How to solve the imaging problem of materials with large thickness difference and density difference in digital radiography?

Multi-energy Fusion Technology

a) Technical Background and Advantages

In industrial radiographic detection, materials are various, especially materials with different density and thickness will appear in the same workpiece, which will increase the difficulty of detection.If the material in the testing workpiece is separately processed, there will be under-exposure, over-exposure and the possibility of missed detection in the combined part, which will result in the serious lack of structural and density information of the components.

Without changing the hardware of X-ray system, the multi-energy fusion software developed by HATATEST TECHNOLOGY Co., Ltd. uses multi-level energy fusion technology to realize the detection of large thickness ratio and complex structural parts, so that all kinds of materials in the workpiece show the best effect under their respective imaging exposure.then using computer processing method, displaying different material images on an image, with clear layers, natural transition, no violation and sensation, is a new method of ray imaging software processing.

b)Technical points

In conventional imaging detection, the images generated by different materials and corresponding exposure amount have some factors such as weak gray level, blurred recognition boundary and scattering line influence on the image edge.We propose a method of reconstructing material structure by multi-energy radiography, which utilizes multi-channel absorption to reconstruct the internal characteristic structure of materials, especially multi-composite materials. This method can be widely used to detect workpieces and multi-layer composite materials with large thickness ratio and complex structure, and to realize the internal structure inspection and image reconstruction from millimeters to tens of centimeters, including various kinds. Defects, cavities and

inhomogeneity.The functions of multi-energy fusion software adopt a variety of energy and feature processing methods, which have the following four characteristics:

1.Structure detection.the main components of each frame are analyzed, information is extracted, details are enhanced, real-time frame-by-frame fusion of the fused image is obtained, frame-by-frame enhancement processing and frame-by-frame display are carried out to provide users with a good experience. Optimum gray level interval determination of multi-energy ray sequence images.

2.Automatic measurement and adjustment of multi-energy ray sequence image exposure.

3. Detection and Preprocessing of Pseudo-edges in Radiographic Images

4.The multi-scale decomposition and fusion framework based on pyramid transform and contour wave transform can extract, recognize, judge and fuse image feature-level information, and the algorithm is fast.

Suitable for large thickness ratio workpiece of power GIS, insulating layer pipeline and metal composite material.

c) Software characteristics

1.Parallel Processing Technology Using Computer Multi-Core Processors

2. Accelerate with CPU and GPU bottom instruction, adapt to different computer configurations.

3. Multi-mode fusion, automatic and manual parameter adjustment.

4. Customized Gray Curve Mapping

5. Fast image detail enhancement.

Case 1: Inspection of Pipeline Insulation Layer

Workpiece: Insulation layer: rock wool 100mm

Material: Steel

Specifications：89*6

Ray machine：MAPT250

Flat panel detector：Rayence1012WGB

Frame Frequency: 5 frames

Sampling interval：1s

focal length：600mm

Effect: Insulation layer pipeline can be observed at the same time

Treatment effect and steps:

The first frame:

Frame Frequency: 5 frames/1s

Voltage: 150 kV

The second frame:

Frame Frequency: 5 frames/1s

Voltage: 160 kV

The third frame:

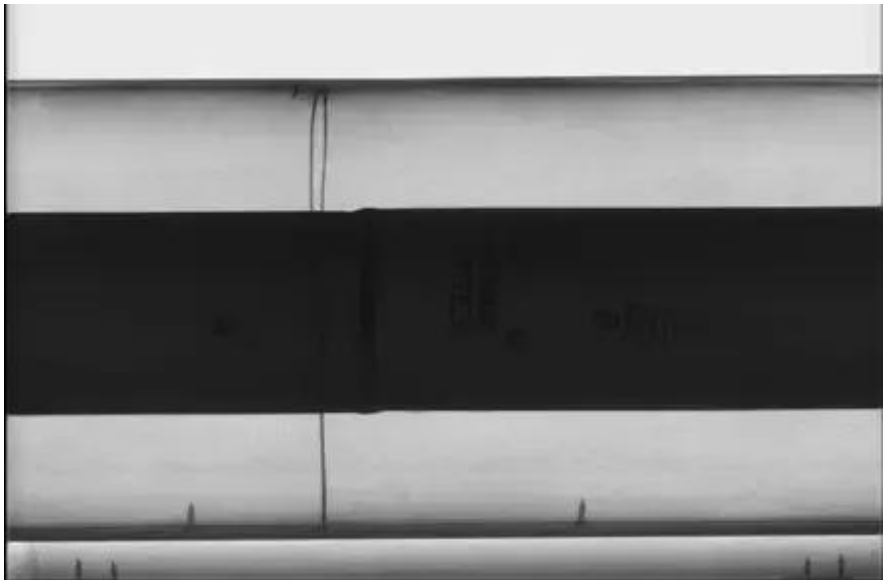
Frame Frequency: 5 frames/1s

Voltage: 170 kV

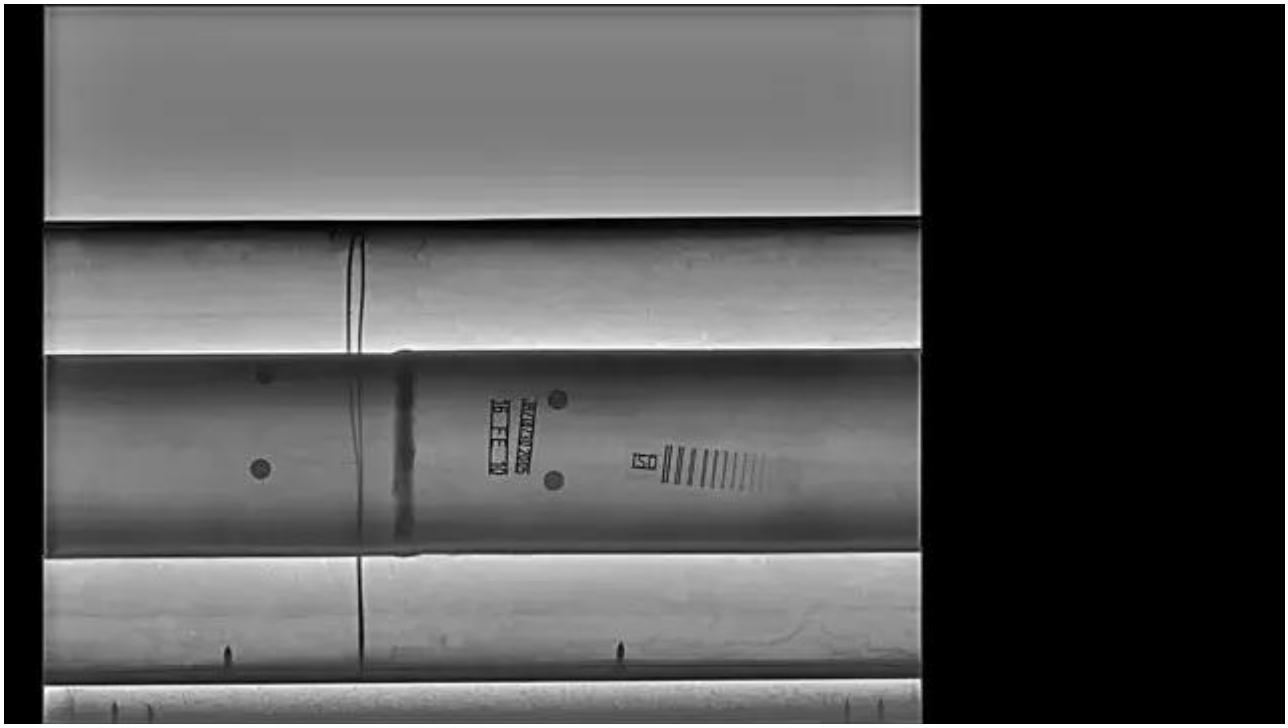
The fourth frame:

Frame Frequency: 5 frames/1s

Voltage: 180 kV



After integration:



Case 2: Casting inspection

Casting Material: Steel

The thickness of each part is 8, 10, 15 and 22 mm, respectively.

Ray machine：MAPT250

Flat panel detector：Rayence1012WGB

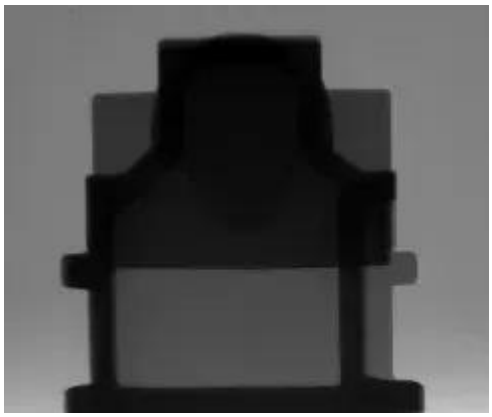
Frame Frequency: 6 frames

Sampling interval: 1s

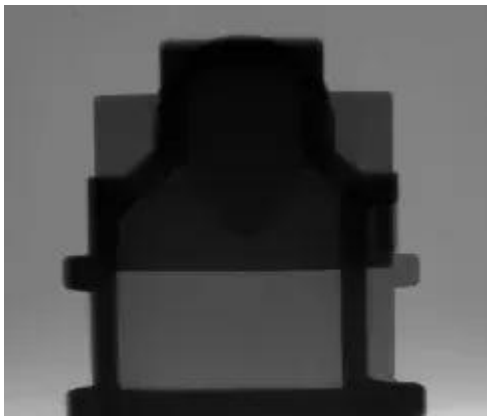
Focal length: 600 mm

Effect: Materials with different thickness can be observed at the same time.

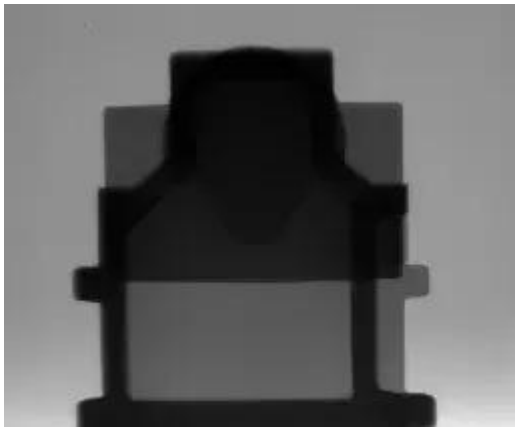
Voltage 1: 150 kV



Voltage 2: 170 kV



Voltage 3: 190 kV



Voltage 4: 210 kV

After integration:

Case 3: Inspection of power tension clamp

Type 630 Tensile Clamp Material

Steel core 16mm

Steel anchor 12mm

Aluminum strand 10mm

Ray machine：MAPT250

Flat panel detector：Rayence1012WGB

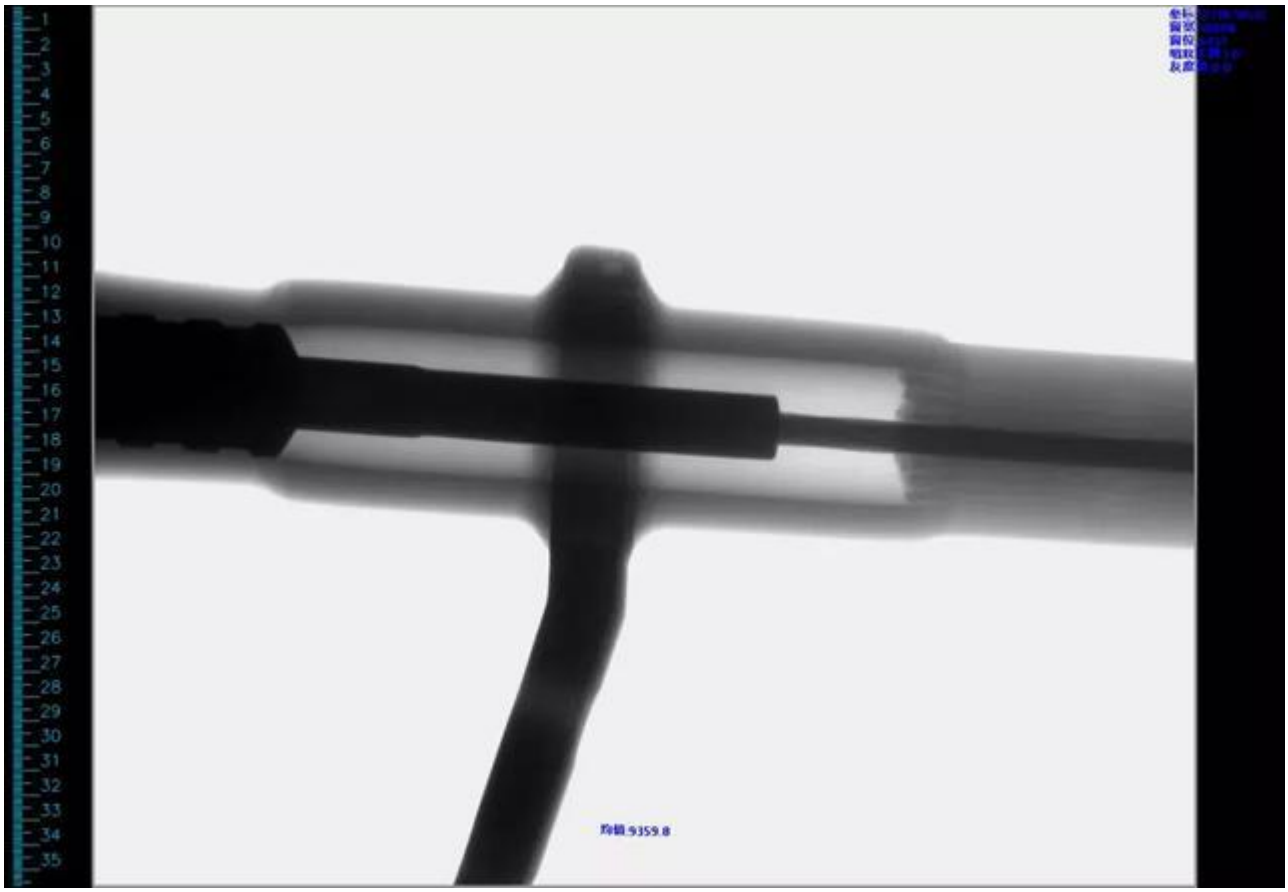
Frame Frequency: 6 frames

Sampling interval: 1s

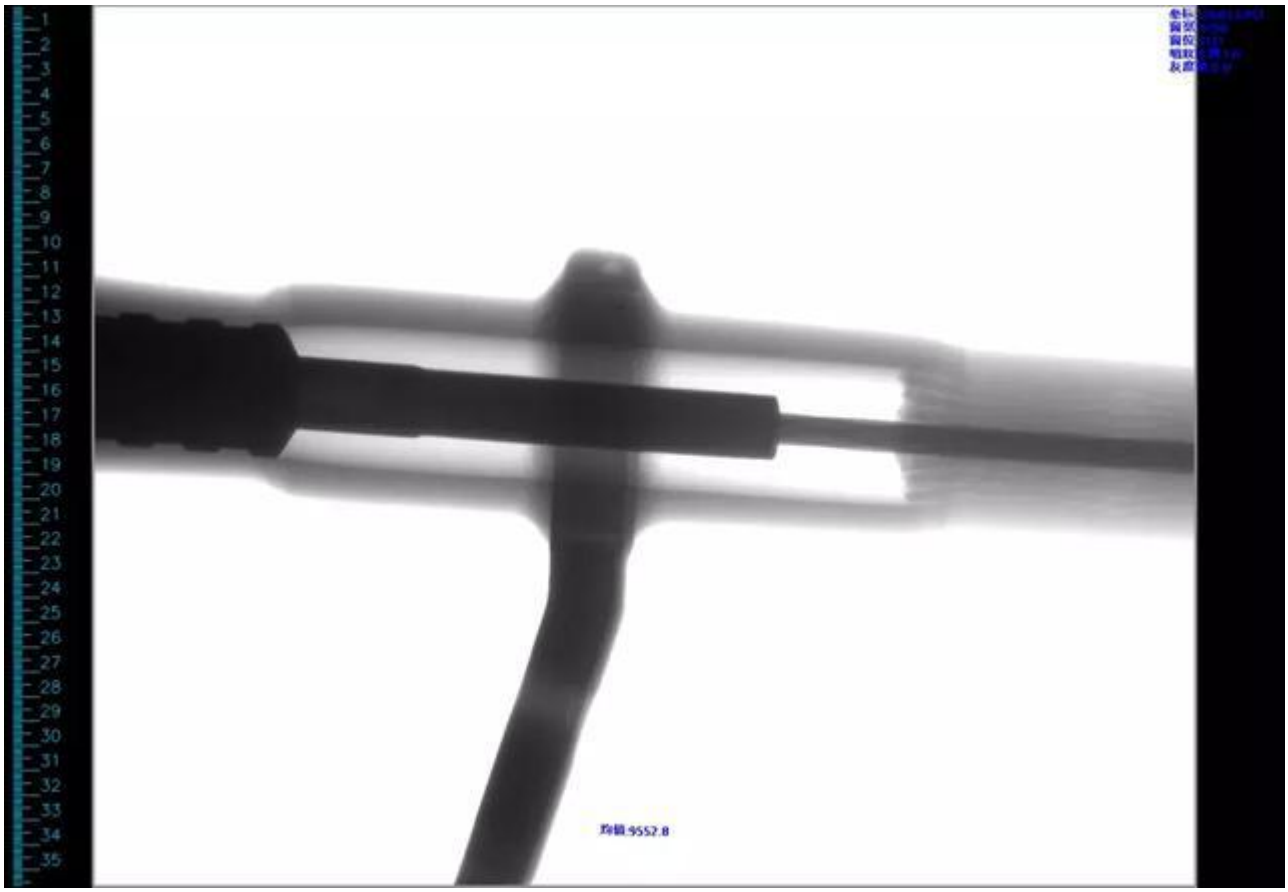
Focal length: 600 mm

Effect: The state of steel anchor, steel core and aluminium strand and the state of aluminium pipe pressing can be observed at the same time.

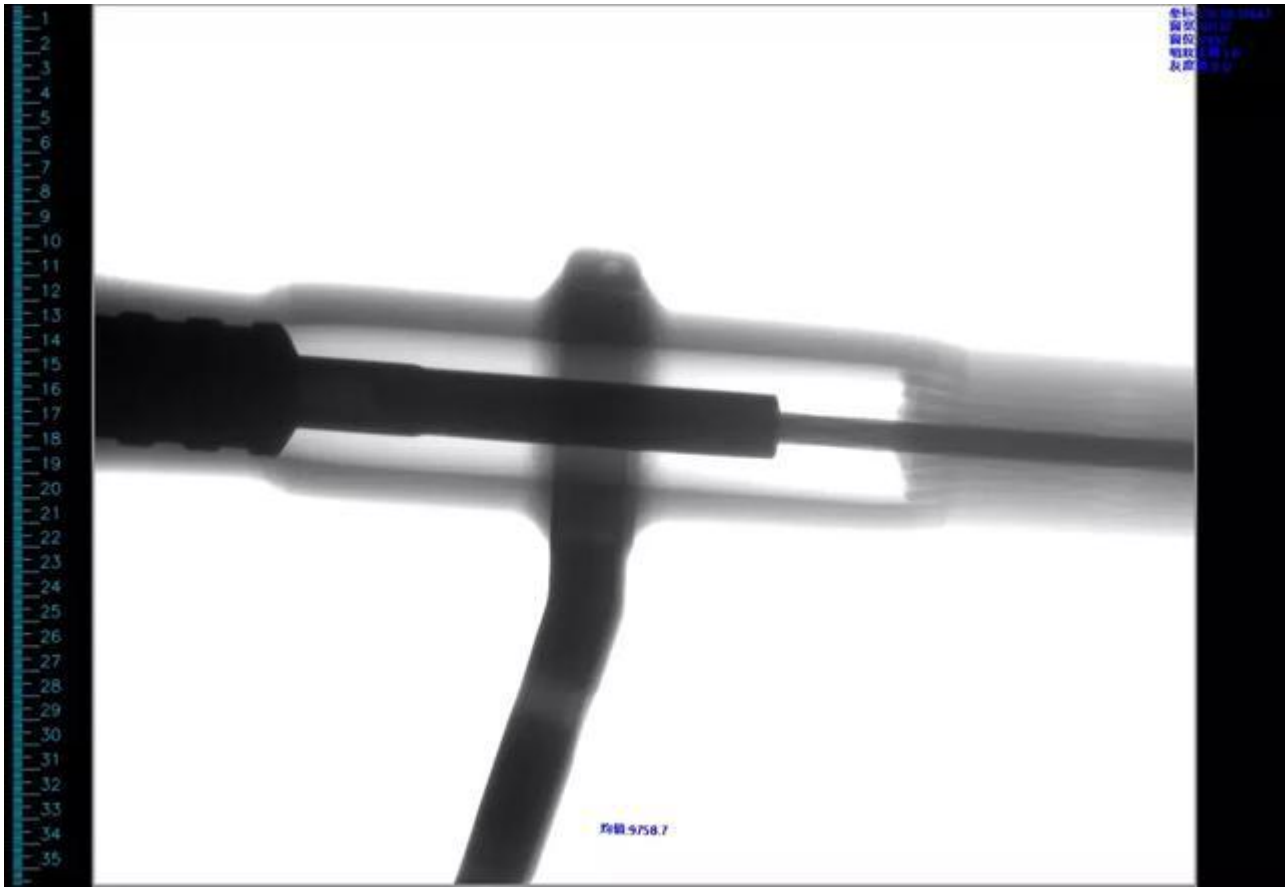
Voltage 1: 130 kV. Aluminum strand can be seen clearly.



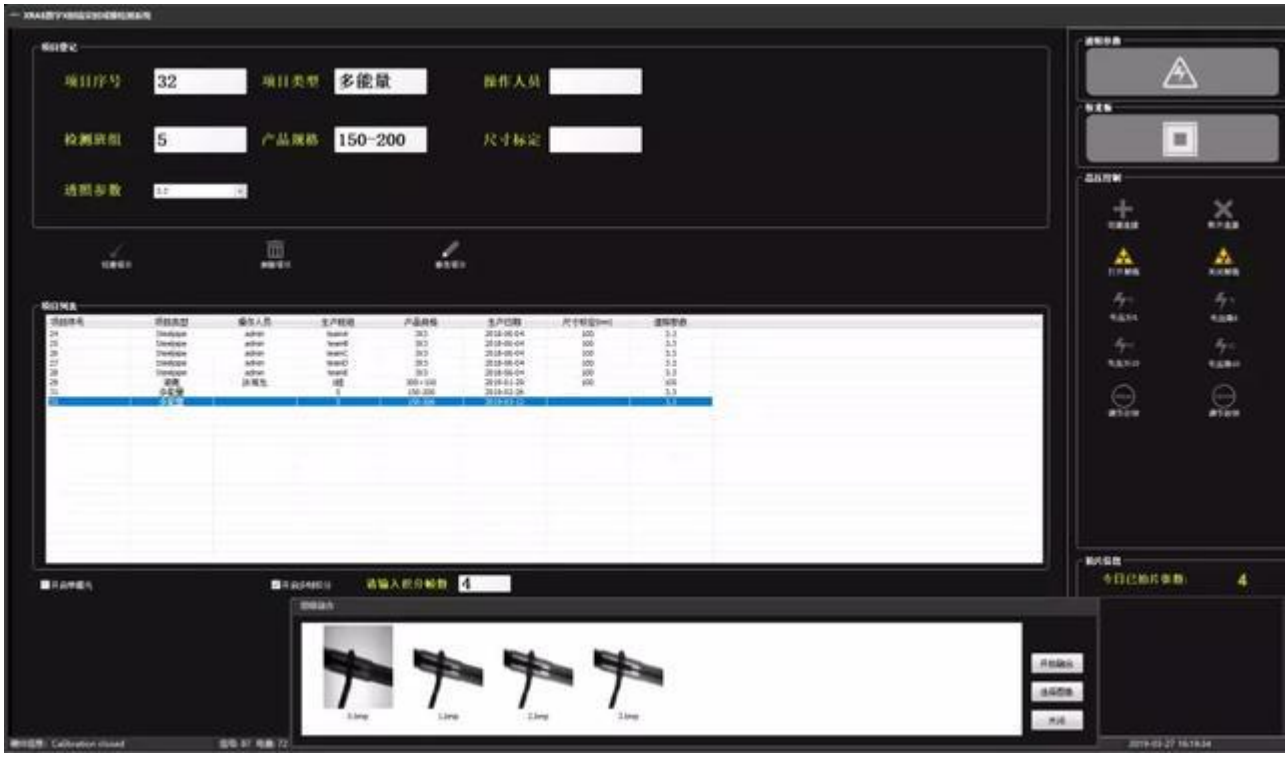
Voltage 2: 140 kV, you can see the state of steel anchor inserting into steel core clearly.



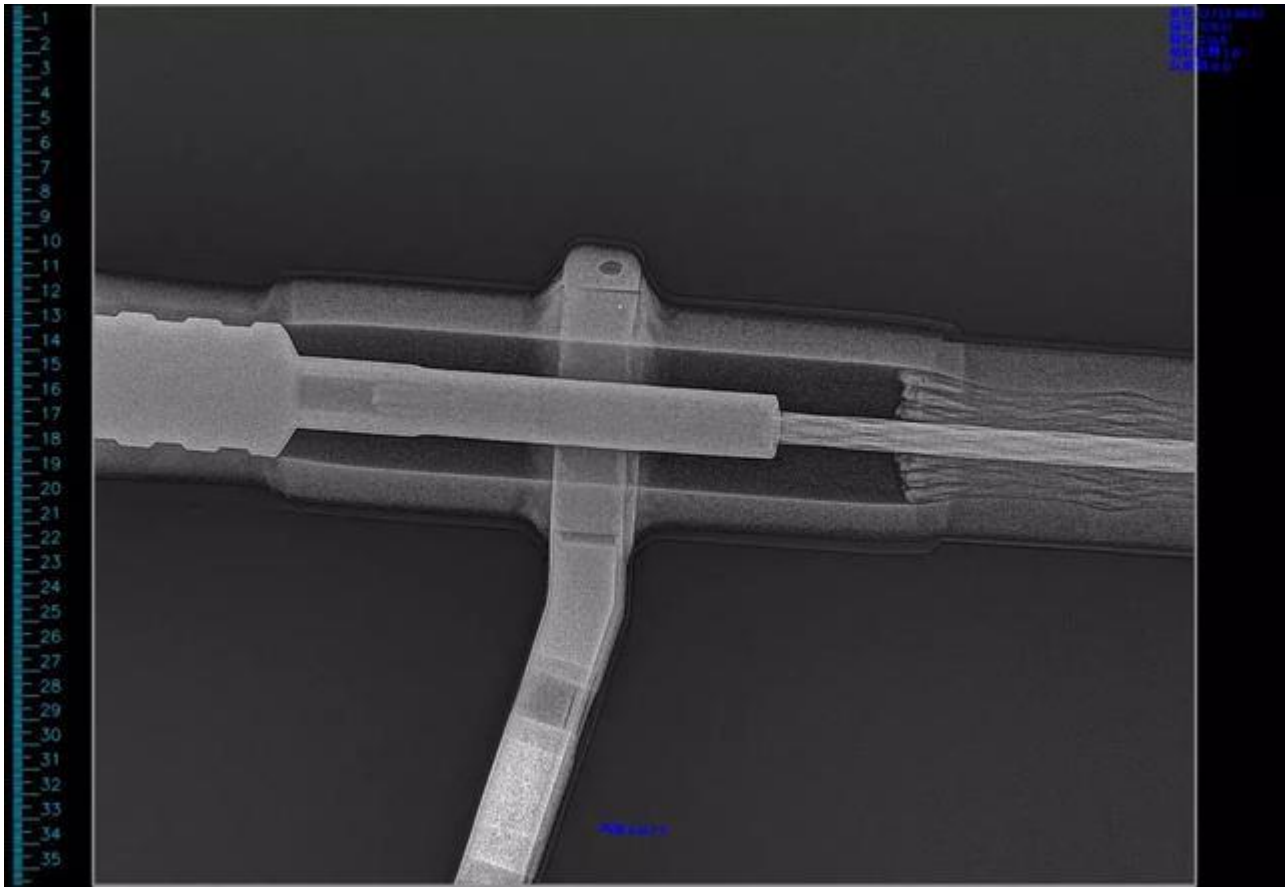
Voltage 3: 150 kV. Pressure state of aluminium tube can be observed.



Fusion interface:



Post-fusion effect



Concluding remarks:

The details of each voltage image are aggregated and fused, which improves the image sensitivity, adjusts the exposure, restrains the false edges. The boundary of transition zone can be displayed at the same time, eliminates the phenomenon of missing detection, improves the defect detection rate, and ensures the safe and stable operation of the equipment.