Claim

1. A test system comprising:

a system for evaluating the scan quality of an X-ray scanner for scanning cargo, and

a test piece comprising a plurality of test panels or test elements, each of the plurality of test panels or test elements is designed to test a specific scan quality of the scanner, wherein the scanner is adapted to scan the test piece,

wherein the system comprises,

a processor configured to communicate with the scanner; and

a memory in communication to the processor for storing instructions executable by the processor,

wherein the processor is configured to:

receive a plurality of scanned images of the plurality of test panels or test elements of the test piece from the scanner, the plurality of scanned images for evaluating a plurality of the specific scan qualities of the scanner,

display the plurality of scanned images,

generate a first plurality of score values for the plurality of specific scan qualities of the scanner based on the plurality of scanned images,

display an evaluation input interface configured to receive user evaluation input based on the evaluation of the plurality of scanned images, and

generate a second plurality of score values for the plurality of specific scan qualities of scanner based on the user evaluation input of the plurality of scanned images,

wherein the first plurality of score values and the second plurality of score values are utilized to evaluate the scan quality of the scanner.

2. The test system according to claim 1, wherein the processor is configured to determine at least one region of interest (ROI) in each of the plurality of scanned images and analyse the at least one ROI to generate the first plurality of score values.

3. The test system according to claim 2, wherein the processor is configured to retrieve a template comprising at least one pre-determined ROI, map the template onto one of the plurality of scanned images to determine the at least one ROI in the each of the plurality of scanned images.

4. The test system according to claim 2 or 3, wherein the processor is configured to extract image data from the at least one ROI in each of the plurality of scanned images and generate statistical data from the extracted image data to analyse the image data of the at least one ROI.

5. The test system according to any one of claims 2 to 4, wherein the at least one of ROI is determined based on one of the plurality of test panels or test elements of the test piece.

6. The test system according to any one of claims 3 to 5, wherein the template is determined based on one of the plurality of test panels or test elements of the test piece.

7. The test system according to any one of claims 1 to 6, wherein the test piece is optimised for CT image quality analysis.

8. The test system according to claim 7, wherein the scanner has a field of view in the range of 100mm x 100mm to 2000mm x 2000mm.

9. The test system according to claim 7 or 8, wherein each of the plurality of scanned images has an image resolution in the range of 0.5mm to 10.0mm reconstructed voxel.

10. The test system according to any one of claims 7 to 9, wherein the scanner has a helical scan system with a scanning speed in the range of 0.01m/s to 10.00m/s.

11. The test system according to any one of claims 1 to 6, wherein the test piece is optimised for transmission X-ray image quality analysis.

12. The test system according to claim 11, wherein the scanner has a field of view in the range of 300mm x 300mm to 4500mm x 6000mm.

13. The test system according to claim 11 or 12, wherein each of the plurality of scanned images has an image resolution in the range of 0.3mm to 10mm spatial resolution.

14. The test system according to any one of claims 11 to 13, wherein the scanner has a linear X-ray system with a scanning speed in the range of 0.01m/s to 100km/h.

15. The test system according to any one of claims 1 to 6, wherein the test piece is optimised for backscatter X-ray image quality analysis.

16. The test system according to claim 15, wherein the scanner has a field of view in the range of 300mm x 300mm to 5000mm x 12000mm spatial resolution.

17. The test system according to claim 15 or 16, wherein the scanner has a linear backscatter scanning system with a scanning speed in the range of 0.01m/s to 20km/h.

18. The test system according to any one of claims 15 to 17, wherein each of the plurality of scanned images has an image resolution in the range of 0.5mm to 20mm.

19. The test system according to any one of claims 1 to 18, wherein the processor is configured to retrieve a plurality of pre-determined first threshold score values and a plurality of pre-determined second threshold score values and compare the plurality of first score values and the plurality of second score values against the plurality of pre-determined first threshold score values and the plurality of pre-determined second threshold score values respectively, and generate a failed signal if one or more of the plurality of first score values is lower than the plurality of pre-determined first threshold score values or one or more of the plurality of pre-determined second score values is lower than the plurality of pre-determined second threshold score values.

20. A computer-implemented method for evaluating the scan quality of an X-ray scanner for scanning cargo, the scanner adapted to scan a test piece comprising a plurality of test

panels or test elements, each of the plurality of test panels or test elements is designed to test a specific scan quality of the scanner, the method comprising:

receiving a plurality of scanned images of the plurality of test panels or test elements of the test piece from the scanner, the plurality of scanned images for evaluating a plurality of the specific scan qualities of the scanner,

displaying the plurality of scanned images,

generating a first plurality of score values for the plurality of specific scan qualities of the scanner based on the plurality of scanned images,

displaying an evaluation input interface configured to receive user evaluation input based on the evaluation of the plurality of scanned images, and

generating a second plurality of score values for the plurality of specific scan qualities based on the user evaluation input of the plurality of scanned images,

wherein the first plurality of score values and the second plurality of score values are utilized to evaluate the scan quality of the scanner.

21. The method according to claim 20, wherein further comprising determining at least one region of interest (ROI) in each of the plurality of scanned images and analysing the at least one ROI to generate the first plurality of score values.

22. The method according to claim 20 or 21, further comprising retrieving a template comprising at least one pre-determined ROI, mapping the template onto one of the plurality of scanned images to determine the at least one ROI in the each of the plurality of scanned images.

23. The method according to any one of claims 20 to 22, further comprising extracting image data from the at least one ROI in each of the plurality of scanned images and generating statistical data from the extracted image data to analyse the image data of the at least one ROI.

24. A non-transitory computer readable storage medium comprising instructions, wherein the instructions, when executed by a processor in a system, cause the system to:

receive a plurality of scanned images of a plurality of test panels or test elements of a test piece from the scanner, wherein each of the plurality of test panels

or test elements is designed to test a specific scan quality of the scanner, the plurality of scanned images for evaluating a plurality of the specific scan qualities of the scanner,

display the plurality of scanned images,

generate a first plurality of score values for the plurality of specific scan qualities of the scanner based on the plurality of scanned images,

display an evaluation input interface configured to receiving user evaluation input based on the evaluation of the plurality of scanned images,

generating a second plurality of score values for the plurality of specific scan qualities based on the user evaluation input of the plurality of scanned images,

wherein the first plurality of score values and the second plurality of score values are utilized to evaluate the scan quality of the scanner.

25. The testing system according to claim 1, wherein the plurality of specific scan qualities of the scanner comprises at least one of contrast, effective nuclear charge, density resolution, extent of beam hardening effect on the scanner, spatial resolution, contrast resolution, spatial resolution, sensitivity to metal artefacts, grid and spatial resolution, sensitivity to small inclusions, penetration level, ability to discriminate between material of different composition, and wire resolution.

26. The test system according to claim 1, wherein the plurality of test panels of the test piece spaced apart from each other along a longitudinal axis, wherein each of the plurality of test panels is perpendicular to the longitudinal axis.

27. The test system according to claim 1, wherein the test piece comprises a base panel comprising a first plurality of the test elements and a longitudinal axis, a rotatable panel comprising a second plurality of the test elements and pivotally connected to the base panel along the longitudinal axis, wherein the rotatable panel is rotatable about the longitudinal axis.

28. The method according to any one of claims 20 to 23, further comprising retrieving a plurality of pre-determined first threshold score values and a plurality of pre-determined second threshold score values and comparing the first plurality of score values and the second

plurality of score values against the plurality of pre-determined first threshold score values and the plurality of pre-determined second threshold score values respectively, and generating a failed signal if one or more of the first plurality of score values is lower than the plurality of pre-determined first threshold score values or one or more of the second score values is lower than the plurality of pre-determined second threshold score values.

~~29. A test piece comprising a plurality of test panels spaced apart from each other along a longitudinal axis, wherein each of the plurality of test panels is perpendicular to the longitudinal axis.~~

~~30. A test piece comprising a base panel comprising a first plurality of test elements and a longitudinal axis, a rotatable panel comprising a second plurality of test elements and pivotally connected to the base panel along the longitudinal axis, wherein the rotatable panel is rotatable about the longitudinal axis.~~