OLYMPUS

Your Vision, Our Future

Automated Ultrasonic Inspection for Pipeline Girth Welds

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Pipeline Girth Weld Inspection:

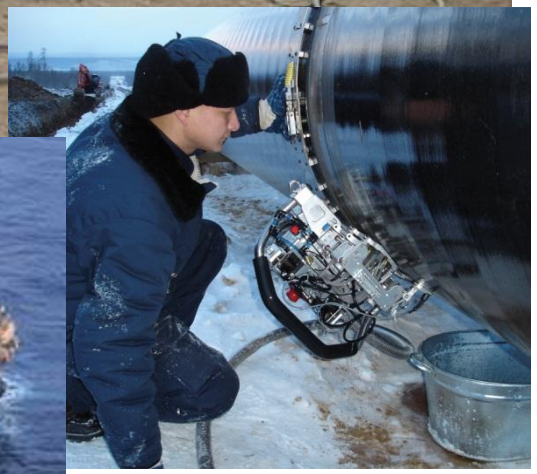
In the last several years Automated Ultrasonic Inspection (AUT) , has begun to really replace traditional X-Ray crawler radiography.

AUT phased-array vs. radiography

Radiography has significant limitations compared to AUT:

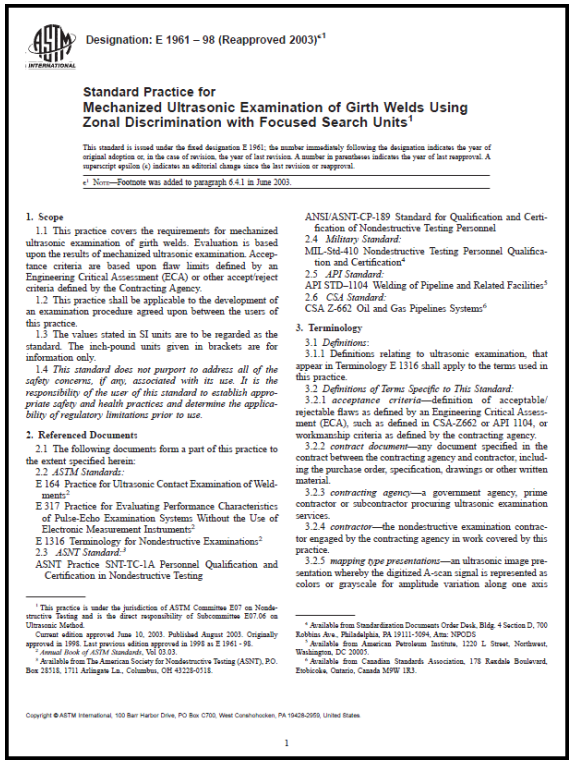
- Poor detection of Planar Defects in some circumstances.
- Accuracy of vertical defect sizing.
- Safety Issues.
- Environmental Concerns.

Girth Weld Inspections: Onshore / Offshore



Codes governing pipeline AUT inspection

ASTM E 1961



Designation: E 1961 – 98 (Reapproved 2003)ε1

Standard Practice for Mechanized Ultrasonic Examination of Girth Welds Using Zonal Discrimination with Focused Search Units[1]

This standard is issued under the fixed designation E 1961; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

ε1 NOTE—Footnote was added to paragraph 6.4.1 in June 2003.

1. Scope

1.1 This practice covers the requirements for mechanized ultrasonic examination of girth welds. Evaluation is based upon the results of mechanized ultrasonic examination. Acceptance criteria are based upon flaw limits defined by an Engineering Critical Assessment (ECA) or other accept/reject criteria defined by the Contracting Agency.

1.2 This practice shall be applicable to the development of an examination procedure agreed upon between the users of this practice.

1.3 The values stated in SI units are to be regarded as the standard. The inch-pound units given in brackets are for information only.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 The following documents form a part of this practice to the extent specified herein:

2.2 *ASTM Standards:*

E 164 Practice for Ultrasonic Contact Examination of Weldments[2]

E 317 Practice for Evaluating Performance Characteristics of Pulse-Echo Examination Systems Without the Use of Electronic Measurement Instruments[2]

E 1316 Terminology for Nondestructive Examinations[2]

2.3 *ASNT Standard:*[3]

ASNT Practice SNT-TC-1A Personnel Qualification and Certification in Nondestructive Testing

ANSI/ASNT-CP-189 Standard for Qualification and Certification of Nondestructive Testing Personnel

2.4 *Military Standard:*

MIL-Std-410 Nondestructive Testing Personnel Qualification and Certification[4]

2.5 *API Standard:*

API STD–1104 Welding of Pipeline and Related Facilities[5]

2.6 *CSA Standard:*

CSA Z-662 Oil and Gas Pipelines Systems[6]

3. Terminology

3.1 *Definitions:*

3.1.1 Definitions relating to ultrasonic examination, that appear in Terminology E 1316 shall apply to the terms used in this practice.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *acceptance criteria*—definition of acceptable/rejectable flaws as defined by an Engineering Critical Assessment (ECA), such as defined in CSA-Z662 or API 1104, or workmanship criteria as defined by the contracting agency.

3.2.2 *contract document*—any document specified in the contract between the contracting agency and contractor, including the purchase order, specification, drawings or other written material.

3.2.3 *contracting agency*—a government agency, prime contractor or subcontractor procuring ultrasonic examination services.

3.2.4 *contractor*—the nondestructive examination contractor engaged by the contracting agency in work covered by this practice.

3.2.5 *mapping type presentations*—an ultrasonic image presentation whereby the digitized A-scan signal is represented as colors or grayscale for amplitude variation along one axis

[1] This practice is under the jurisdiction of ASTM Committee E07 on Nondestructive Testing and is the direct responsibility of Subcommittee E07.06 on Ultrasonic Method.

Current edition approved June 10, 2003. Published August 2003. Originally approved in 1998. Last previous edition approved in 1998 as E 1961 - 98.

[2] *Annual Book of ASTM Standards*, Vol 03.03.

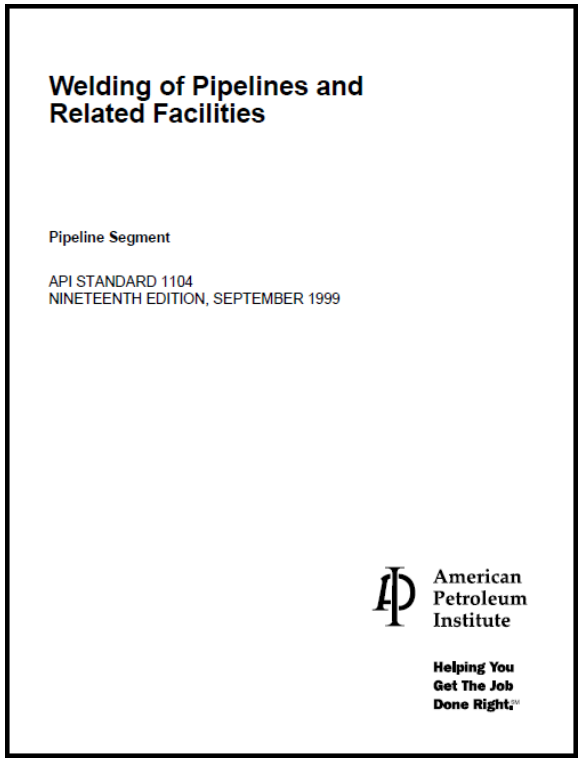
[3] Available from The American Society for Nondestructive Testing (ASNT), P.O. Box 28518, 1711 Arlingate La., Columbus, OH 43228-0518.

[4] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS

[5] Available from American Petroleum Institute, 1220 L Street, Northwest, Washington, DC 20005.

[6] Available from Canadian Standards Association, 178 Rexdale Boulevard, Etobicoke, Ontario, Canada M9W 1R3.

API 1104



Welding of Pipelines and Related Facilities

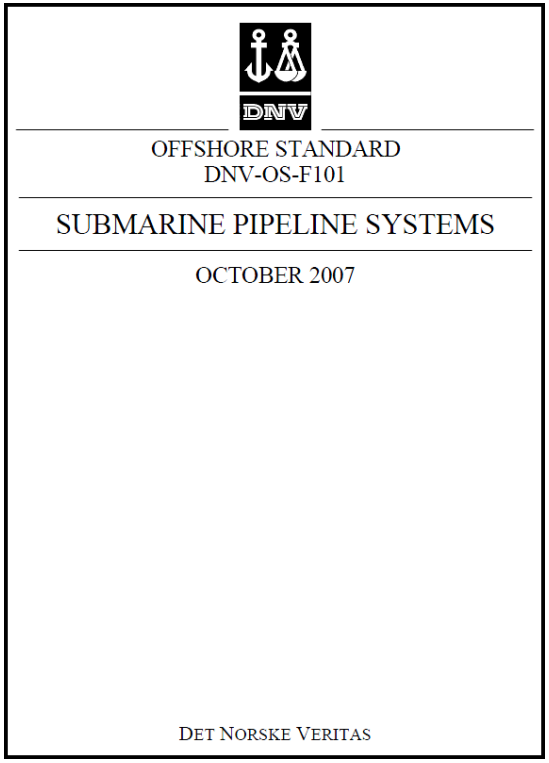
Pipeline Segment

API STANDARD 1104
NINETEENTH EDITION, SEPTEMBER 1999

American Petroleum Institute

Helping You Get The Job Done Right.SM

DNV-OS-F101



DNV

OFFSHORE STANDARD
DNV-OS-F101

SUBMARINE PIPELINE SYSTEMS

OCTOBER 2007

DET NORSKE VERITAS

Code Compliance:

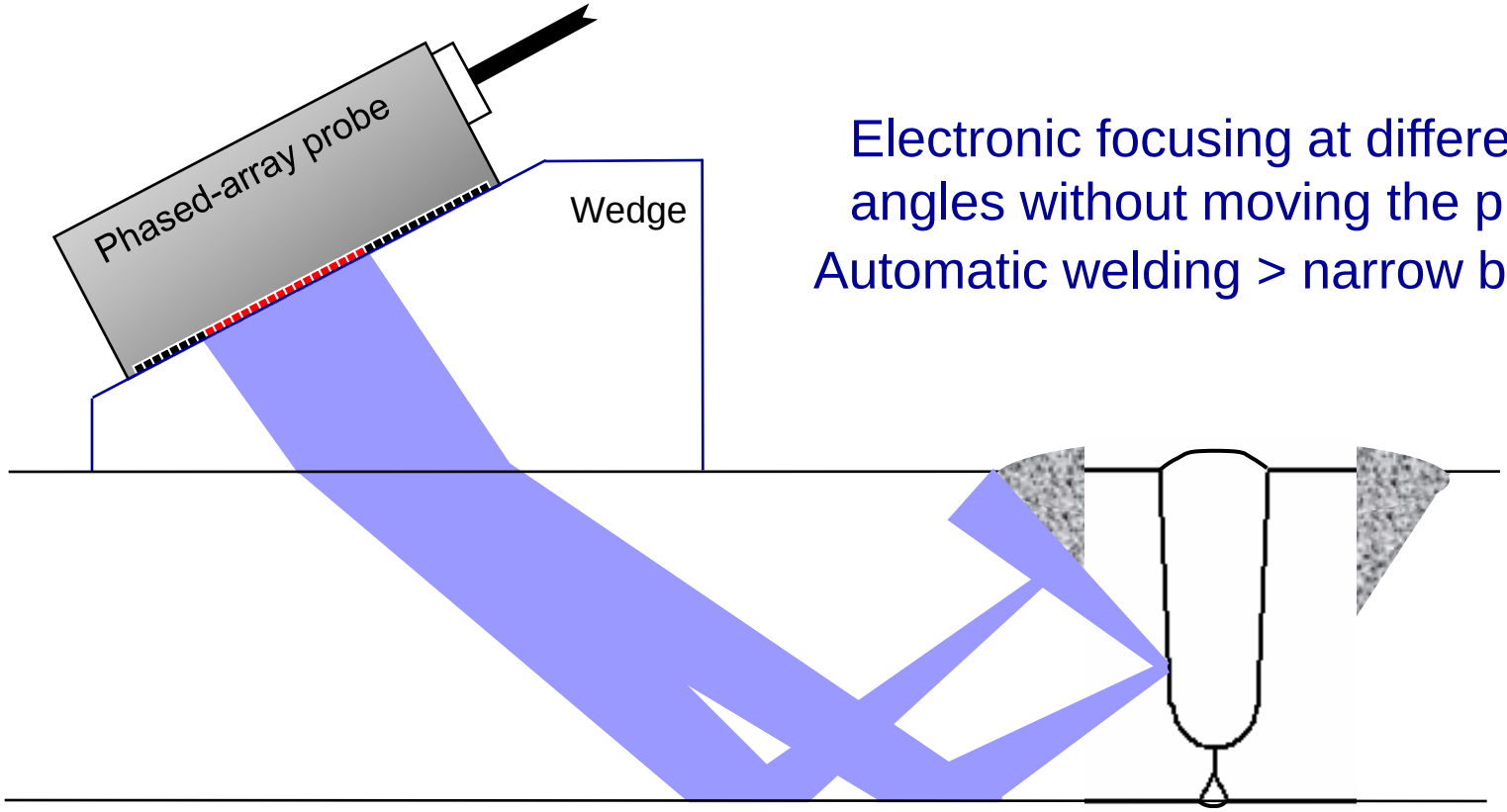
In 1998, the ASTM published the E-1961-98 code (reapproved in 2003), which covers key elements of AUT of girth welds - **zone discrimination, rapid data interpretation, specialized calibration blocks**, and configuration procedures.

The E-1961 code is designed for ECA. Similarly, in 1999, the American Petroleum Institute (API) published the 19th edition of Standard 1104, which covers mechanized ultrasonic testing and radiography of girth welds.

PipeWIZARD allows inspections to comply with the ASTM E-1961 code, and by inference, with the API 1104 standard. It also allows compliance with the DNV-OS-F101 standard, the offshore AUT code.

Company specifications may exceed the codes, typically by asking for improved sizing or better resolution.

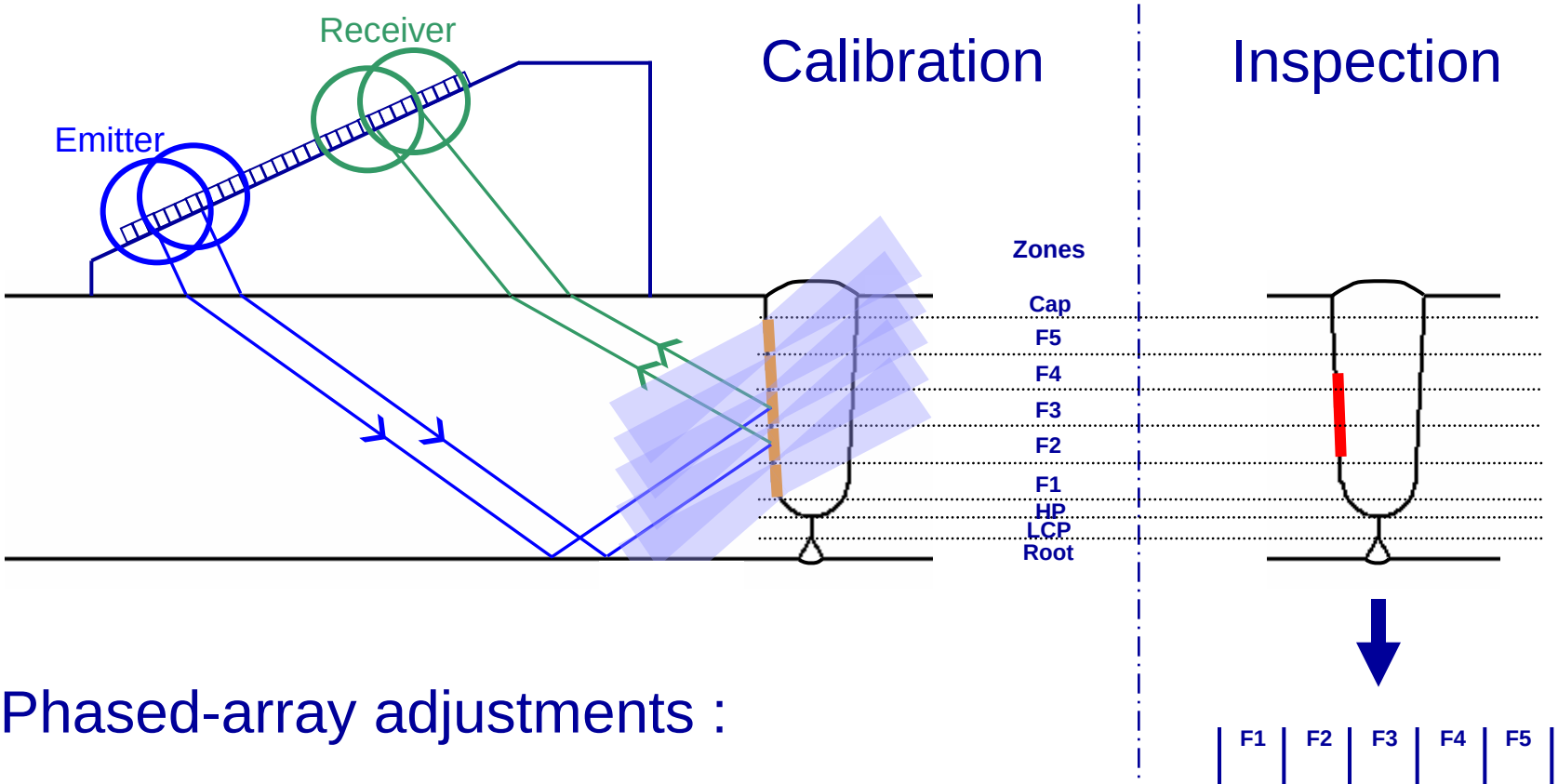
AUT - Basic Ultrasonic Phased-array principles



Electronic focusing at different angles without moving the probe

Automatic welding > narrow bevel

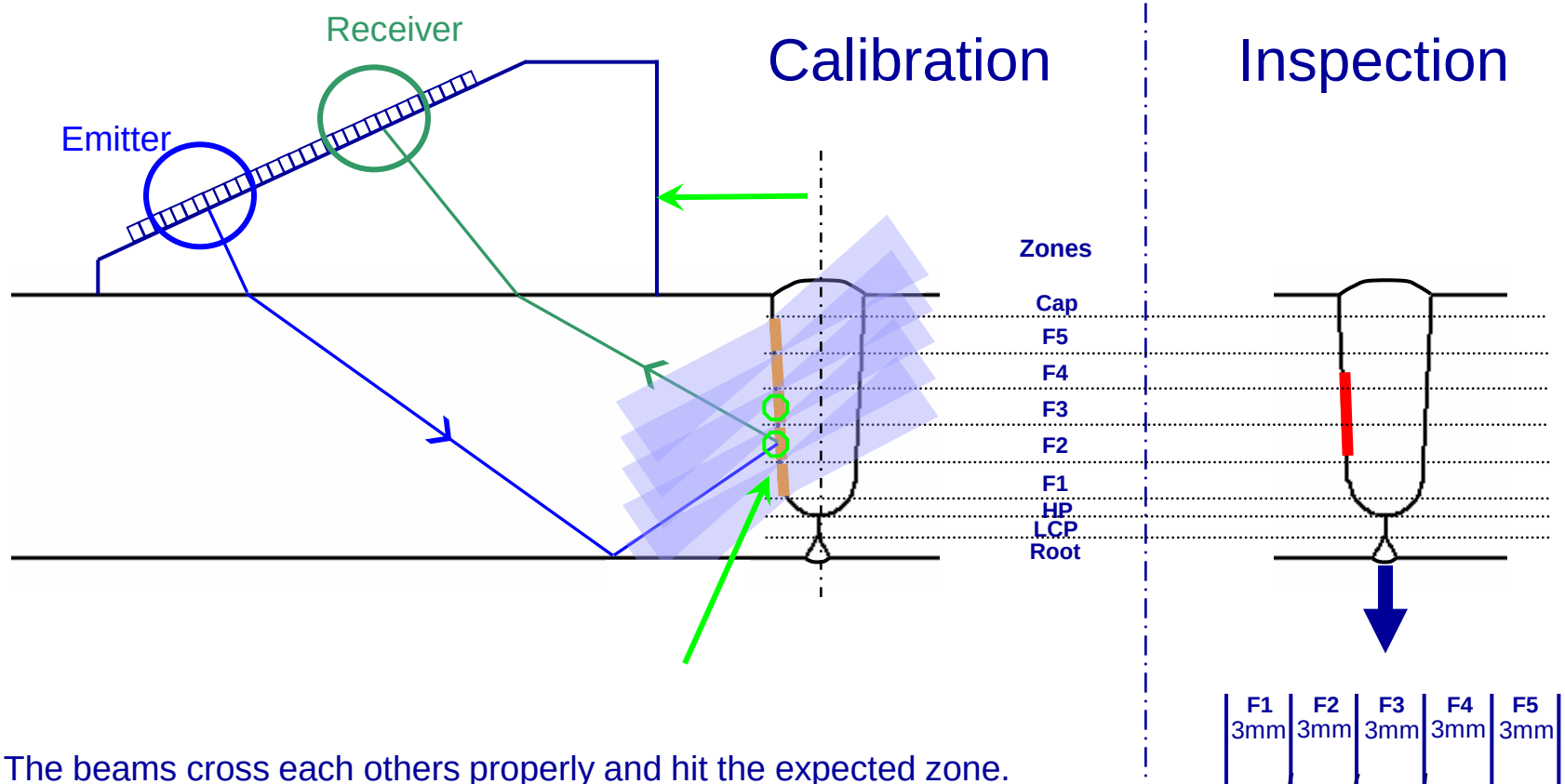
AUT - Zone discrimination technique



Phased-array adjustments :

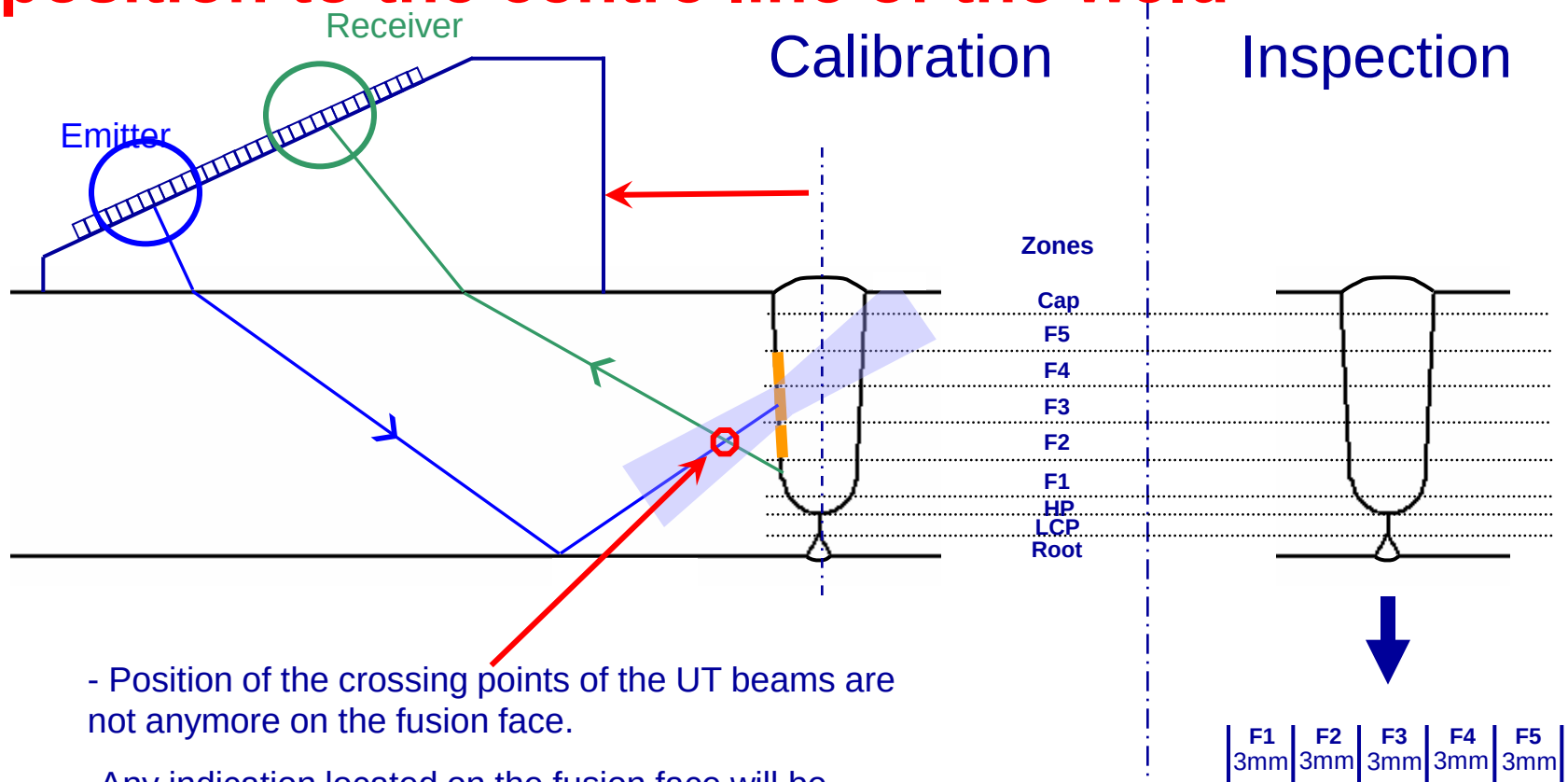
- Adjustment of emitter and receiver to hit the zone
- Adjustment of beam width to cover the height of the zone
- Adjustment of overlap in next zone

Zone discrimination technique: GOOD position to the centre line of the weld



- The beams cross each others properly and hit the expected zone.
- A flaw will generate an echo which amplitude will be proportional to its size.

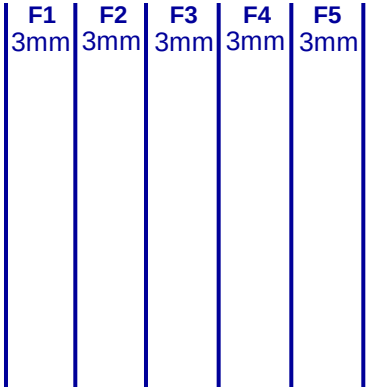
Zone discrimination technique : BAD position to the centre line of the weld



- Position of the crossing points of the UT beams are not anymore on the fusion face.

-Any indication located on the fusion face will be missed

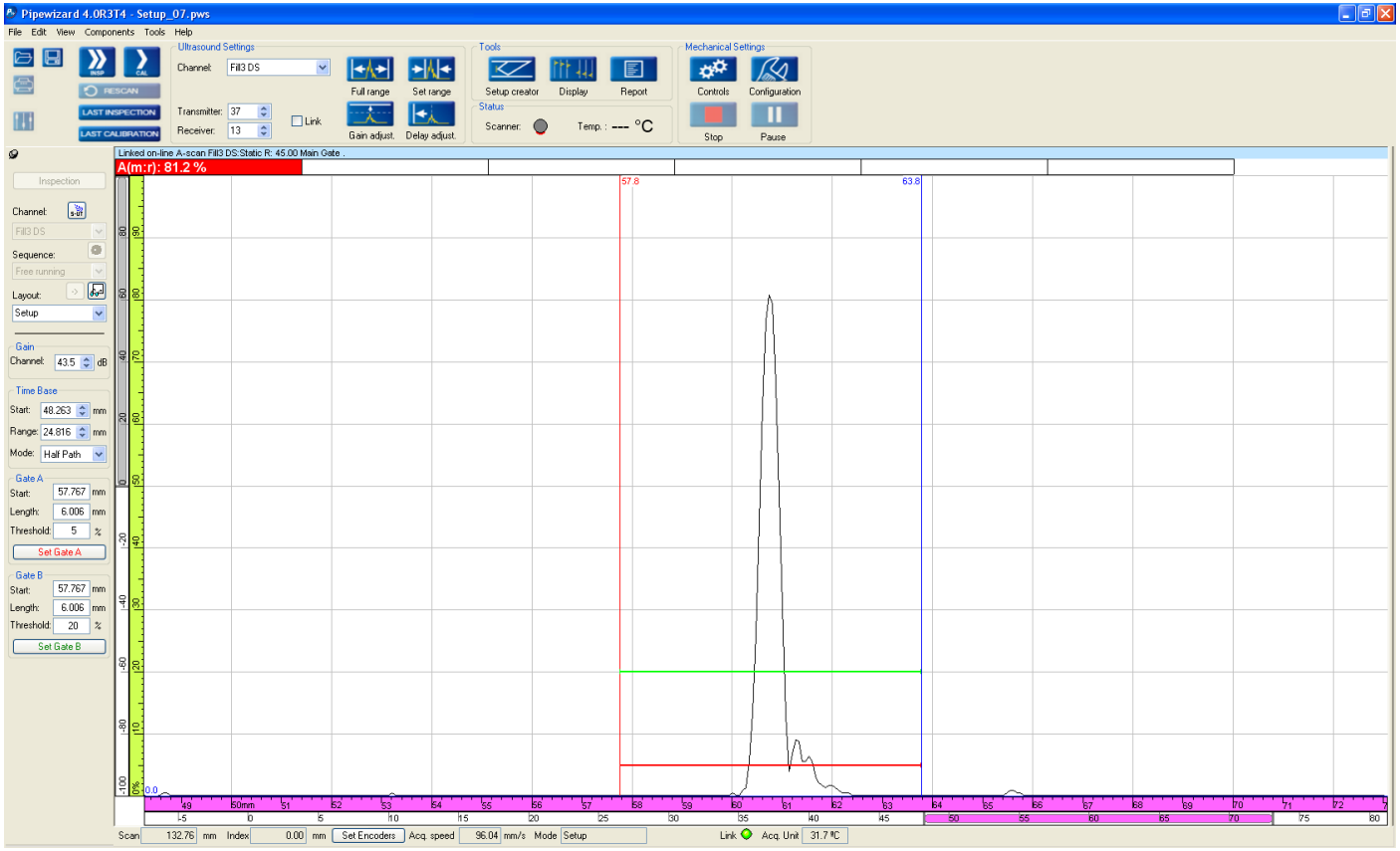
- Or the amplitude will drop significantly underestimating the flaw size and giving a wrong depth



PipeWIZARD V4 - Software

User-friendly advanced software

- Twin-gate strip chart : amplitude and position



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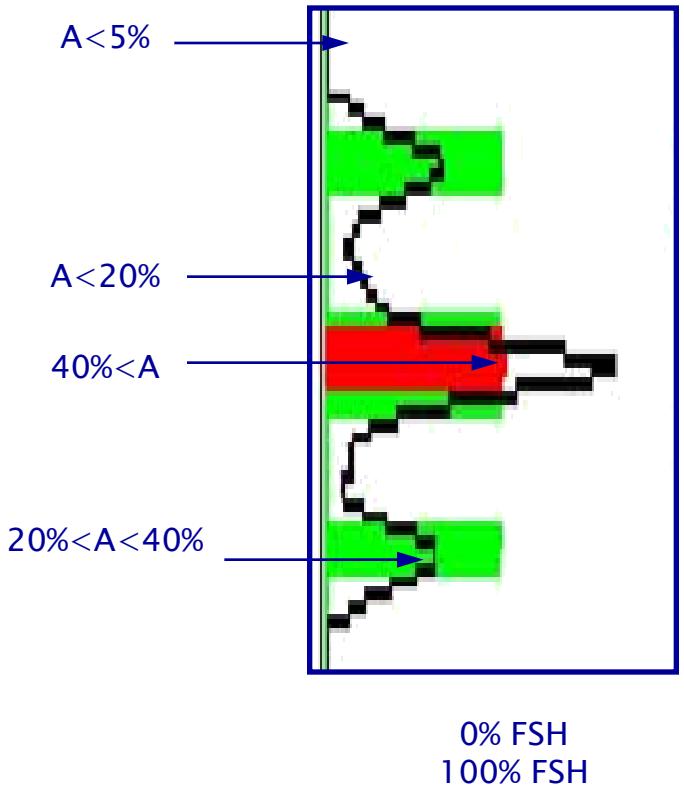
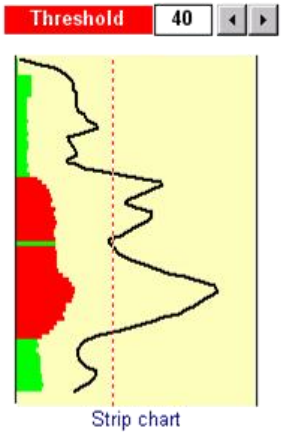
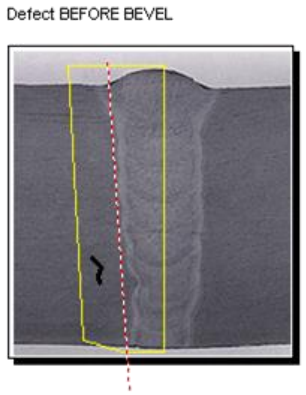
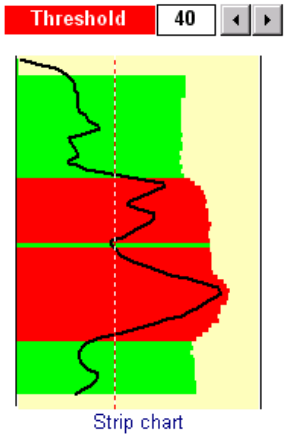
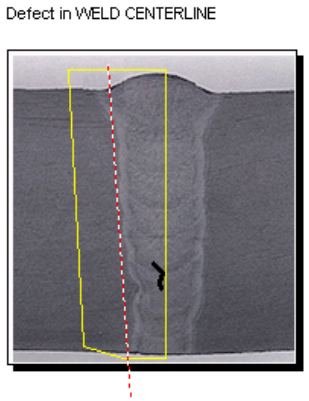


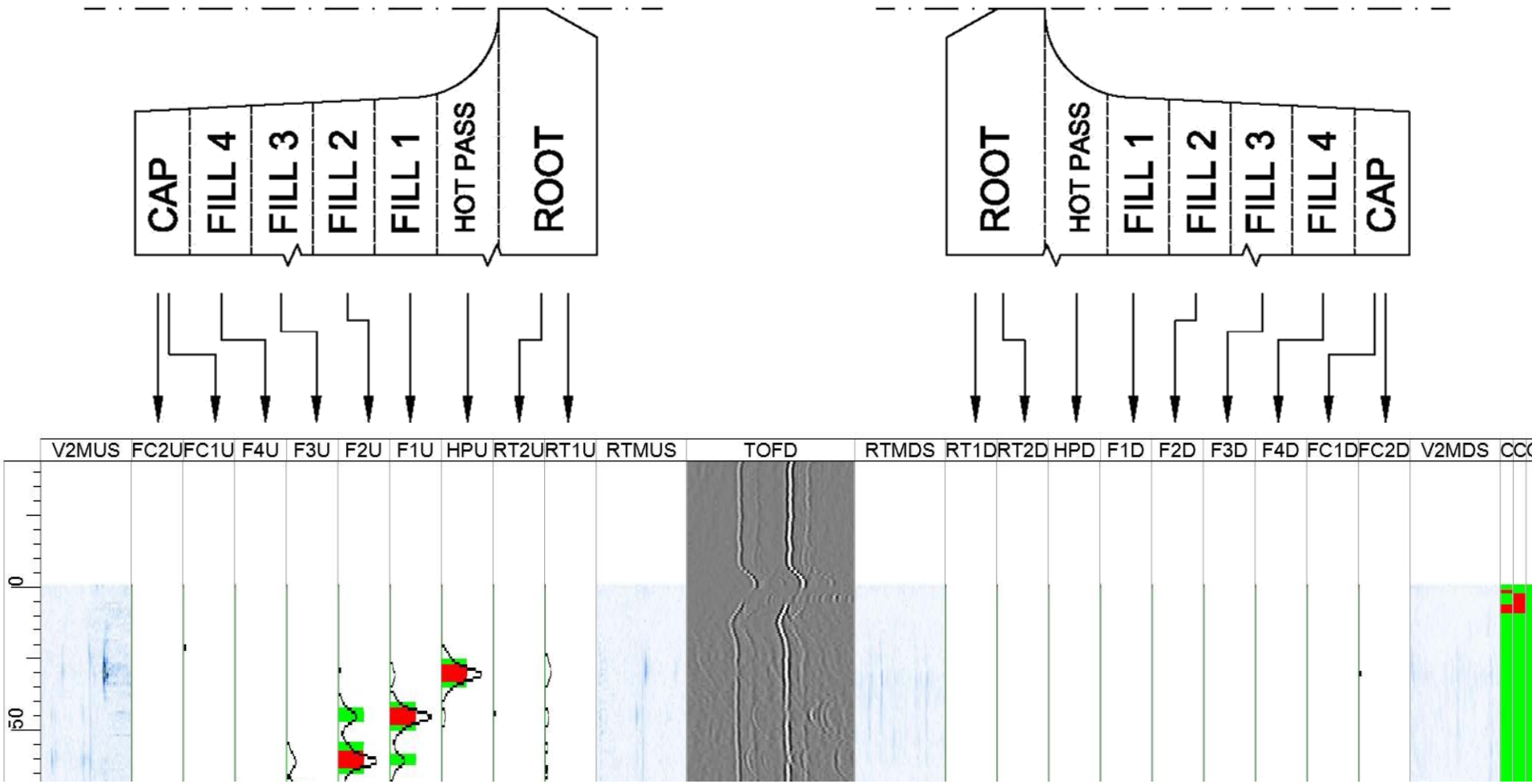




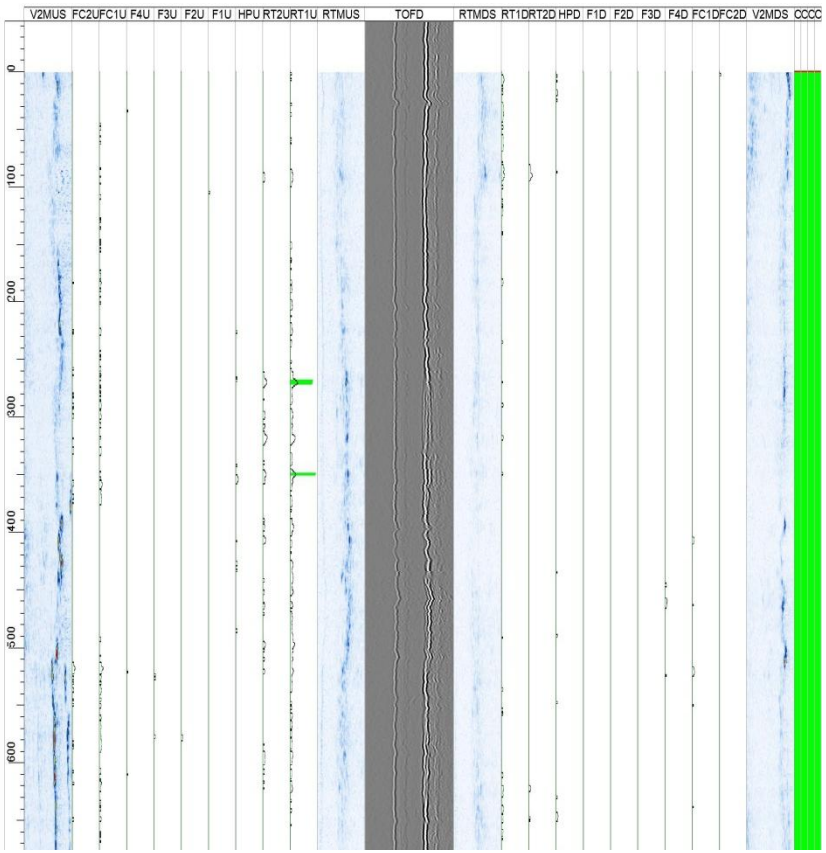




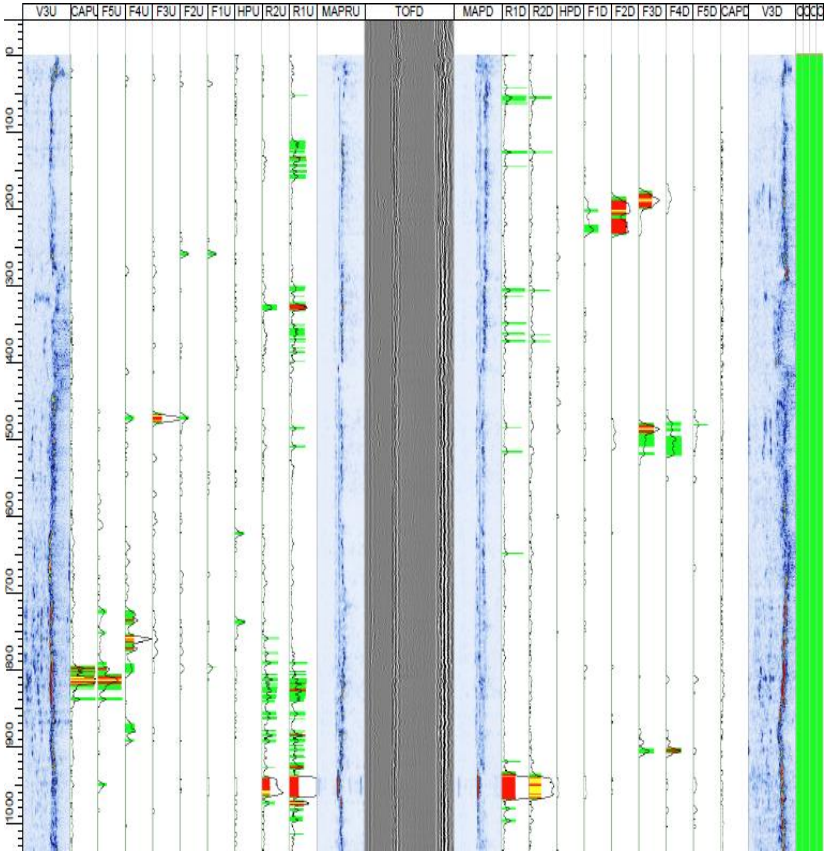
Strip-chart layout



Scan output of a weld without indication

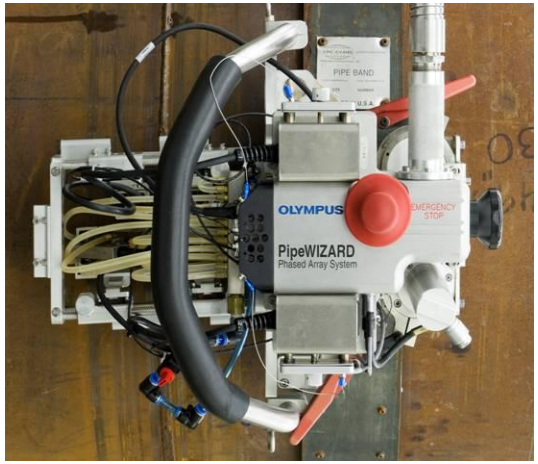


Scan output of a weld with indications

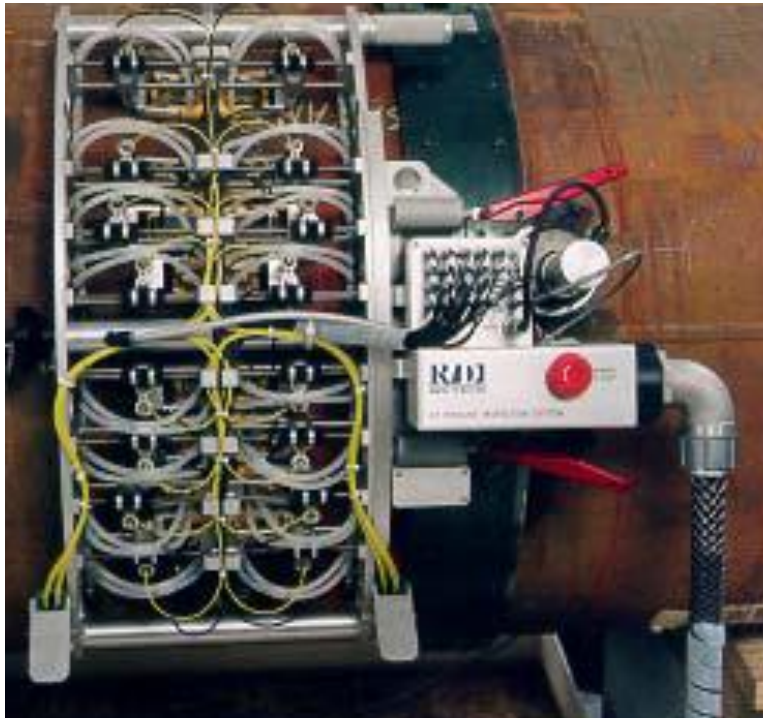


The weld is accepted or rejected according to the acceptance criteria

AUT phased-array vs. AUT multiprobe

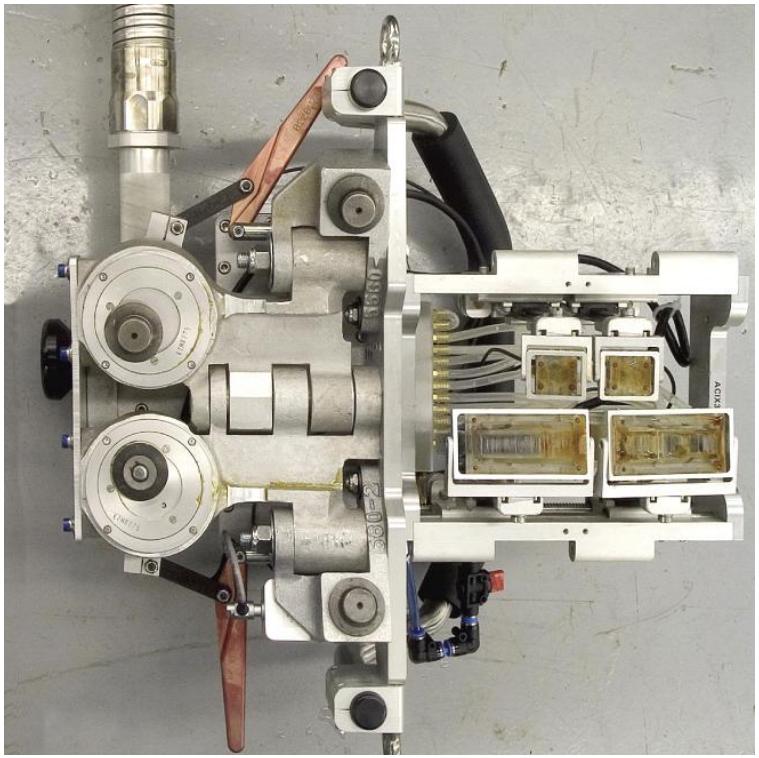


Phased-array scanner



Old multiprobe scanner

PipeWIZARD scanner



PipeWIZARD V4

Built upon the proven PipeWIZARD®, the PipeWIZARD V4 system offers a highly reliable solution for onshore and offshore inspections in harsh environments.

PWZ-V2

PWZ-V4

PipeWIZARD V4

Reliability

- **FocusLT 64:128** rackmount housing (IP64)

- **Strong field experience :**
  - > more than 200 units in the field
  - > more than 3 million welds inspected
  - > hundreds operators trained on PipeWIZARD

- Designed for **harsh environments** :
Middle-East deserts, Brazil forests, Siberian colds, salty-air offshore laybarges, etc.
(IP 66 Scanner Head)

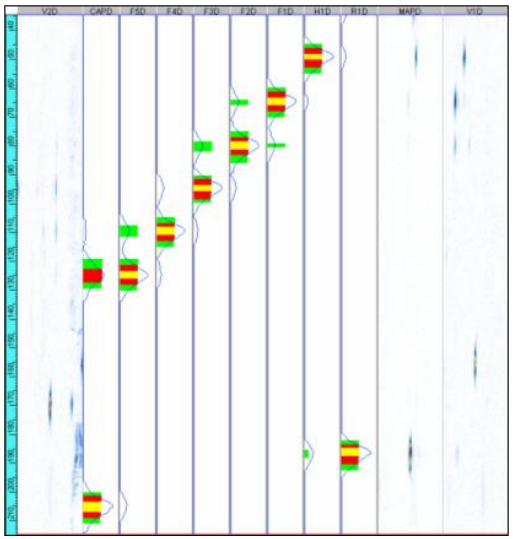
- **Umbilical cable** has been redesigned and field tested for more than 3 years.

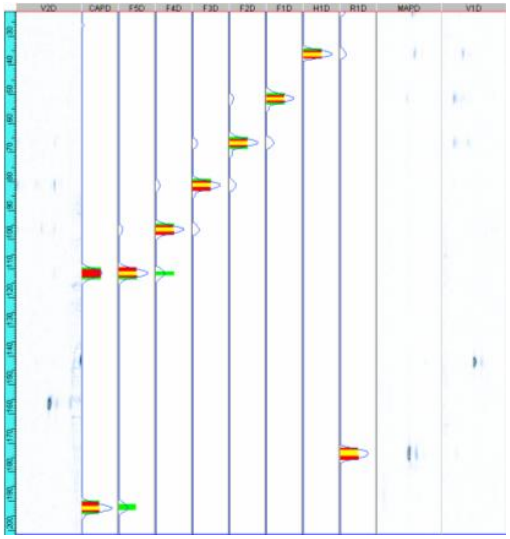
PipeWIZARD instrumentation

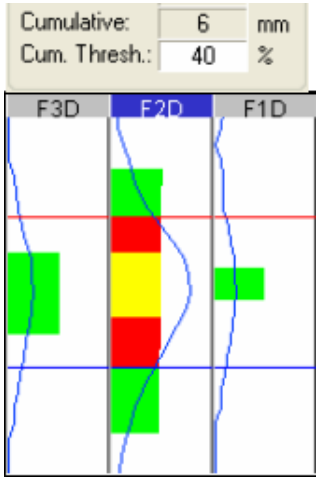
Improved defect length sizing

Laterally focused arrays

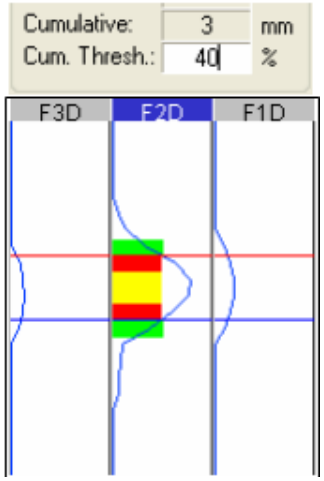
Reflector size used for this example is of 3mm







Non focused probe



Focused probe

Note : optional probes,
std probes are non-focused.

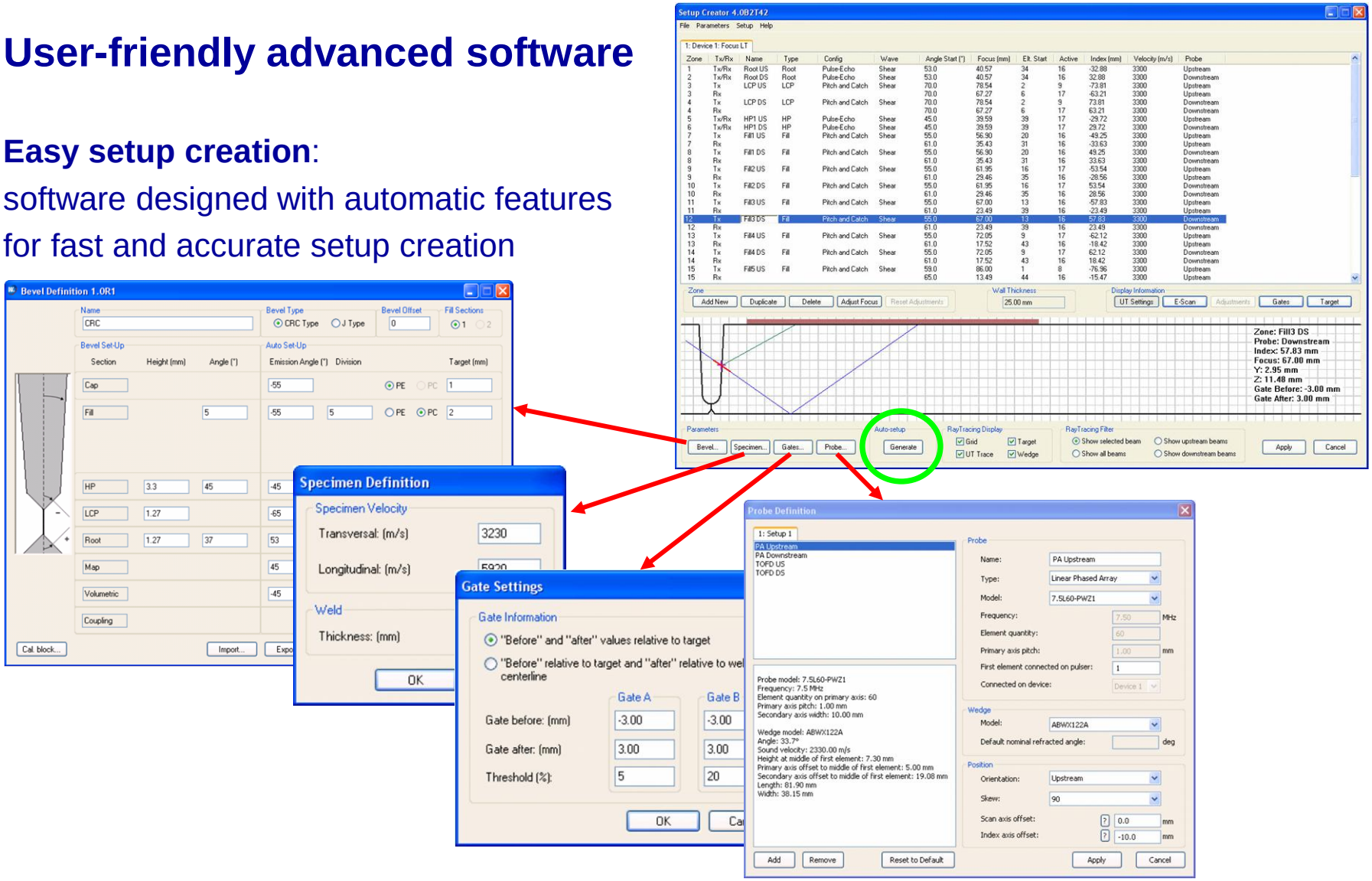
OLYMPUS

PipeWIZARD V4

User-friendly advanced software

Easy setup creation:

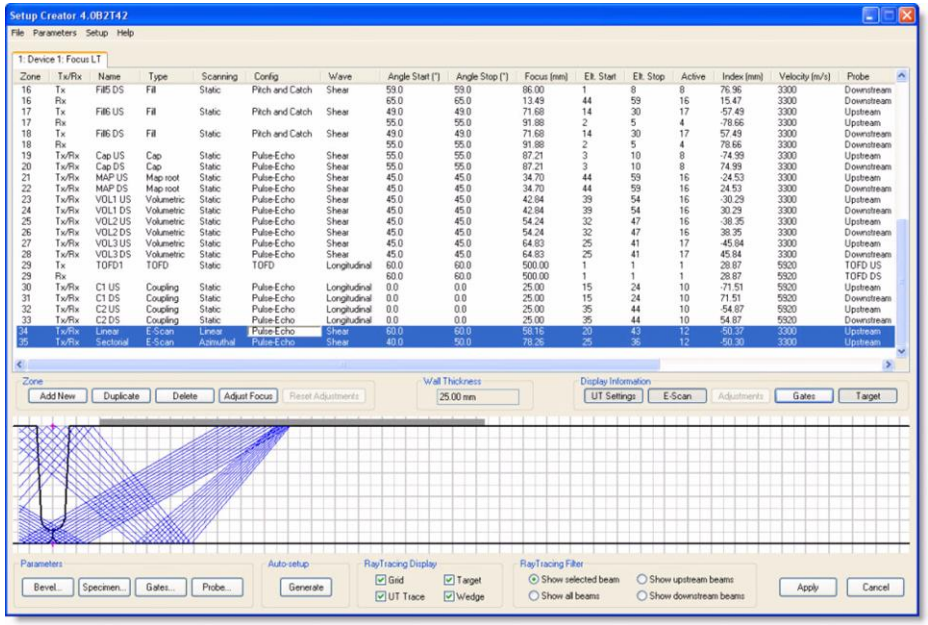
software designed with automatic features for fast and accurate setup creation

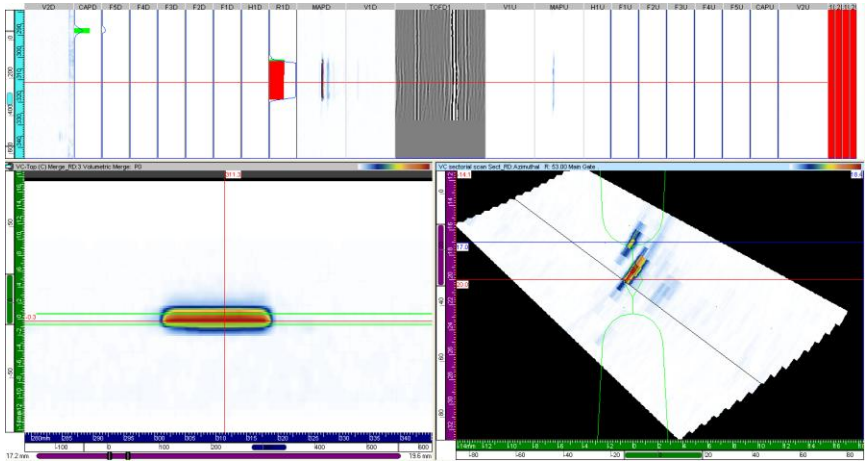


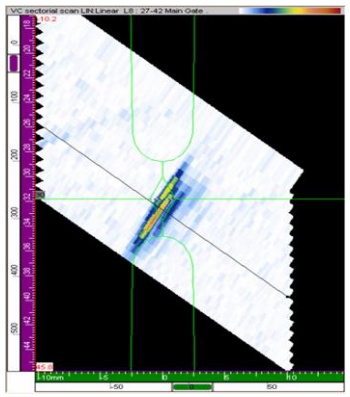
PipeWIZARD V4

User-friendly advanced software

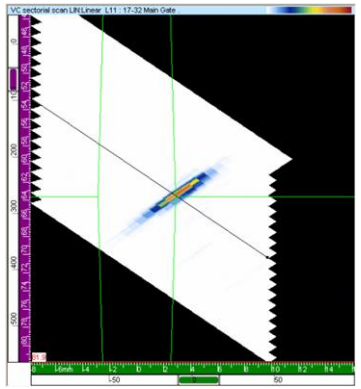
- Sectorial and linear scan capabilities
- More data information for better interpretation
- Weld overlay display
- Tip-diffraction technique
- Data merged to get a top view and side view of the weld







Root reflector

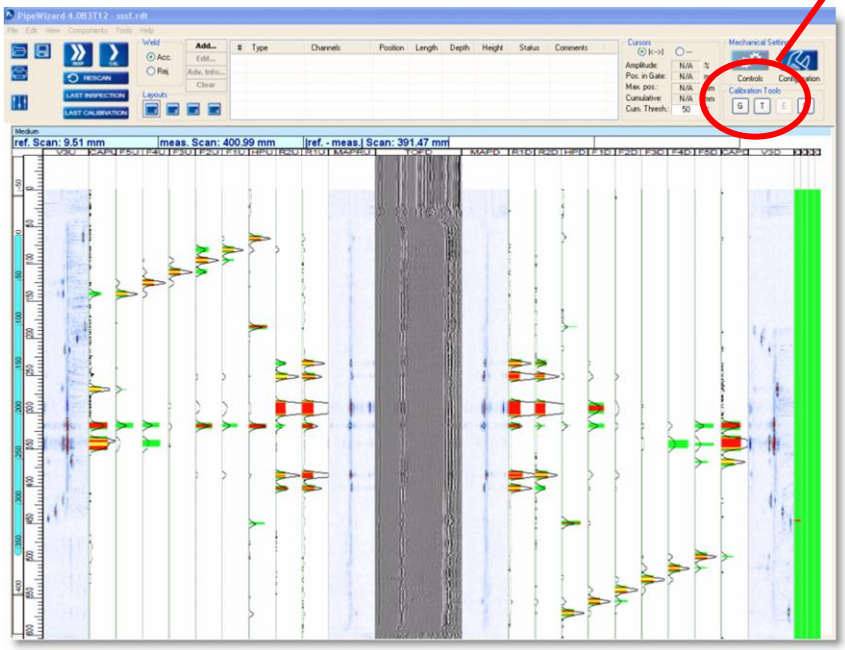


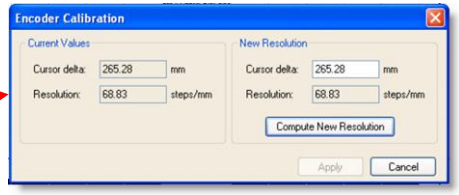
Cap reflector

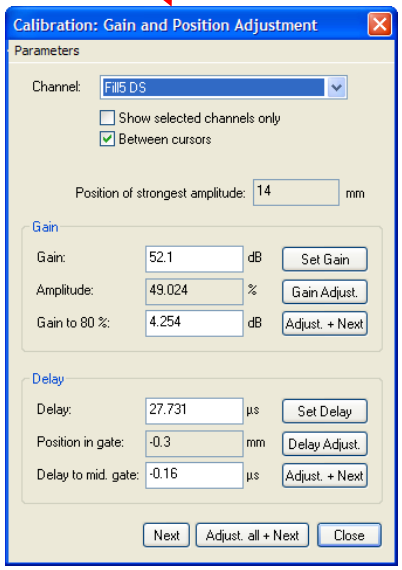
PipeWIZARD V4

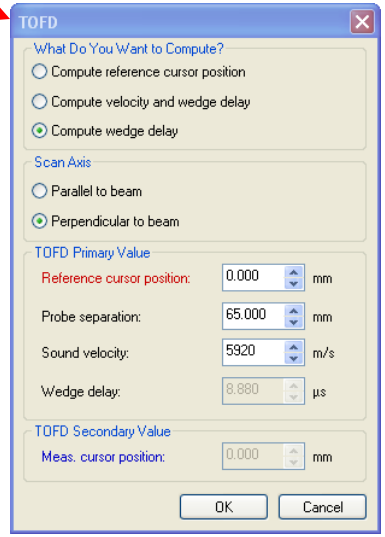
User-friendly advanced software

Fast calibration verification and adjustments for each channel (gain, signal position in gate), TOFD channel and encoder resolution.







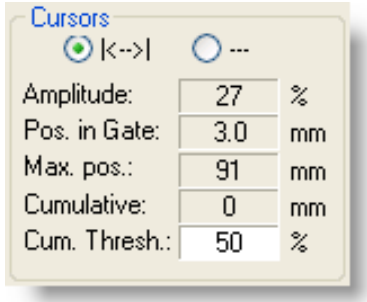


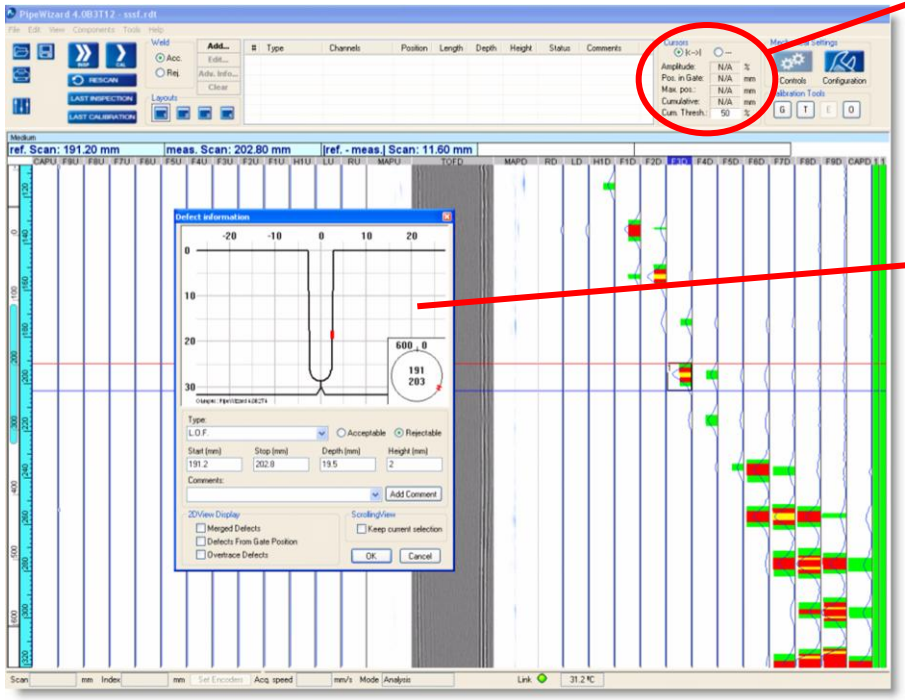
PipeWIZARD V4

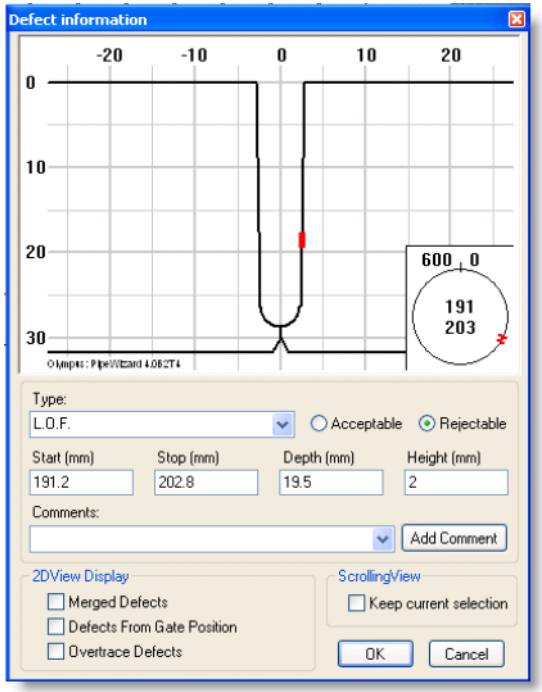
User-friendly advanced software

Easy interpretation:

Many tools available for fast and accurate analysis



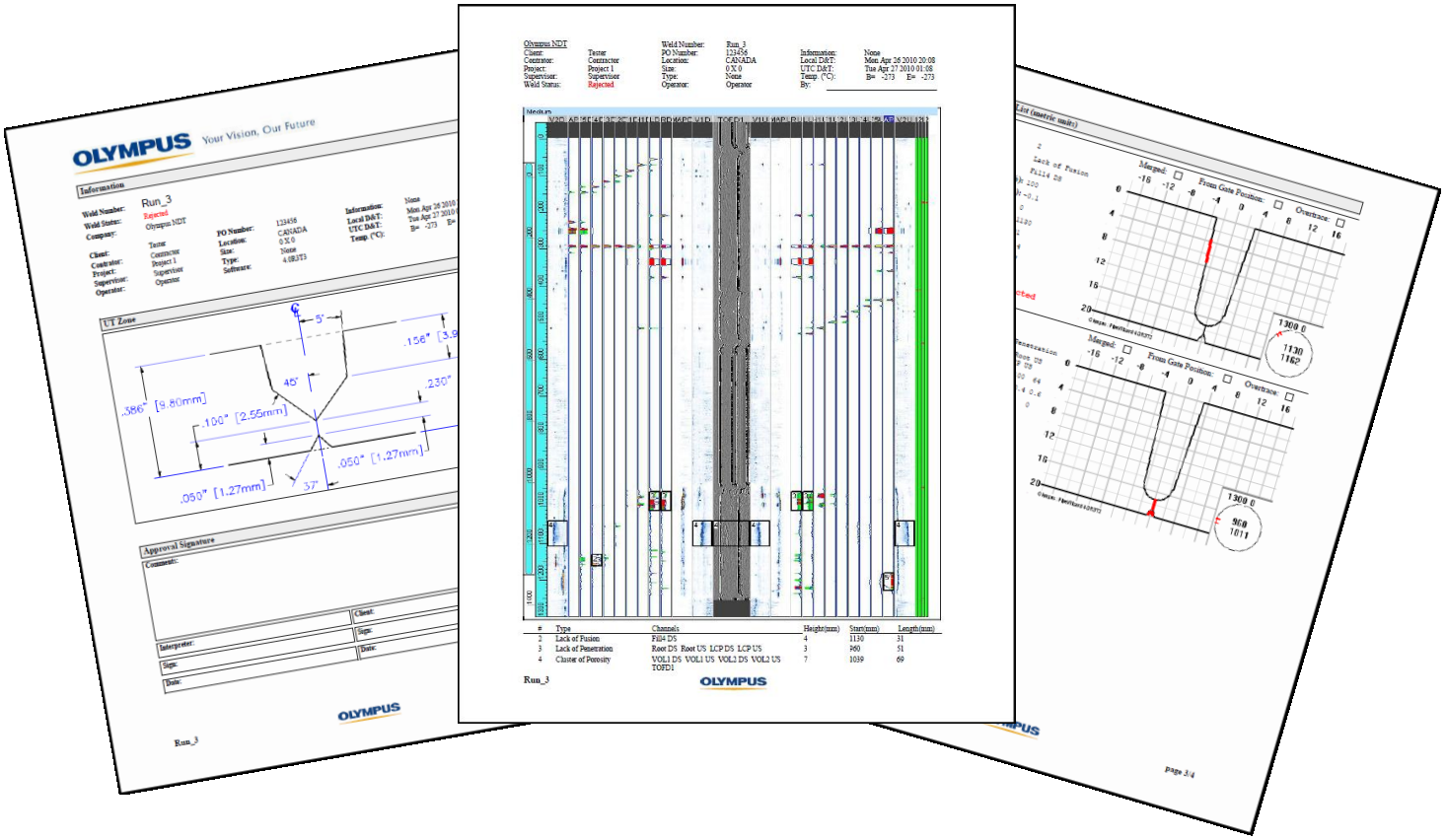




PipeWIZARD V4

User-friendly advanced software

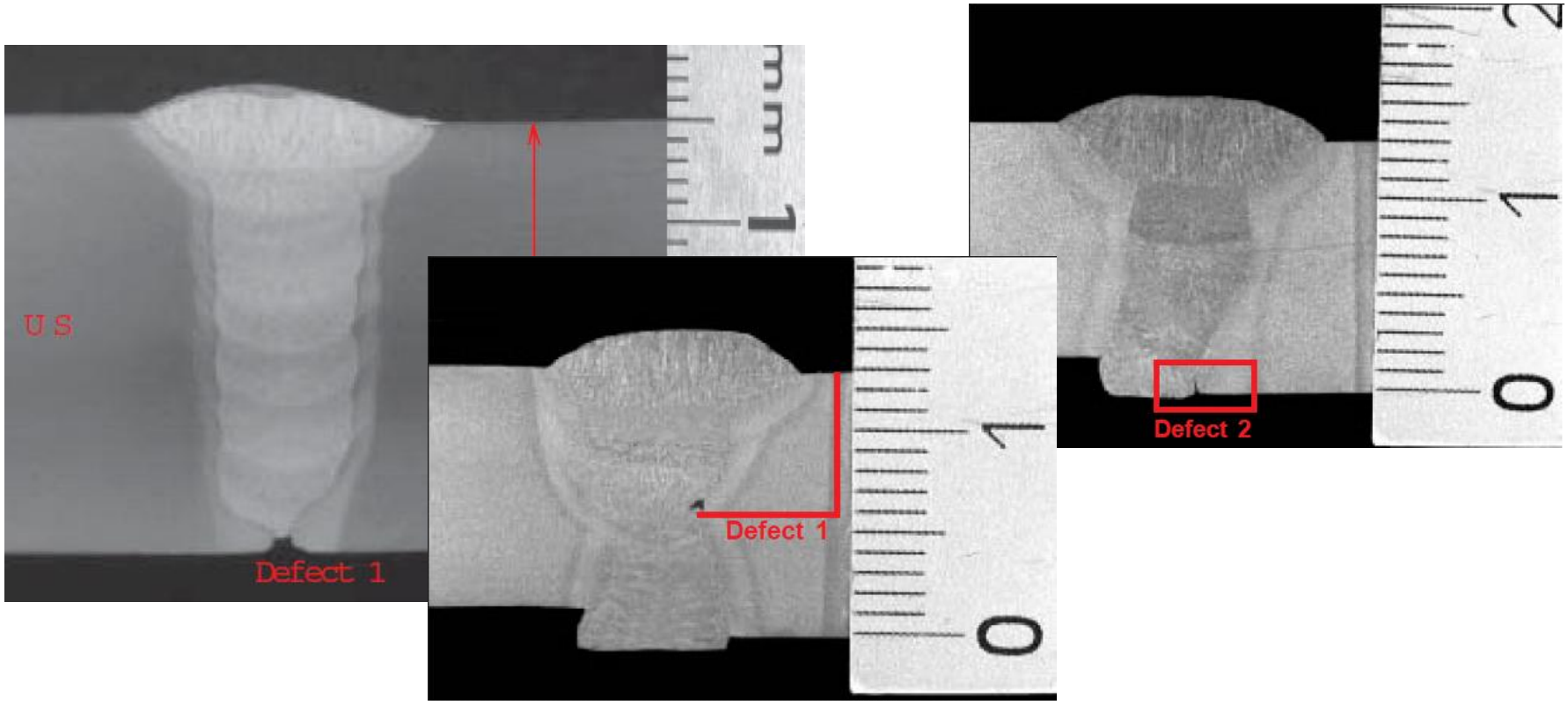
Easy reporting: detailed and clear automatic reports



PipeWIZARD V4

High accuracy in defect sizing

All inspection projects with phased-array PipeWIZARD systems have demonstrated an accuracy between 0.5mm (20 mil) and 1mm (40 mil) when sizing the height of defects



PipeWIZARD V4

Short AUT inspection cycle time for high production rates

Typical operation (depends on operators, type of weld, location, environment, etc):

- Water quenching of the weld (if necessary – offshore) → 20s to 60s
- Position inspection band on pipe → 50s
- Position scanner on band → 20s
- Positioning scanner for inspection start → 5s
- Scanning the weld (depending on pipe diameter) → 20s to 120s
- Analysis and defect marking → done during scanning and 30s after
- Removing the scanner and place it on calibration block → 20s
- Removing inspection band → 10s
- Calibration every weld (offshore) or every 10 welds (typical onshore): during band removing and/or water quenching of next weld.

Total : from 2min to 5min

PipeWIZARD key points

- Highly reliable, compact and modular.
- **Over 200 systems in use, and over 3 Million Welds inspected to date**.
- Sectorial and linear scan available in addition to standard strip-charts and TOFD
- High accuracy in defect height sizing: between 0.5mm (20 mil) and 1.0mm (40 mil)
- Advanced capabilities for special configurations (special pipe material, very thick pipe, pipe with wall-thickness variations)

- **The PipeWIZARD phased-array system has been qualified for many of the major pipeline projects around the world in the last 10 years, and is already pre-qualified by many companies**

Olympus Worldwide Support

> Fast spare parts supply and equipment calibration

- India (Blue Star)
- China
- Middle-East (Abu Dhabi)
- Australia
- Singapore
- Korea
- Japan
- Europe (UK, France, Italy & Germany)
- Canada
- USA
- Brazil
- Mexico

PipeWIZARD V4

advanced AUT inspections

Questions ?