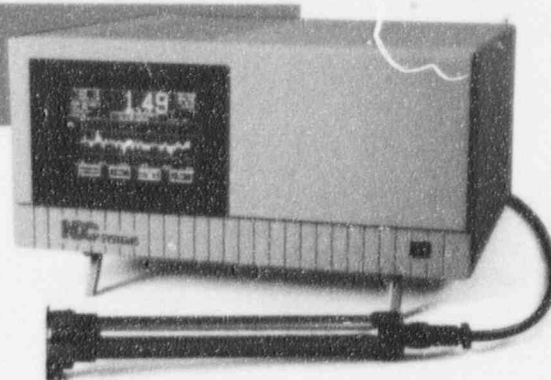
FROM BASIC SENSORS TO SOPHISTICATED SYSTEMS...

NDC offers a complete line of thickness gauging and control systems based upon proprietary sensors designed to solve specific application problems. These sensors are characterized by:

- Small size
- One-sided measurement
- Exceptional stability
- Low cost

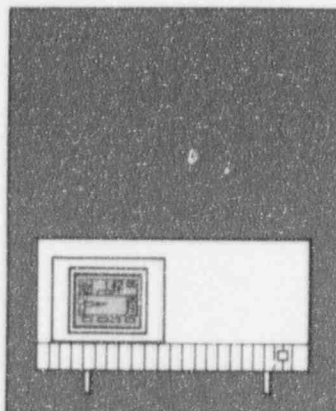
The small, one-sided probe is very easy to mount, especially when space is limited. If the probe is to scan the web, the unique NDC scanner is very small compared to traditional transmission type thickness gauges. A customer stated, "I don't have to torch my line to install your gauge."

MODULARITY NDC systems are modular in concept. It is possible to start with a small gauge and grow into a system with more capabilities. For example, a gauge with a



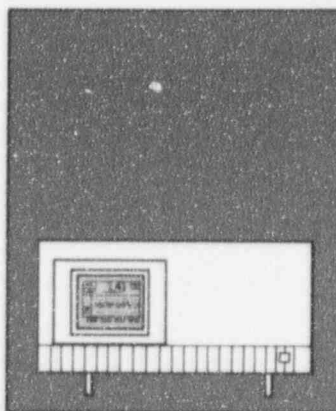
▲ Model 100T

fixed probe can be upgraded to a system with a probe that scans the web. All basic gauges feature a touch-screen interface that offers an ease of use and learning that is unmatched by systems using mechanical push-buttons, switches, etc. Upgrading to the NDC Model 8000 system with high-resolution color monitor and touch-screen controls adds more sophisticated displays, reports, and statistical analysis.



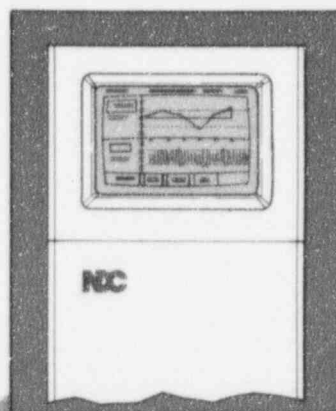
**Model 100T Series
Basic Fixed-Probe System**

The basic gauging system consisting of a sensor with appropriate mounting device, flexible armored cable, and electronics console. The console features a 7-inch, flat touchscreen for operator interface, and display of the measured variable in engineering units. Displays include machine direction trend and histogram. Options include a rotapusher for line speed input and a printer that can simulate a chart recorder.



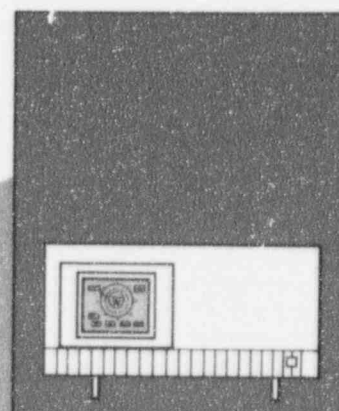
**Model 6100T Series
Basic Scanning System**

Adds scanning capability to the basic gauge. As with all NDC gauging systems, the 6100 features a touchscreen interface for ease of use. Displays include machine direction trend, cross direction profile, histogram, maximum/minimum/average of each scan, and much more, including several production reports. Control functions include speed control of screw, line, or pump, and dual gap control for roll coaters, doctor blades, and the like.



**Model 8100 Series
Scanning System with
Color Graphics Interface**

The top-of-the-line scanning system. Besides the basic measurement, this system features a 19-inch high-resolution color monitor with split screen display and touchscreen controls. The NDC implementation of a touchscreen affords an ease of use, understanding, and versatility unparalleled by any other type of system or operator interface. The system provides composite profiles, trends, process statistics, management reports, and two-way communications with a host computer or CIM system.



**Model 5100T Series
Fixed-Probe System
with Control**

Similar to the 100T, but with the addition of a rotapusher and control package that allows automatic speed control (speed of nip rolls) of a blown film line. Displays include flat or polar profile of the bubble. The system includes several useful reports, plus die bolt mapping for accurate display of the relation between thickness or weight, and an actual die bolt position.

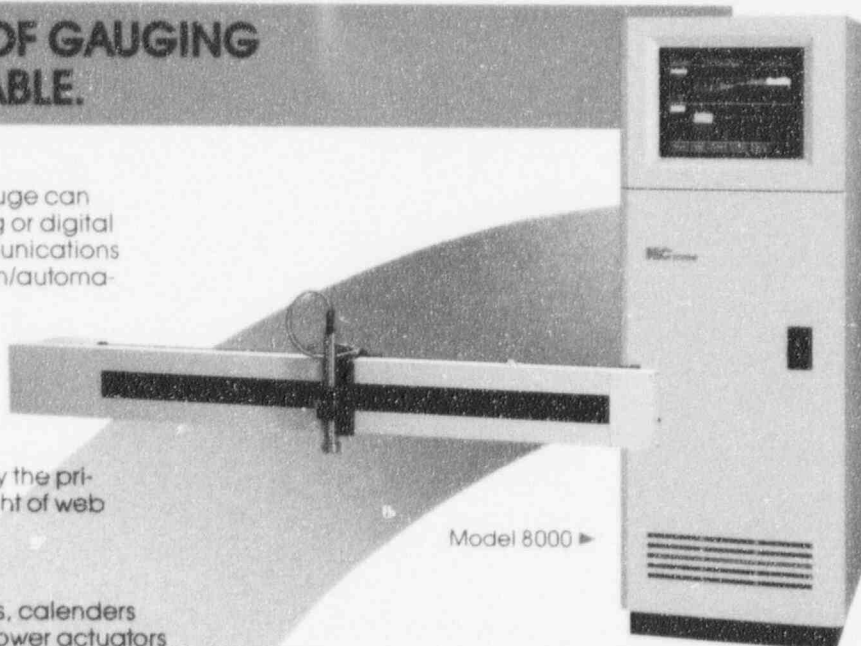
...A COMPLETE RANGE OF GAUGING AND CONTROL IS AVAILABLE.

COMMUNICATIONS Even the smallest NDC gauge can output data to a host computer in either analog or digital form. The larger systems feature two-way communications with a host computer or a plantwide information/automation system via point-to-point or network interface. NDC communications are designed to assure upward compatibility with developing plantwide automation or CIM.

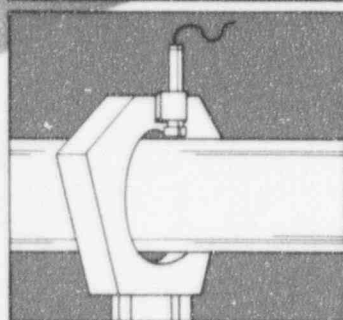
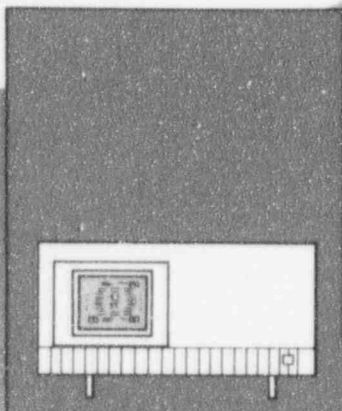
AUTOMATIC CONTROL NDC has chosen to limit the application of automatic control to only the primary measured variable, i.e., thickness or weight of web products.

NDC offers proven systems for control of:

- Speed—Line, pump, screw, etc.
- Gap Actuators—Roll coaters, doctor blades, calenders
- Auto Die—Dies with thermal bolts or other power actuators

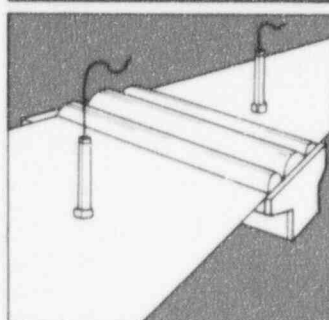
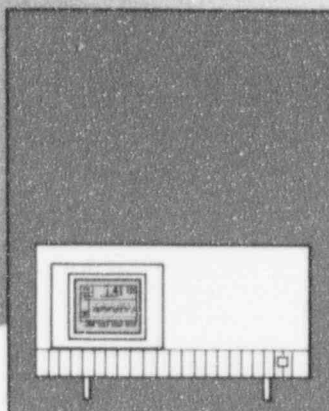


Model 8000 ▶



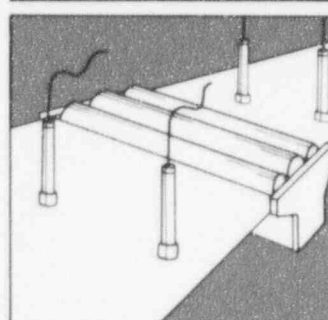
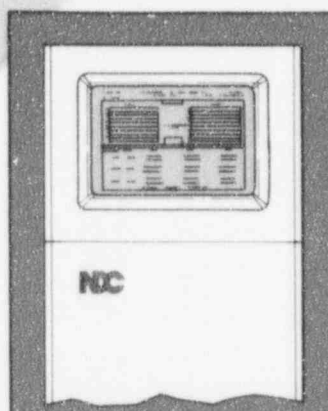
Model 4000T Series
Pipe and Tubing Wall Thickness
Gauging System

With a rotating (oscillating) scanner, it is possible to measure the circumferential thickness of plastic pipe. The touchscreen can display either a polar profile or a segmented screen that gives average thickness about each of a selected number of die bolts. Automatic control of hauloff speed keeps wall thickness at a constant average value, and a histogram or special report offers 'proof of compliance.'



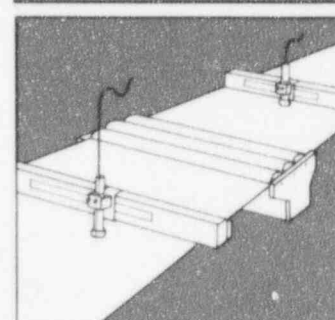
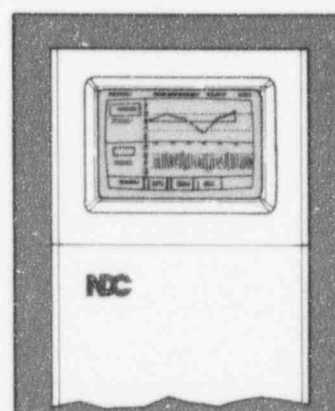
Model 5200T Series
Coating System with
Two Fixed Sensors

For coating applications, measuring the thickness or weight before and after a coating station and then subtracting the two readings will yield the net coat weight. The NDC 5200/2, with fixed probes before and after a coating station, affords a low-cost solution to coating weight measurement. Typical applications include small or narrow coaters, and saturators where scanning (profile) measurement and control are not practical, or needed.



Model 8000 Series
Coating System with
Fixed Sensors

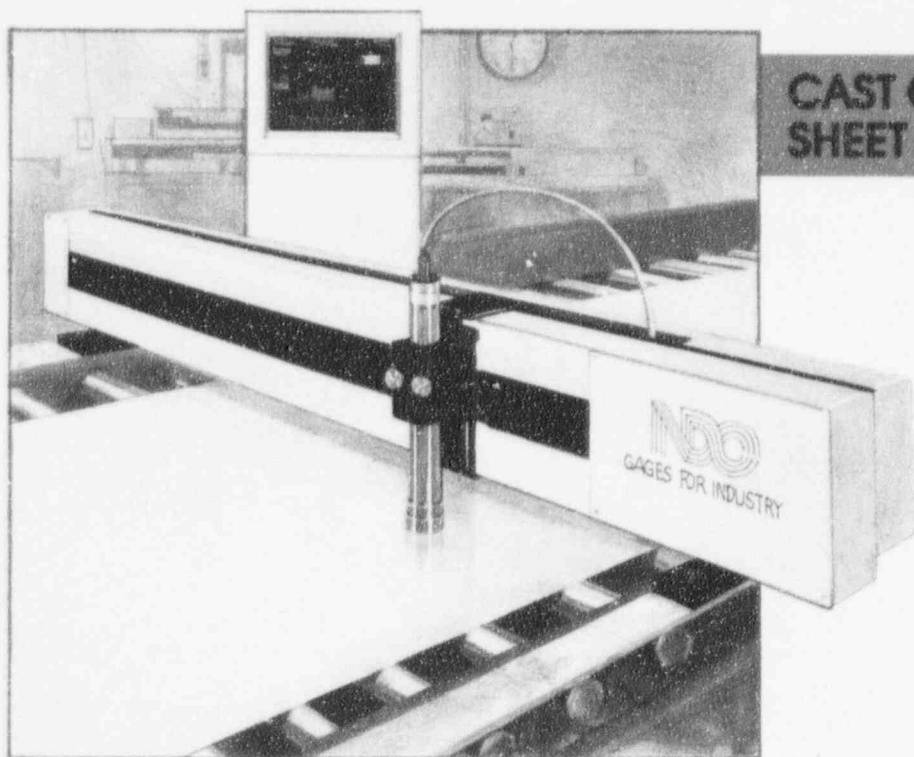
The Model 8000 can accommodate any practical number of fixed probes, depending upon the application. In one application, an 8000-8 has eight fixed probes, two left and two right, before and after three in-line coating stations. A very popular version has four probes, left and right, before and after a reverse roll coater. It should be noted that for certain very thin coating applications, NDC fixed-mount gauges can offer better response time and precision than any scanning system.



Model 8200 Series
Scanning Coating Weight
System

Scanning gauges develop a composite profile of the "net coat weight," which can be used to adjust (manually or automatically) the bolts on a die or left/center/right gap actuators. The 8000 system can control up to three scanners, and all units feature precise, same-spot measurement.

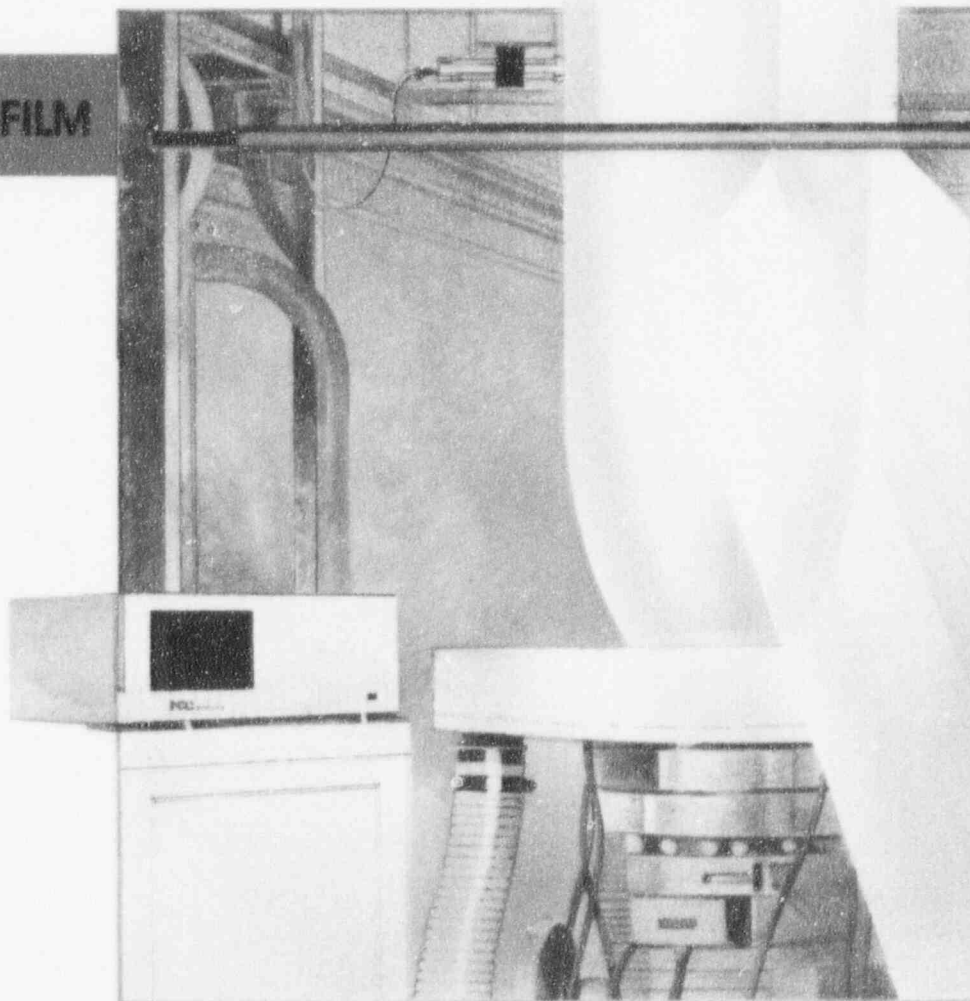
CAST OR EXTRUDED SHEET & FILM



Applications range from very thin films, on the order of 0.5 mil (12 microns), to sheet (including foamed sheet) as thick as 800 mils (20 mm) or more. With the NDC gamma probe, it is possible to measure sheet passing over a steel roll (for example, a chrome chill roll) which allows for faster response to thickness changes and installation on lines where large transmission gauges will not fit. Long time users include W.R. Grace, Impact Extrusions, Dixico, Amoco Fabrics & Fibers, and Goodyear.

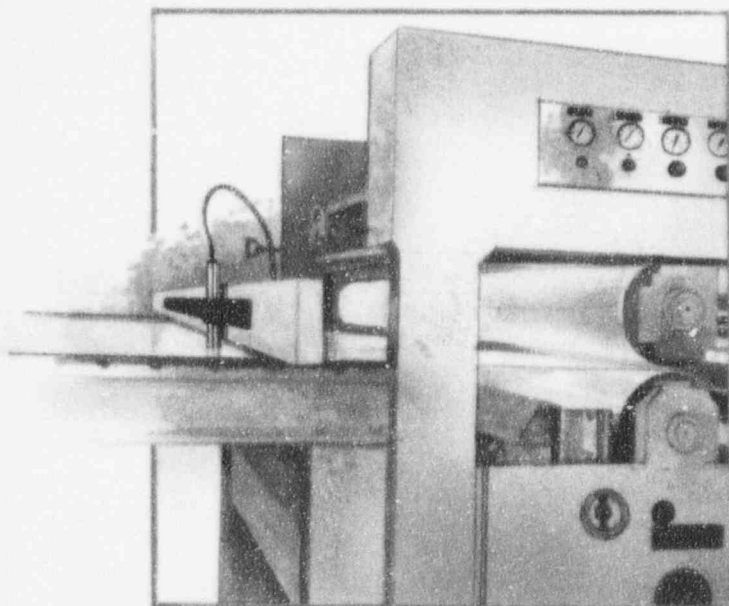
BLOWN FILM

Depending upon the application, the NDC gamma probe is mounted on the collapsing frame (because of the one-sided measurement) or on the edge of the layflat. Unlike other sensing techniques, the gamma measurement is not affected by changes in composition, opacity, color, or ambient variables (temperature and humidity). The touchscreen gives graphic indication of profile, average thickness at each die bolt position, machine direction variation, process spread (histogram), and much more. An optional control package automatically adjusts the speed of the nip rolls to maintain constant thickness. A printer option provides hard copy statistical information such as maximum, minimum, range, averages, standard deviation, footage, etc. A unique dynamic roll weight calibration feature provides the utmost in accuracy of calibration. Over 400 NDC blown film systems are in use by companies such as Union Camp, Borden, Goodyear, American Can, Union Carbide, Crystal Print, First Brands, and Arrow.



RUBBER & VINYL

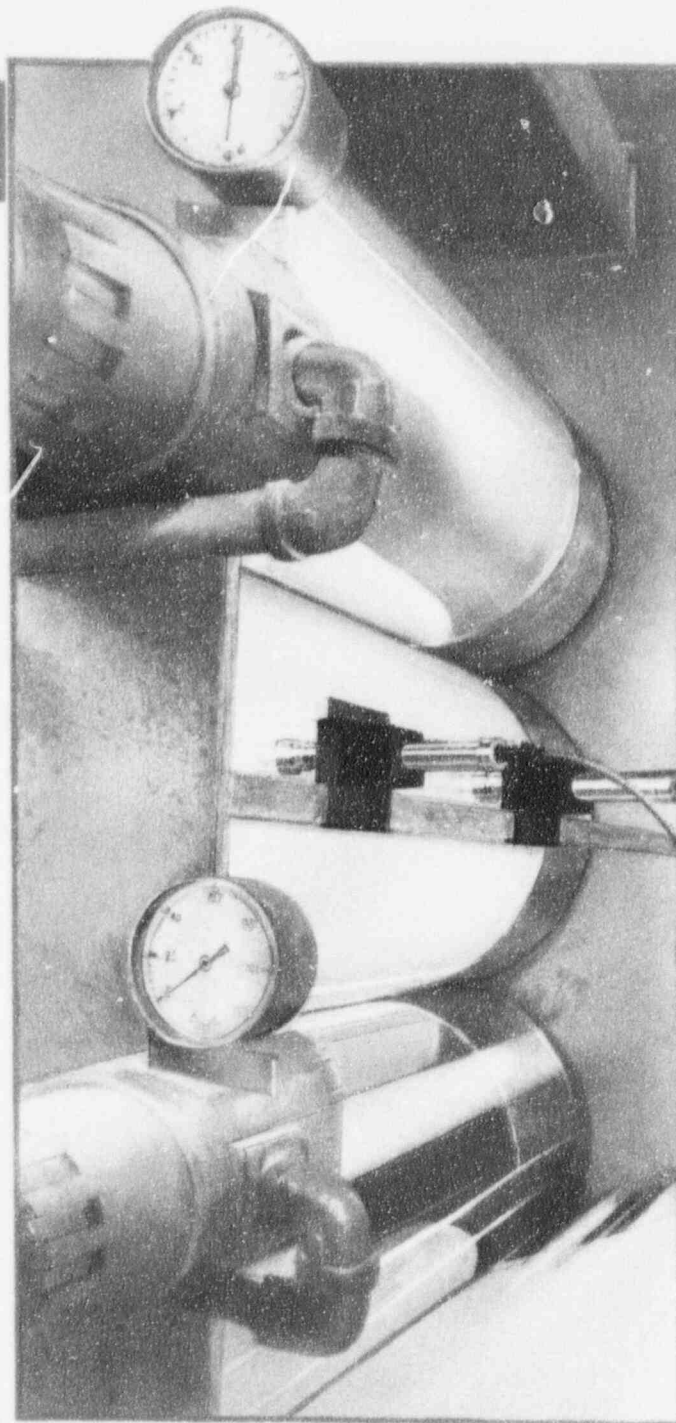
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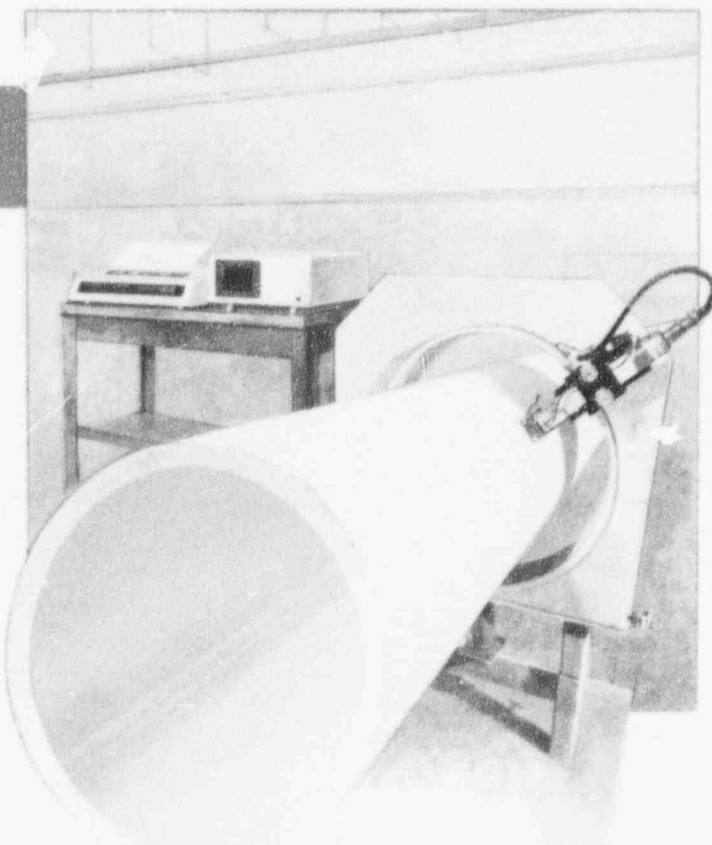
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