

# Design of Vessels and Tanks -2

## Master Checklists

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# Critical Variables Underlying Vessels Design

- Temperature – full range of conditions in the vessel and related system.
- Pressure (including maximum liquid heads) – full range of conditions in the system. Assess for all pressure vessels, pressure piping and other pressured items such as jackets, etc.
- Chemicals and varying concentrations – as also for compatibility with vessels, other equipment and piping in the system. Critical variables are selected material and corrosion allowance design.
- Pressure rating of all equipment in the system at the maximum system temperature.
- For plastic based systems the inter-relationship between the temperature, rated pressure and the chemical compatibilities requires a careful review for all vessels, equipment and piping, as the inter-relationships are complex.
- Required vessel, tank or piping capacities including heads at maximum fill levels for vessels. Special control requirements for blending equipment such as operational time cycles, and especially batches management for residence times and other system needs.
- Correct design standards especially hazardous elements such as vessel vents (types, sizes).

## Vessel Systems Design – Equipment Selection Stages

**Prepare** information analysis, systems analysis, scope analysis, risk analysis for each vessel or equipment type.

**Start** with batch volume, SG, viscosity for the process; state the chemicals in full detail; state full pressure and temperature conditions of the products handled.

**Select** materials for vessel and internals. Selection is based on the corrosion information and available sizes.

**Select** the basic blender type, if any, from the viscosity, power consumption guidelines and industry experience.

**Select** the appropriate vessel design standard (see guideline chart following) and *proceed to basic design* of all shell and component details. Non-metallic design standards are not reflected on the charts following.

**Check** SANS 310 for hazardous products storage vessels design and the total system safe-handling design details.

**Check** that there are no issues of crystallization, floating light liquids, foaming, de-aeration, solids suspension or other unusual process conditions to consider for the total design.

**Re-Check** all vessel details and review scope analysis studies for total system design; prepare upgraded scope.

**Check** all design details as to whether a full HAZOP is required for any item of the vessel system design.

**Review total system design with equipment specialist suppliers to enable detailed review/quotations/pricing.**

# General Process Design Risk Check-list Part 1

- Full description of the process including reactions is to be assessed for risks.
- Full requirements as key objectives of the process system are to be detailed and assessed. Any run-away conditions that may arise are to be given special assessment attention.
- All equipment within the boundaries (battery limits) of the total system are to be listed with pertinent details (initial designs) and any areas of high risk in function thereof.
- All key personnel to be consulted for sign off of the system and initial signed general arrangement drawings are to be prepared.
- All special process requirements especially details that may be unique to the relevant process must be listed including materials. Risk of failure from materials to be assessed.
- A summary spreadsheet of risks of all nature and types is to be prepared and assessed in detail with risk ratings in a formal risk matrix.

## General Process Design Risk Check-list Part 2

- Details of any hazardous products to be handled or hazardous situations that may arise to be fully described, detailed and assessed.
- Where exceptionally high risk situations may arise and a HAZOP has been implemented this must be provided to the lead design party.
- Special and unique features of the products and special performance needs of the equipment that may impact on risk to be detailed and assessed.
- If the system is required to operate at pressure and temperature conditions that may lead to registration as a system that is a pressure vessel – these details must be fully provided and presented to the lead design party.
- A review of risks and hazards that are unique to each item of equipment is to be made and assessed with specialist suppliers for a risk prevention design.