

# RAYEX® D

## State-of-the-Art X-Ray Measuring and Control Systems for Wall Thickness (3 layers), Eccentricity, Diameter/Ovality

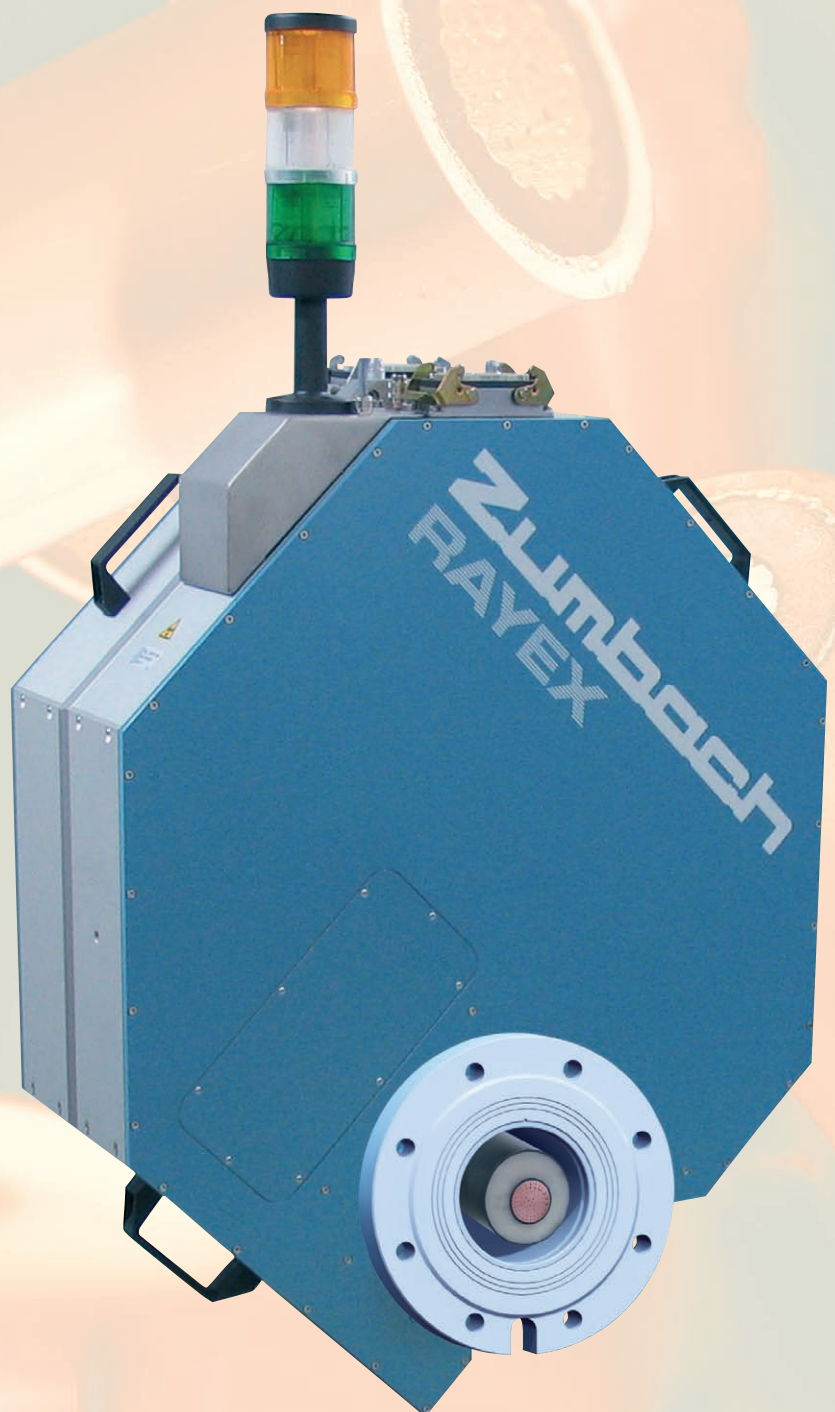
**Safe, Accurate, Economic  
in any Line and Process.**

■ **CV lines**

- CCV
- VCV
- MDCV
- Steam CV
- Rubber CV

■ **Silane for LV and MV**

■ **Subsea cables**



## Introduction

RAYEX® D is a low energy X-ray and high speed scanning system for the measurement of wall thickness, eccentricity, diameter and ovality of multilayer or single layer products in CV lines or others. RAYEX® D is based on the worlds first system which was able to measure all relevant cable parameters from outside the tube looking through beryllium windows.

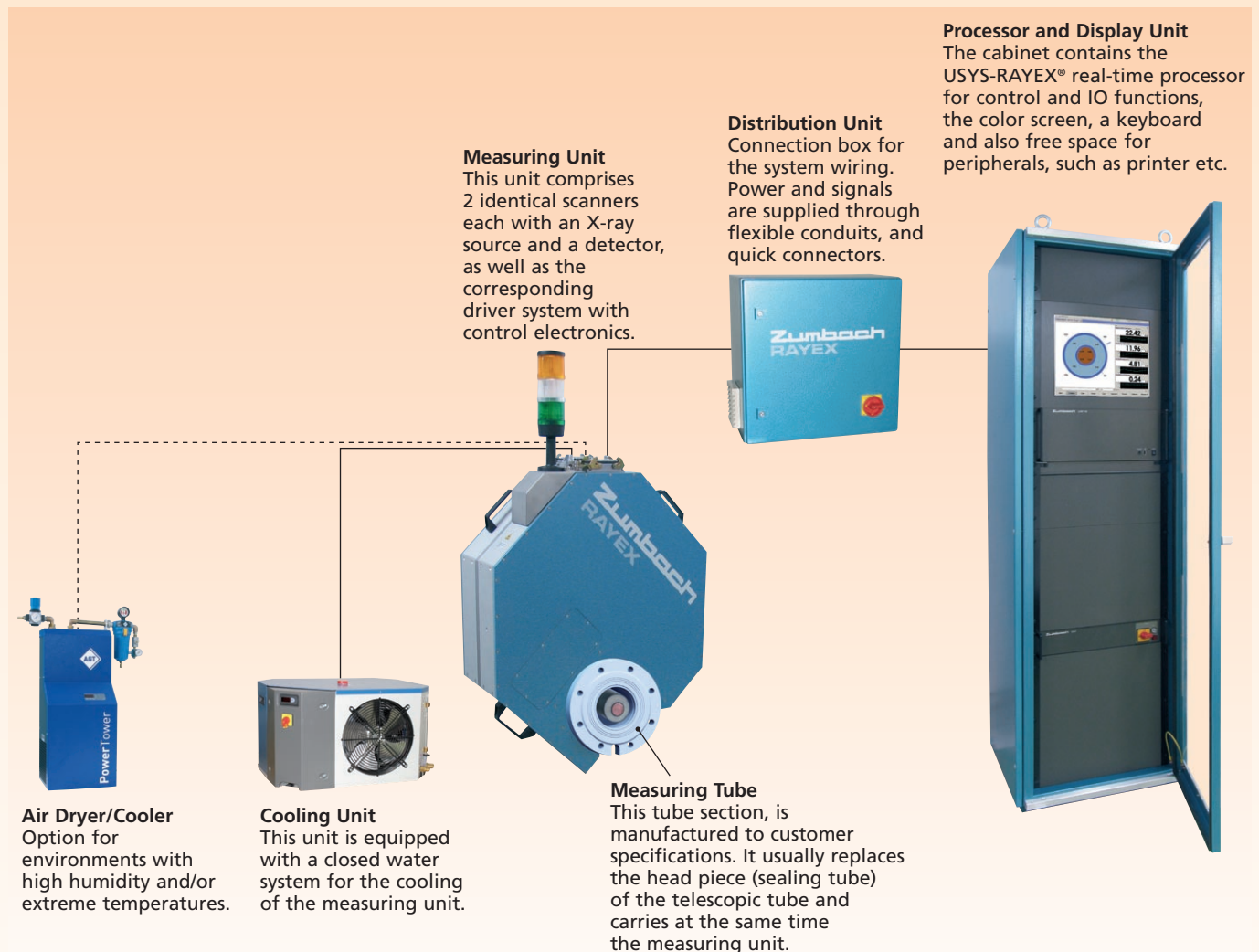
The RAYEX® D is protected under international patents CH 685 336 A5, US 5 518 681, US 5 795 531 and other rights.



## Modular & Practical

The RAYEX® is engineered as a modular system. There are practically no limitations in cable lengths between the main components and the auxiliary displays etc. The measuring unit is composed of

2 identical, light-weight scanners. All this means flexibility and easy installation, maintenance and service.



## The Unique RAYEX® D Features

### Highest Accuracy and Stability

- Ultra stable X-RAY source guarantees high local sensitivity and measuring accuracy thanks to highly focused beam and stable intensity.
- Even a 0.3 mm (.012 in.) inner semiconductor is measured accurately.

### High Measuring Rates, Simultaneously in X and Y Axis

- Preprocessing already within scanner, guarantying high measuring rate and quality of measurements.

### Unique Protection System for Beryllium Windows

- For efficient protection of the Beryllium windows (which is crucial regarding safety, lifetime and maintenance cost) a unique protection tube for quick exchange was conceived.
- Special version for steam CV lines

### Modular Light-weight Scanners

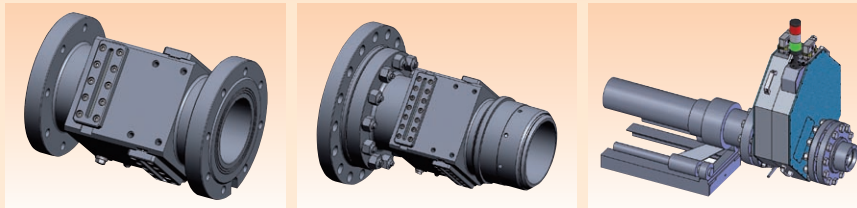
- Superior design with 2 interchangeable scanners for X and Y axis.
- Operation with 1 single scanner is possible.
- Excellent X-ray protection; easy and simple integrated microfocus X-ray source. No interference possibilities.
- Fully enclosed and protected scanners without external motors, cables etc.

### Diagnose and Function Test

- Reference scan possibility to readjust dirt contamination.
- Fine tuning possibility to set against off-line comparison with overhead projector/shadow graph.

## Customized Measuring Tube Segments

Zumbach Electronic has wide experience and a high quality standard for the design and manufacture of customized tube segments for each particular case and country.



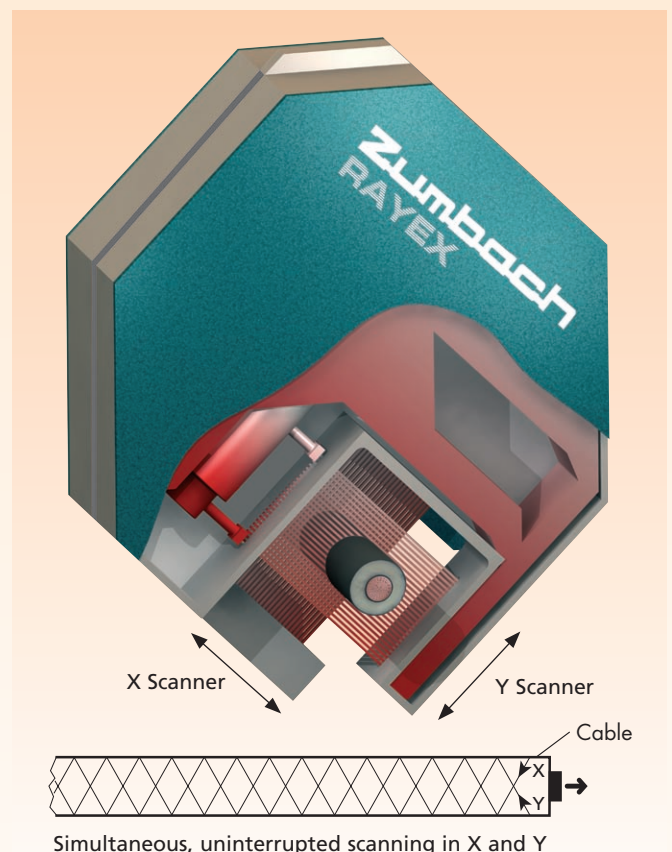
Typical designs of customized and delivered segments.

- For nitrogen and/or steam CV lines
- For all relevant safety standards (TÜV etc.)
- Made of highest quality stainless steels and completely machined out of the full.

## Measuring Principle

In order to achieve an accurate measurement of the individual layers, a scanner with a ultra-stable X-ray source was developed. The source supplies a very narrow beam (pencil beam) which penetrates the cable very selectively at the points of interest. The receiver has a very high resolution and is made so that no scattered radiation can falsify the readings. Source and receiver are mounted on a C-frame which is moved back and forth across the cable by a stepping motor driving a ball screw. A special processor controls the scanner speed and positions. Two such units scan the cable in perpendicular planes oriented at 45° to level.

A needle beam penetrates the product (e.g. high voltage cable etc.) in vertical and horizontal direction. Each X-ray scanner (X and Y) is accommodated in a separate scanner box. The intensity of the radiation after the penetration of the product cross-section is captured by a receiver (Scintillator), located on the opposite side of the X-ray sources. The sensor signals are processed directly in the scanner box. The simultaneous processing of the X and Y axis allows a very high measuring rate.



## Ultra Stable X-Ray Source

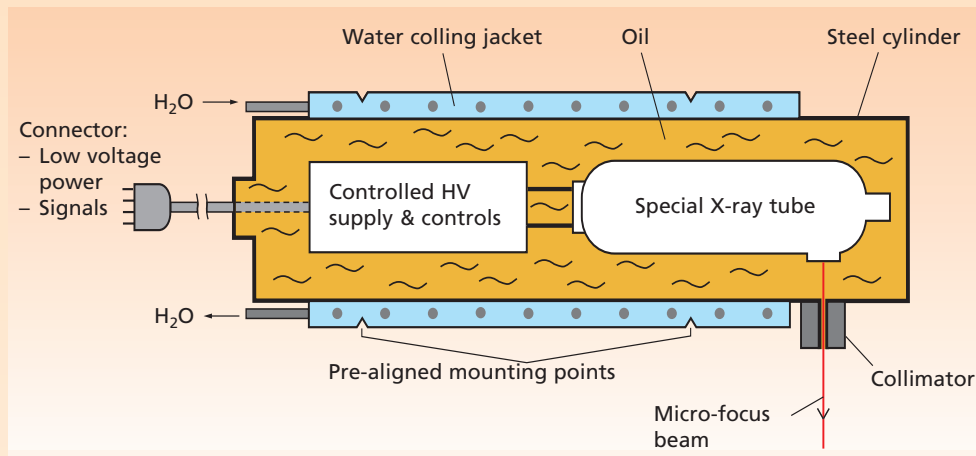
Since suitable X-ray sources were not available on the market, ZUMBACH decided to develop a special, integral source to solve the subject problems. The result is an Ultra-stable Micro-focus X-ray source, in short called **UMX source**. The UMX source is a self-contained module, containing the actual X-ray tube, the high voltage generator and auxiliary devices, all in an oil-filled and sealed steel cylinder.

Contrary to most other systems, there is no need for an external high voltage generator with long HV cables, which can cause instabilities and noise. Also, operating safety and reliability are improved.

## Advantages of the Zumbach X-Ray Source

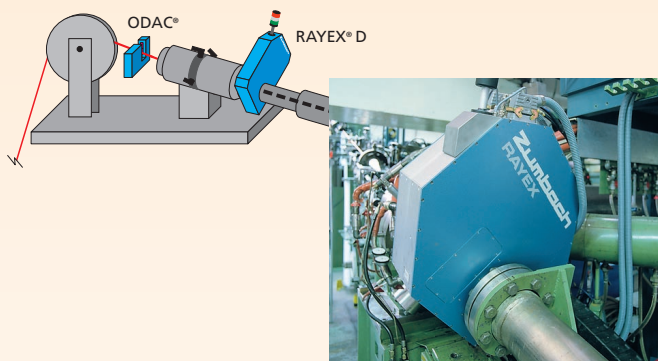
- The stability of the UMX-source is better than standard X-ray tubes with external high voltage supply.
- Both voltage and current are accurately closed loop controlled.
- The X-ray beam is highly focussed and specially shaped by means of a beam "collimator" to ensure high local resolution.
- Thanks to precise mounting points the complete source can be changed quickly and without re-alignment by the user.

## Unique X-Ray Source



## RAYEX® D & Other Gauges

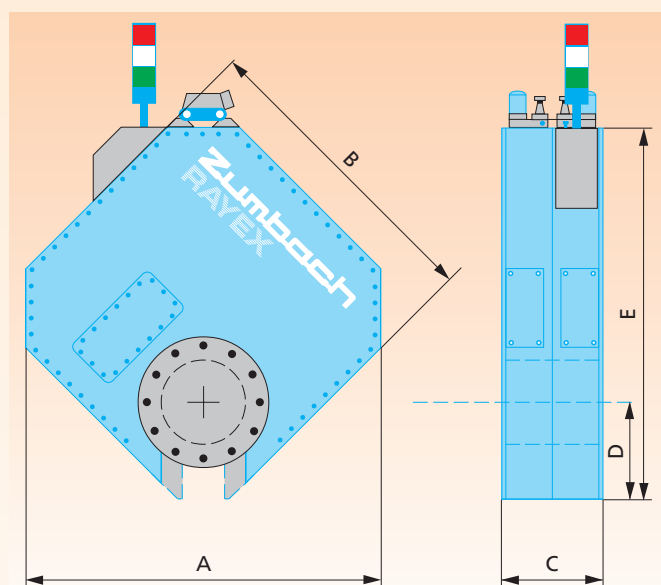
Specific RAYEX® D versions are available for use on CCV and VCV lines operated with nitrogen and/or steam. Conductor diameter and ovality can be measured in addition by placing an ODAC® laser measuring head in prior of the extruder.



Depending on product and quality strategy, any RAYEX® D system can be complemented with additional cold end gauges:

- Additional **RAYEX® D** with "hot-cold" function for automatic shrinkage compensation and monitoring of the drop effect.
- **ODAC®** laser diameter gauges

## Measuring Unit Dimensions



Model	A	B	C	D	E
RAYEX 160D	640 mm 25.20 in.	690 mm 27.17 in.	240 mm 9.45 in.	202 mm 7.95 in.	830 mm 32.68 in.
RAYEX 220D	840 mm 33.87 in.	728 mm 28.66 in.	240 mm 9.45 in.	230 mm 9.05 in.	874 mm 34.41 in.

## General Technical Data

Measuring Units (each unit comprises 2 measuring heads)		
Power supply	115/230 V~, 50/60 Hz (central connection to distribution unit)	
Max. power consumption	Distribution unit: 800 VA	Cooler unit: 1600 VA
Measuring range (max. cable Ø)	Model 160D: 90 mm (3.5 in.)	Model 220D: 140 mm (5.5 in.)
Max. insulation thickness <sup>1)</sup>	XLPE: max. 40 mm (1.57 in.)	EPR: max. 10 mm (.4 in.)
Min. semicond. thickness	0.3 mm (12 mil)	
Insulation / core material	XLPE or EPR / Cu or Alu (special materials on request)	
Measuring accuracy	Typically $\pm 0.03$ mm (.001 in.) repeatability for medium measuring range	
Resolution	0.01 mm (.0005 in.)	
Scanner system	2 X-ray scanners, at 90° to each other in the X and Y axis	
Scan mode	Simultaneous, Hi-speed scanning in X and Y	
Scan / updating time	1...3 seconds (automatic adaption to cable diameter)	
Operating temperature	0...45° C (32...113° F)	
Cooling <sup>3)</sup>	Heat exchanger for closed water circuit + optional air dryer/cooler	
Weight	RAYEX® 160D: 48 kg (105.8 lbs.)/measuring head RAYEX® 220D: 52 kg (114.6 lbs.)/measuring head	
Altitude	0...2000 m (0...6560 ft.)	
Humidity (max.)	95 % non condensing (for higher humidity optional air dryer is requested)	
Protection class	IP 60 (Distribution unit: IP 64)	
Radiation level	Max. 0.2 µS/hr above natural level <sup>2)</sup>	

<sup>1)</sup> For higher values in XLPE or EPR special measuring units upon request.

<sup>2)</sup> Measured at a distance of 100 mm (4 in.) Note: This value is far below most national regulations

<sup>3)</sup> Due to the fact that the sensing part is outside of the pressure tube, the cooling of the system is not critical. A closed water circuit for the X-ray source and the measuring head ensures that permitted operating temperatures are not exceeded and guarantees long lifetime of the X-ray tube.

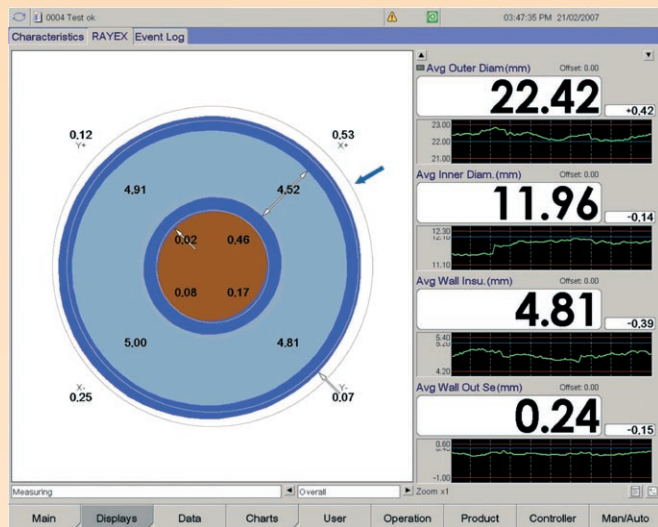
Processor and Display Unit		
Dimensions / Weight	510 x 600 x 2020 mm / approx. 120 kg (23.6 x 23.6 x 79.5 in. / approx. 264 lbs.)	
Power supply	115/230 V~ + 6 %/- 10 %, 50/60 Hz $\pm 1.5$ %	
Temperature	Operating: 0...45° C (32...113° F)	Transport: -20...50° C (-4...122° F)
Display	SXGA color TFT touch screen	
	<ul style="list-style-type: none"> <li>- Instant display after each measurement</li> <li>- Graphic display of the measured values</li> <li>- Bar graph or numerical or trend display</li> <li>- Measurement value display : <ul style="list-style-type: none"> <li>- Diameter (min. / max. / average)</li> <li>- Wall thicknesses (outer semiconductor / insulation / inner semiconductor)</li> <li>- Eccentricity</li> </ul> </li> <li>- SPC/SQC data / charts: <ul style="list-style-type: none"> <li>- Average (X-bar)</li> <li>- Max./Min. value (range)</li> <li>- Standard deviation</li> <li>- Statistical distribution (histogram)</li> </ul> </li> <li>- Output for remote readout</li> </ul>	
Processors	<b>USYS 2100 IPC</b> <ul style="list-style-type: none"> <li>- CPU: Intel 1.2 GHz Celeron</li> <li>- Memory: 128 MB</li> <li>- Interface: 3 x USB 1.1, Ethernet, Parallel</li> <li>- Serial Interface: 2 x RS-232</li> <li>- Extension PCBs: Quad RS-422, IO.012</li> </ul>	<b>IO.012 PCB</b> <ul style="list-style-type: none"> <li>- Static controller: 1 (<math>\pm 10</math> V, <math>\pm 5</math> mA)</li> <li>- Analog inputs: 1</li> <li>- Analog outputs: 3</li> <li>- Digital inputs: 7</li> <li>- Digital outputs: 5</li> <li>- Relay outputs: 3</li> </ul>
Interface unit	<ul style="list-style-type: none"> <li>- Easy and safe connection of RAYEX measuring units</li> <li>- Interface for additional user hardware</li> <li>- 24 V safety loop output</li> <li>- Spare output 24 V / 1.25 A</li> </ul>	

▪ All technical data are subject to change without notice

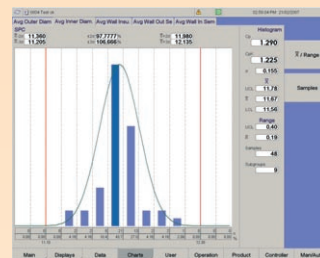
## Data Display On Touch Screen

Special emphasis was given to a clear and self-explanatory display of the measured data. This is achieved by using multi-color graphics, supplemented by numerical values, bar graphs, trends, etc. Out-of-

tolerance situations will be immediately spotted, as respective areas turn red. Free moving arrows always point to the thinnest position of each layer.

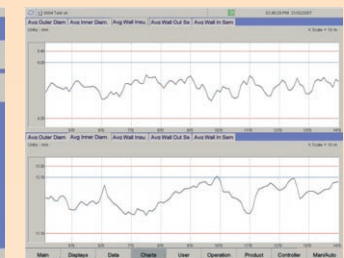


Cross-section and characteristics view



Statistics

Main screen showing, among others, line schematic, status and instrument view, as well as characteristics view.



Trends

## Savings Thanks To Wall Thickness Reduction

The worldwide increasing raw material prices have an important influence on the cost structure. The increasing production costs in the competitive market can hardly be transferred to the end customer. Thanks to the experience of over 50 years in the measuring, control and data processing technology, Zumbach offers solutions which guarantee most cost effective manufacturing, highest accuracy as well as continuous production and quality monitoring.

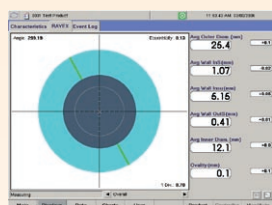
Expected savings of 4% (wall thickness reduction of 0.08 mm/.003 in. at a nominal wall of 2 mm/.078 in.) turns into annual savings of min. 140'000 US\$ (see below table), which is much more than the investment of a RAYEX® D system.

Annual Savings	
Annual material costs US\$	3'615'600
Expected savings %	4
<b>Annual savings US\$</b>	<b>144'624</b>

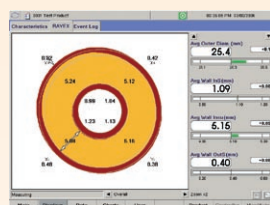
Note:  
the material price of US\$ 1.31 is at a very low level.  
As higher the material price, as higher are the savings.

## RAYEX® D For Other Applications

RAYEX® D can also be used for the measurement of foamed core pipe, foamed coax, CATV and antenna cable products. Ask for detailed literature.



Cross-section of single-layer CATV antenna feeder cable



Cross-section of multi-layer pipe

## Optional Software

**USYS Web Server** for data display and management at remote terminals.

**USYS Data Log** for easy data collection from one or several processors and for saving the data in text or Excel™ files.

™ Excel is a trademark of Microsoft Corporation

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