

Quality Assurance of Transformer

- Ronnie Minhaz, P.Eng.

Why Quality Assurance?



Purpose of Quality Assurance

- Operational reliability
- Life expectancy

Purpose of Quality Assurance

Operational reliability

- Withstand capability during fault (mainly electrical fault)

Purpose of Quality Assurance

Life expectancy

- Due to thermal
- Due to electrical

Quality Assurance of Transformer

Factory Location

Dry Area

Vs

Wet/Humid Area

Quality Assurance of Transformer

Age of the Factory

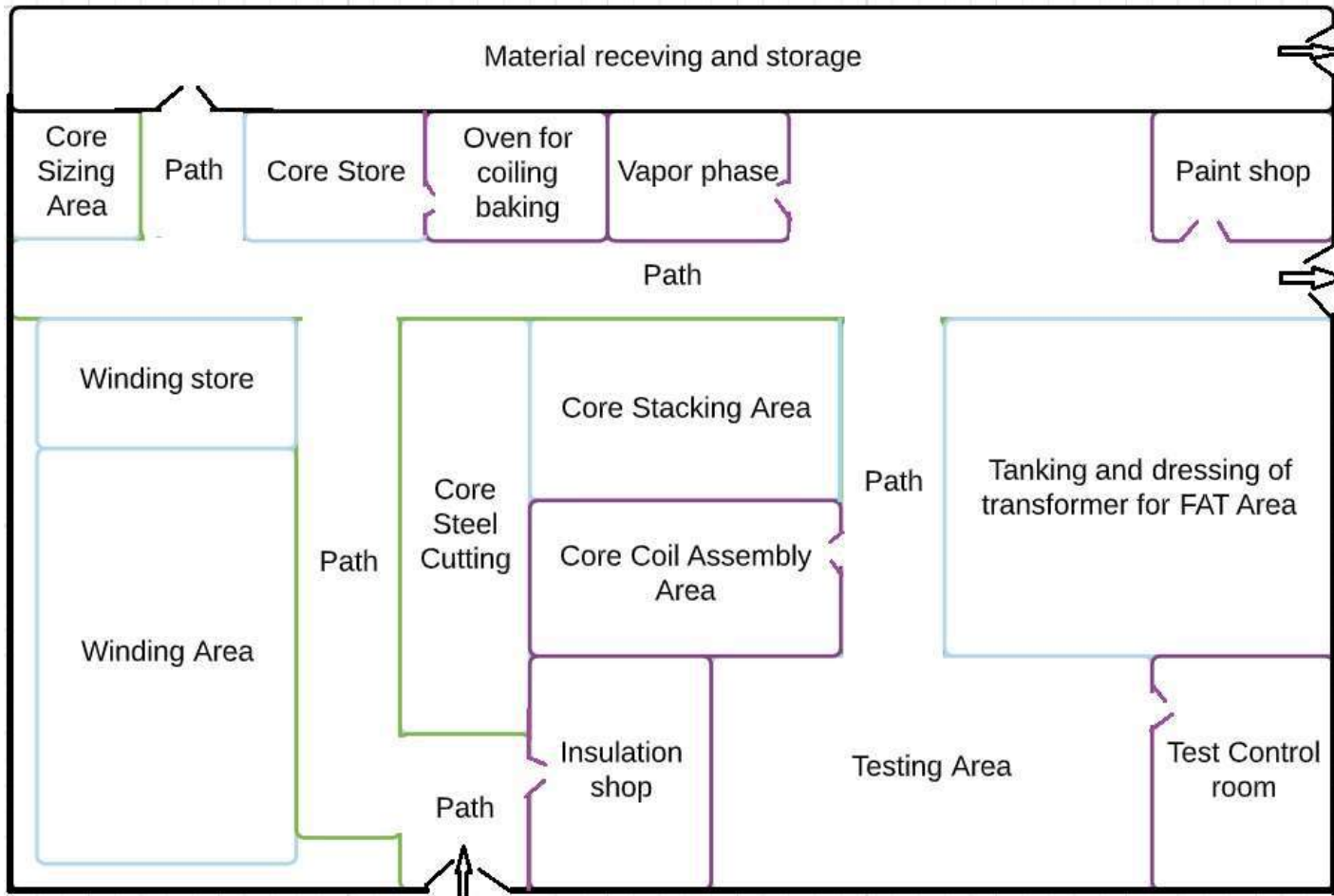
Old Factory

Vs

New Factory

Quality Assurance of Transformer

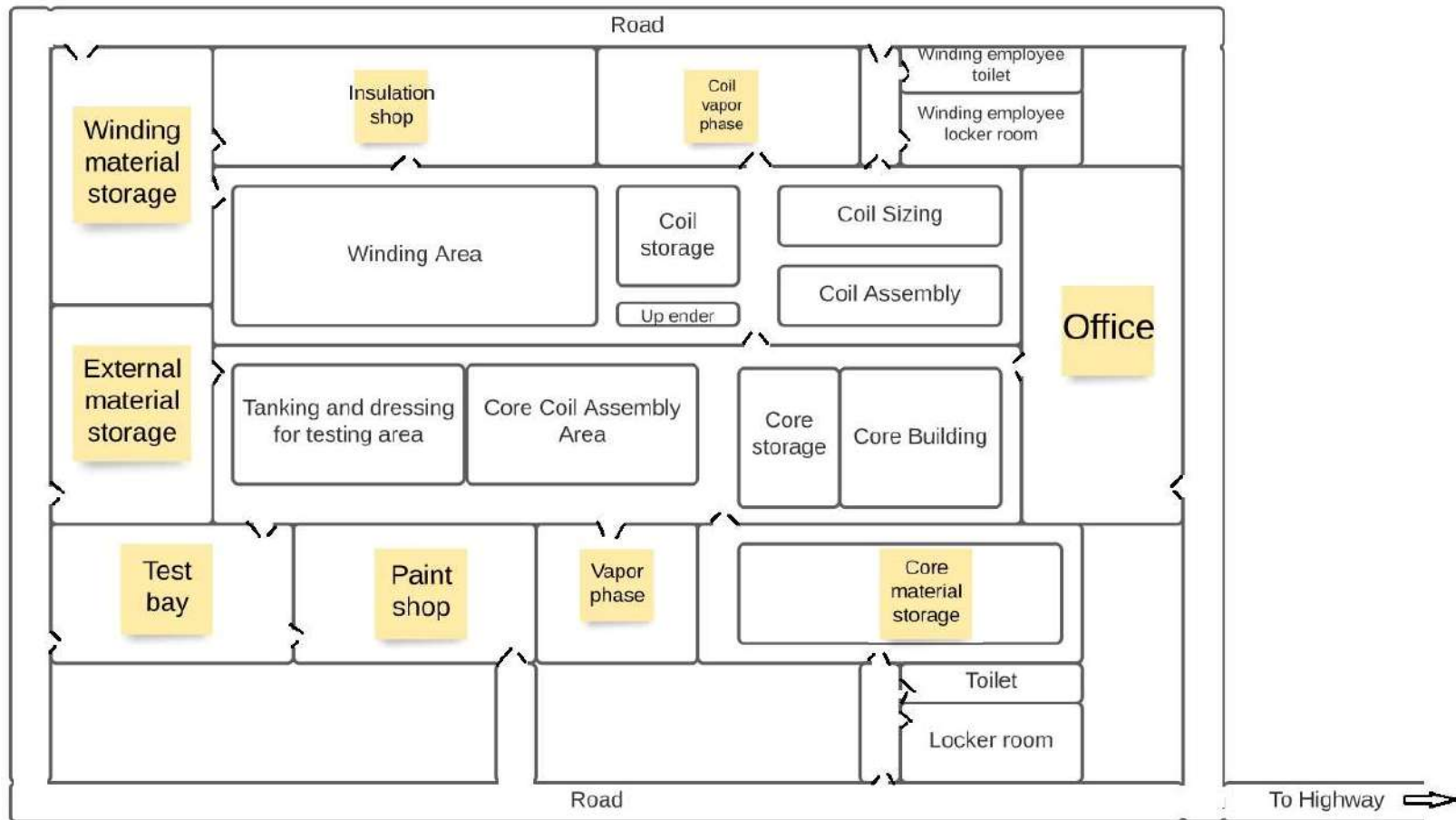
Old Factory Layout



Only the insulation shop, core coil assembly area, oven, vapor phase, test control room and paint are closed area. Rest are open.

Quality Assurance of Transformer

New Factory Layout



Insulation shop, Winding shop, Core building area, Core coil assembly area and tanking area are fully climate controlled.

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Climate control in Factory

Fully climate control

Vs

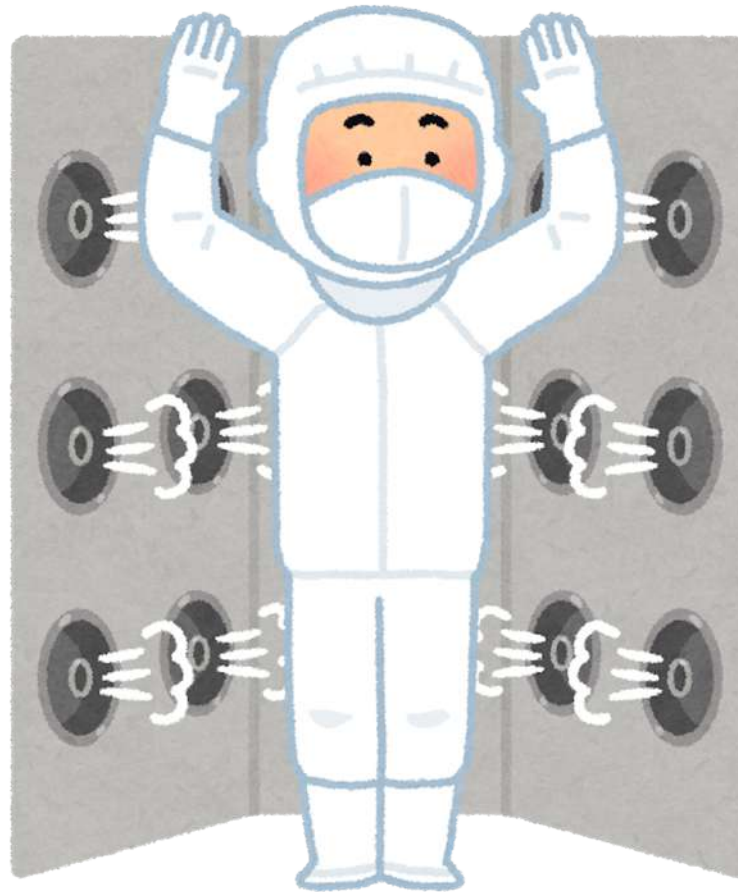
Partially climate control

Vs

No climate control

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Is everyone using it?



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Inside Factory

Clean room

Vs

Non-clean room

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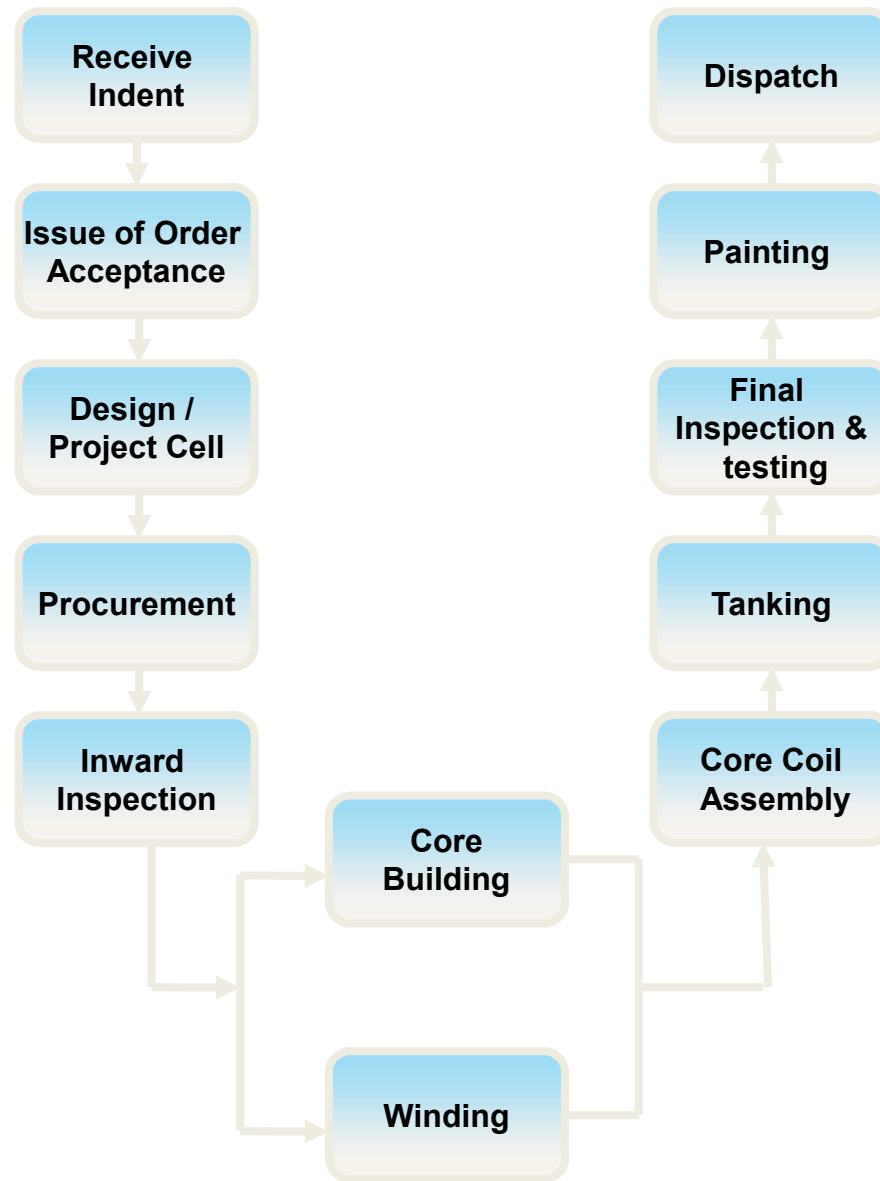
Cleaning approach

All employees part of cleaning process

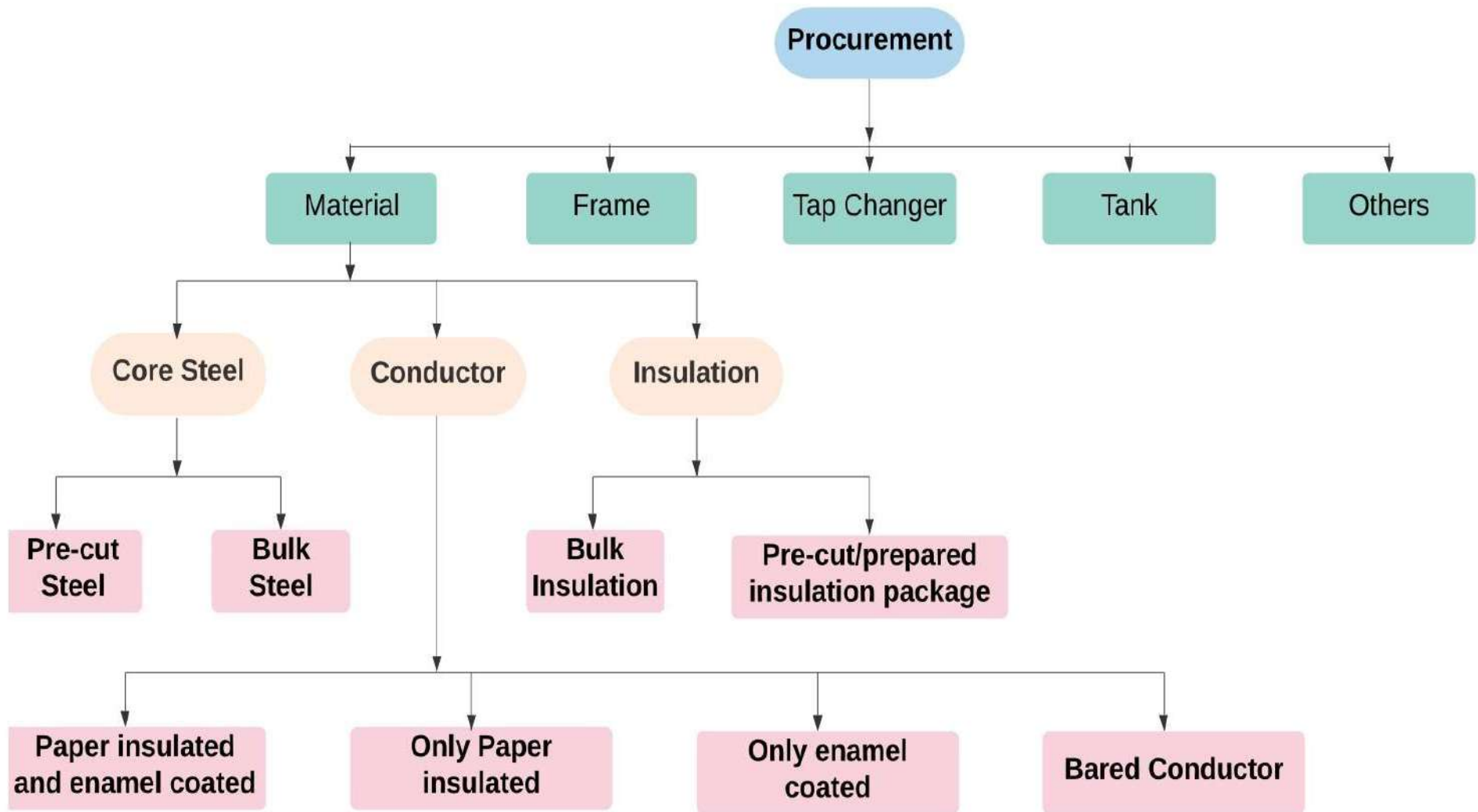
Vs

Cleaning company in charge of cleaning

Transformer Manufacturing Flow chart:



Procurement Flow chart:



Procurement : Core Steel



Pre-Cut by supplier

Procurement : Core Steel

Cut steel in house



Procurement : Conductor

Types of Conductor



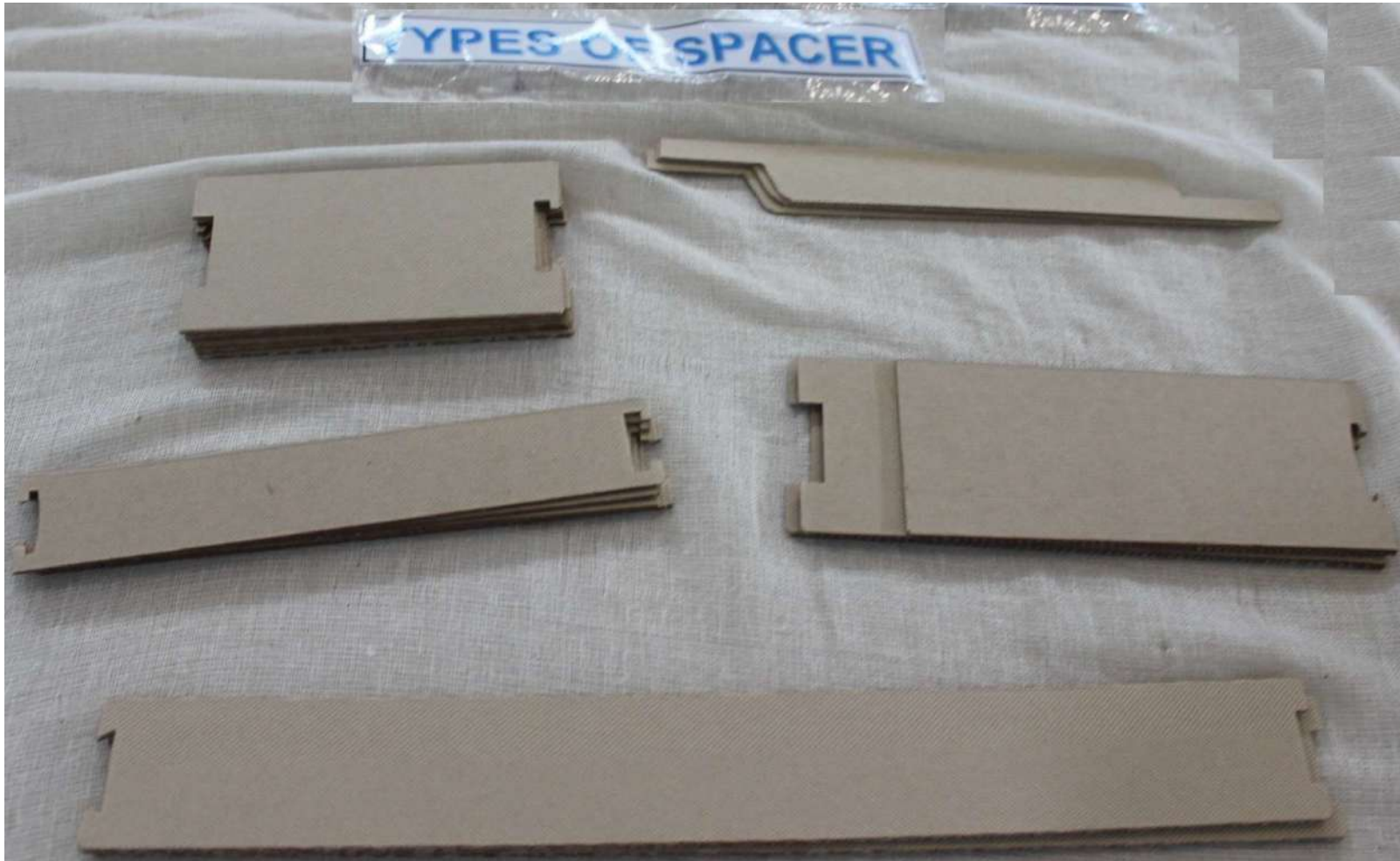
Procurement : Insulation



Types of Insulation Paper

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Procurement : Insulation



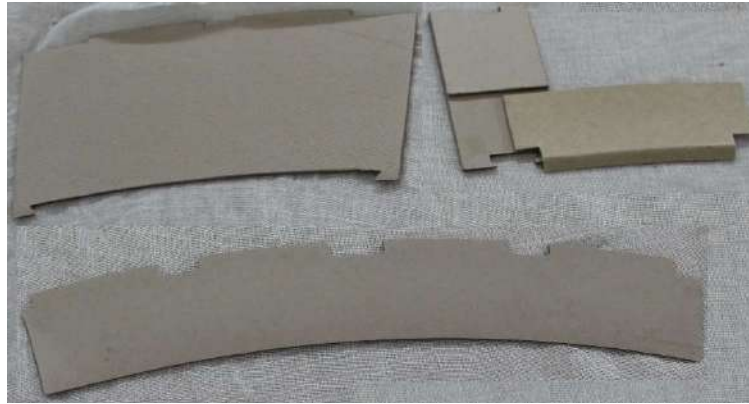
Types of Spacer

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Procurement : Insulation



Types of Strips



Line Shield



Types of Cooling Ducts



Types of Molded component



Riding Block

Procurement : Insulation



Transformer cylinder, end ring

Procurement : Insulation



Making insulation in house

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Inward Inspection



Core steel packed to prevent rust

Hole in the packing of the conductor reel/drum



Core steel on the floor

Quality Assurance: Shop floor Iron filing in the shop floor



Iron filing from the crane operation can cause failure

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Core Building/Stacking

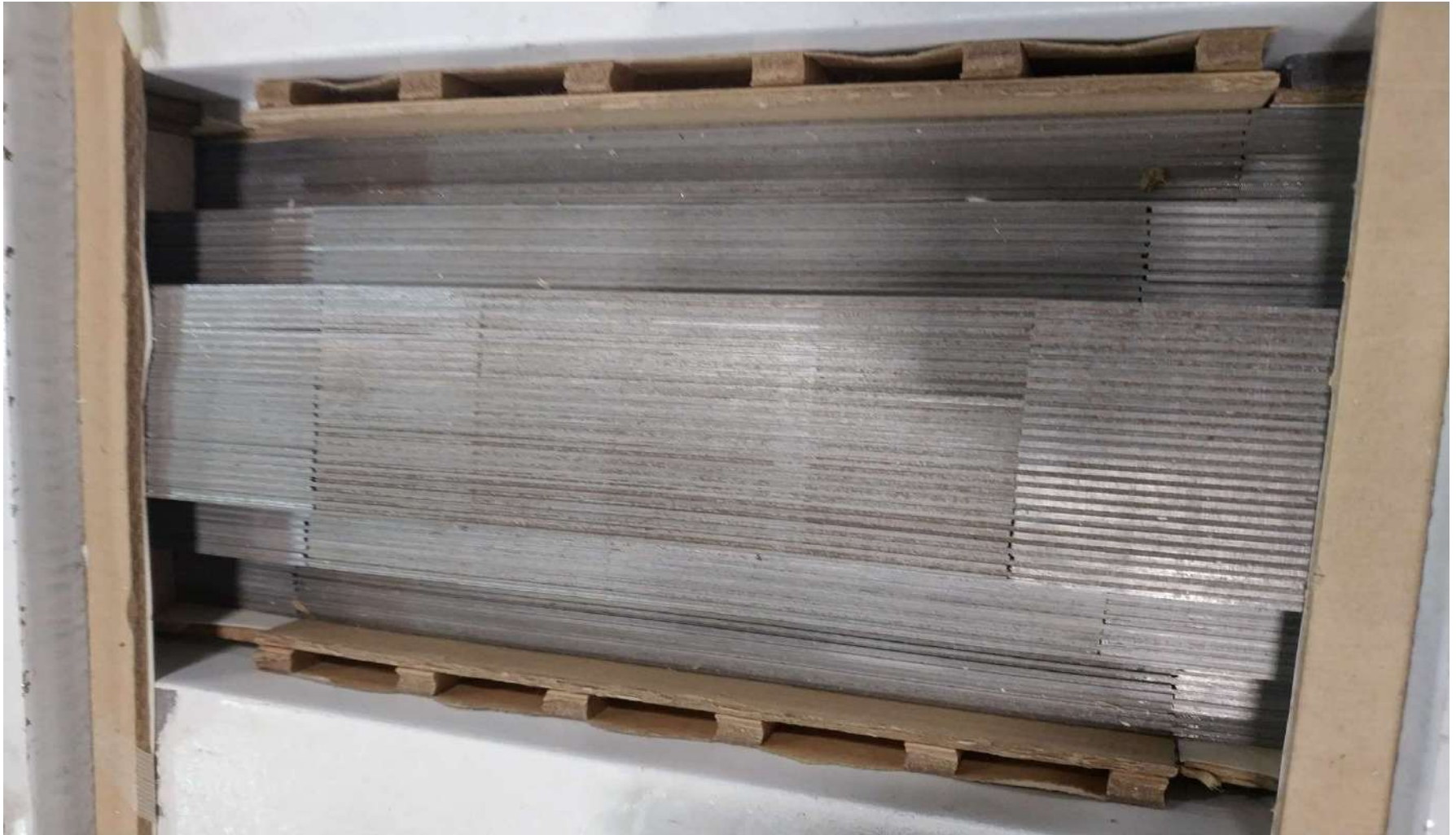
Core Stacking without
stacking bed



Core Stacking in
stacking bed



Quality Assurance: Core



Rust in Core

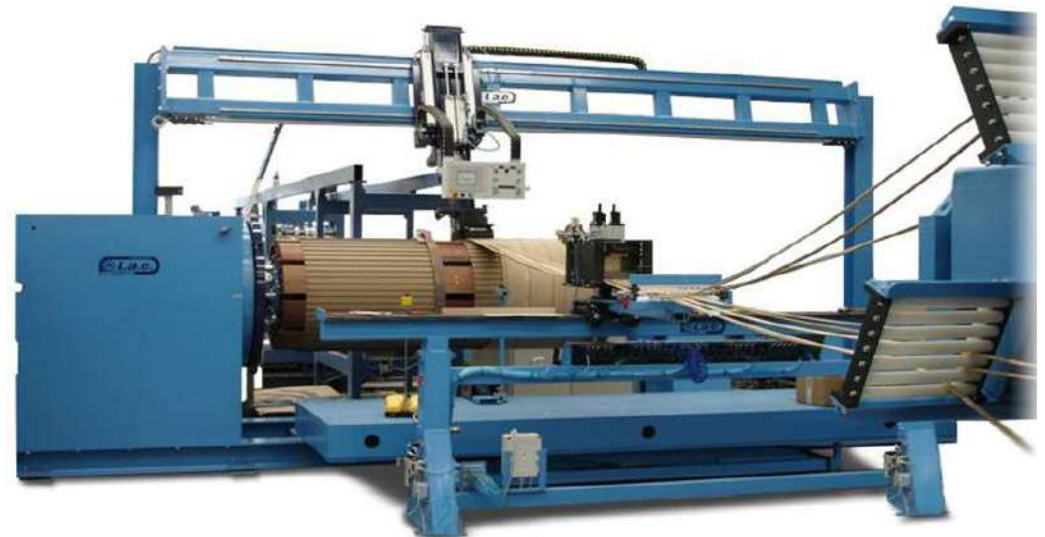
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Winding: Horizontal Winding Machine

Old Horizontal winding machine without breaking mechanism



New Horizontal winding machine with breaking and tension mechanism



Winding: Vertical Winding Machine



Old Vertical winding machine
without breaking mechanism



New Vertical winding machine with
breaking and tension mechanism

Quality Assurance: Winding



Loose turn to create space for conductor to move



400 millimeter reduction during coil sizing

Core Coil Assembly



Coil preparation for nesting



Coil nesting in Core

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Lead Braising



Gas welding



Induction machine

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Pre-Vapor Phase



Extended period of vapor phase will require a lot of energy usage

Quality Assurance: Core Coil Assembly

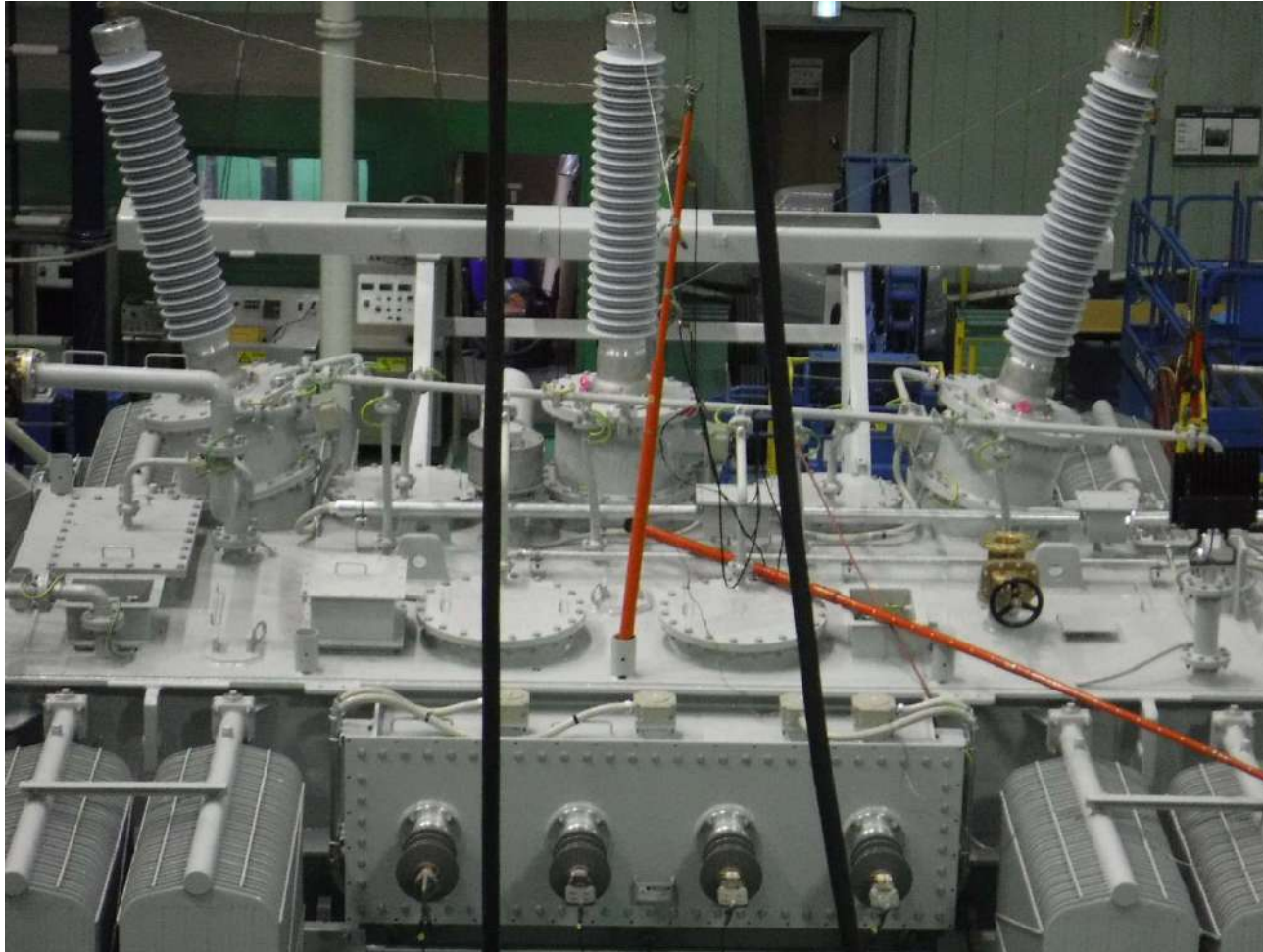
Vapor Phase



Extract moisture up to certain point to have certain Power Factor during FAT

Quality Assurance: FAT

Passed FAT but still reliability and longevity compromised



Pure refined oil and controlled FAT environment can compensate aggressive design and contamination (dust, moisture etc.) during manufacturing

Quality Assurance of Transformer

QA/QC management

Is ISO certification good enough?

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QA/QC management

- Is there any check and balance in the QA/QC process?
- Is the process properly documented?
- How often auditing take place?

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Non-Conformance Report (NCR)

- Is NCR a good indication for factory compliance to QA/QC?
- Is there any lesson learned session on issued NCR?

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Subcontractors/Suppliers

- Is there any procedure to ensure subcontractors/suppliers are compliant to QA/QC?
- How often subcontractors/suppliers are being audited?

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Training for all employees

Continuous training

Vs

Occasional/no training

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What could be viable solution?

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Viabale Solution

- Factory audit
- Design review
- QA inspection during manufacturing

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Factory Audit

What to look into during factory audit?

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Design Review

How design review helps to ensure quality?

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QA inspection(s)

- Core and Coil inspection
- Coil nesting in core
- Pre-vapor phase inspection
- Pre-tanking inspection
- FAT witness
- Inspection prior to shipping

Q&A?

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