X-Ray Tube assembly and testing procedures

Sources for X-Ray Tube Housing

Housings are obtained from a variety of sources.
Clients that purchase a new Ray-Pac housing are required to return the used housing that is being replace for the core charge. OEMs with return housings they will not use. Independent medical supply resellers.
When return core housings are received they are inspected for any exterior damage and electrical stator readings are taken to verify the model.

Sources for inserts

Ray-Pac uses two international X-Ray Tube manufactures. These manufactures can supply any X-Ray tube insert for any manufacture in the past forty years.
Varian Medical Systems and Kailong Medical Instruments

Insert deliveries

The glass X-Ray tube Inserts are thoroughly inspected once received at the Ray-Pac facility.
Ensuring serial numbers match the inventory sheets.
Inspect for damage during shipping, cracks, deterioration of target, loose wires, burnt filaments, or foreign materials that would be considered unusable.

Housing disassembly

Opening optic window to empty all mineral oil.
Remove all other ends or openings to access internal parts.
Discard all used rubber parts such as O-rings, diaphragms, plastic screws, and lexan windows.
Clean all remaining internal parts and housing with mineral oil and alcohol.

X-Ray tube Housing and insert selection

Each X-Ray tube manufacture has a number of housing models designed for different needs.
The main high volt cables may be located on different sides of the housings.
Different stators are used depending on the anode rotation speed required and the generator output used. Different filtration, target design and total kilowatt's the insert is capable of creating during x-ray tube exposures.

Pre-assembly

The desired housing is selected and prepared for assembly with the proper horn angle and stator type. The appropriate X-Ray Tube insert has been selected for the design specifications needed.
The stator and insert are installed into the housing and prepared for alignment.

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X-Ray Tube Alignment

The x-ray tube and housing are moved to the lead lined alignment booth. The alignment scope is mounted to the X-Ray tube housing window.
All wires are connected to the insert from the high voltage generator to create test exposures.
The lead lined cover is lowered over the housing to protect from x-ray exposure during testing.
A high voltage exposure is generate to create light in the x-ray tube. The light is emitted threw the alignment scope. The alignment scope window is marked with cross hairs centered in a circle.
Very seldom the emitted X-Ray is centered perfectly the first time. Realignment of the insert in the housing is readjusted and another test exposure made until alignment is accurate.
Once proper alignment is achieved and stabilizing of the alignment ring is secure a second technician verifies alignment is correct and signs off on the work sheet.
Before touching the X-Ray housing for removal it is needed to ground the housing to release all static electricity by using a grounding rod.

Final assembly

Remove x-ray Tube from alignment booth.
Connect all internal wires from insert to wires from high voltage cathode and anode wells. Connect interior stator wires to exterior.
Test exterior connections and have a second technician verify insert functions are working properly.
Inspect for any debris and finish assembly with all new O-rings and windows.
Technician signs assembly section on work sheet before moving to pump station.

Pump Station

The X-Ray housing is filled with mineral oil to remove all air from the housing. This eliminates any internal high voltage arching.
The oil is preheated to between 145 and 160 degrees and should not exceed 170 degrees.
A clear inspection reservoir bottle is connect to the viewing window to fill the mineral oil and visually check for any air in the housing.
The housing is put under a vacuum before filling with oil. Once filled the housing is rotated to release any captured air. Once satisfied there is no remaining air the clear inspection reservoir bottle is removed and the viewing window installed and sealed. Further inspection threw the window for air is done.
Clean excess oil from exterior with alcohol and sign cap off section on the work sheet.
Move housing to electrical testing area.

Radiation Leakage Test

Mount x-ray tube on rotation stand. Connect stator wires and test for anode rotation. Connect high voltage cables. Mount lead plate over viewing port window to stop radiation leakage during testing exposures.
Adjust exposures to the highest rated KV & MaS level. Start radiation leakage test by rotating x-ray tube while applying radiation. Leakage test is recorded (on a strip chart printer). Transfer test numbers to work sheet. Remove housing from leakage rotation stand and mount on filtration stand.

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Filtration Leakage Test

The x-ray tube housing is mounted on filtration stand and aligned. The appropriate KV and MaS are adjusted for the filtration test.
Two second exposures are made and recorded on 4 different filters. Final readings are calculated and record on the work sheet.
The housing is removed from the filtration stand and moved to the appropriate OEMs computerized generator.

Calibration and Exposure Testing

Once all stator wires and high voltage cables are connect to the generator computer, calibration and exposure testing can be done and recorded.
In calibration mode the KV & MA numbers are create during test exposures. The final settings are recorded for client use during new installation. Once the generators computer is calibrated we move into normal operating mode as will be used in the field.
Test exposures are made on the small and large focal areas from the lowest KV and MaS settings to the highest KV and MaS exposures. Assuring that the new X-Ray tube will work properly once Installed on the client operating system.
All test readings and calibration numbers are recorded and kept on file as permanent record with the work sheet.

Painting Completed Housings

All housings are sanded, cleaned, and taped for painting.
Ray-Pac uses the highest quality PPG industrial urethane paints.
Appropriate colors are used to match OEM (Original Equipment Manufacturer) colors.
After painted, units are un-tape and moved to the finishing area.

Final Inspection and Packaging

Final detailed cleaning is done and end caps are installed. Insulating compound removed from high voltage cable wells.
Appropriate window filters are added as required for the specific housing.
Appropriate labels are added and making sure all screws and connectors are in place.

Boxing and Shipping

Ray-Pac shipping containers are designed for specific X-Ray housings. Boxes are pre-made and lined with appropriate shipping materials.
Making sure proper literature and calibration papers with each housing. High voltage insulating compound is added for use on high voltage cable connections.
Ensure shipping documents are correct before shipping.
Seal boxes with staples and straps for shipping