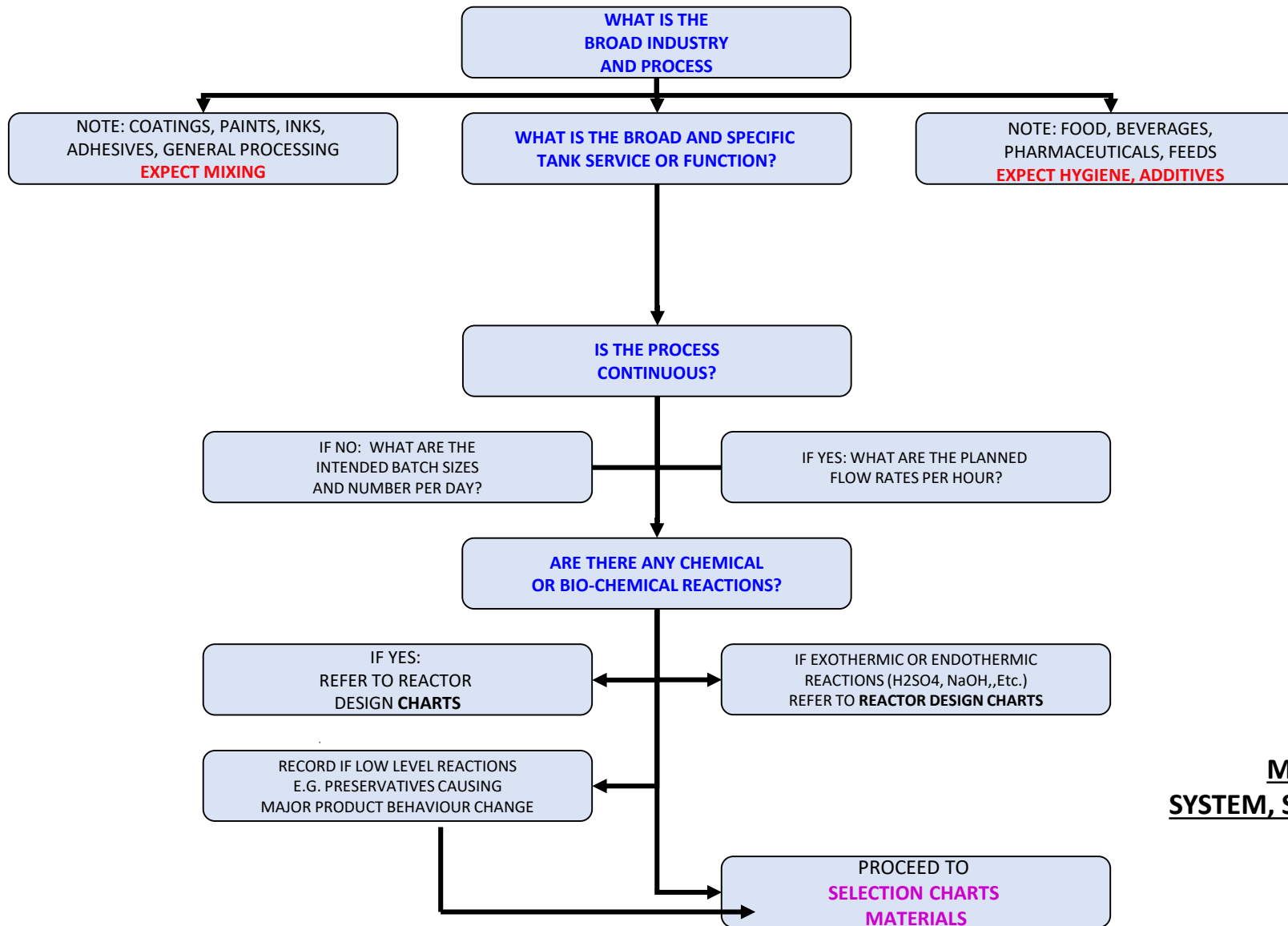
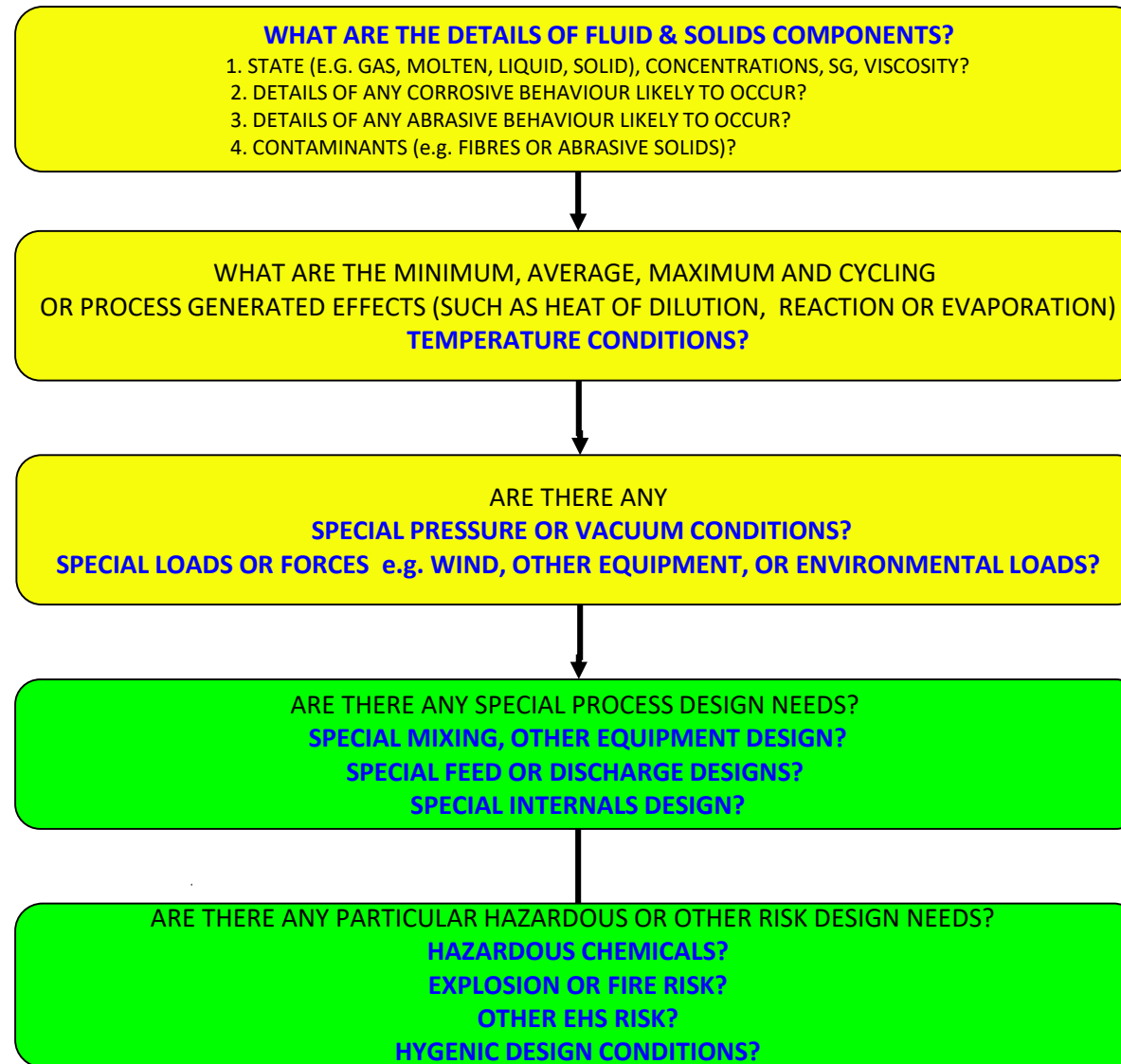


Design of Vessels and Tanks

Master Checklists



**MASTER DESIGN
SYSTEM, SCOPE, INFO. ANALYSIS
CHECKLIST 1**



MASTER DESIGN – SYSTEM, SCOPE, INFO. ANALYSIS CHECKLIST 2

UNDERSTANDING FIRST LEVEL DESIGN FACTORS IN MATERIALS SELECTION

From the systems, scope and information analyses, and the master design checklists, a range of data and knowledge will have been extracted that is essential in material selection.

Some key further considerations for selection follow from this data.

1. OSH Act, environmental legislation and regulations (e.g. pressure) will impact the material selection such as eventual spillage, etc.
2. Hazardous products identified will require special considerations.
3. Hygiene requirements identified will require special considerations.
4. The external and internal process parameters should have been fully considered. Temperature, pressures or vacuum and all static, dynamic and cyclical loads are essential information.
5. Fluid compositions and anticipated corrosion or abrasion conditions are also essential.
6. Position and location, whether a tank, pipe or part is important.

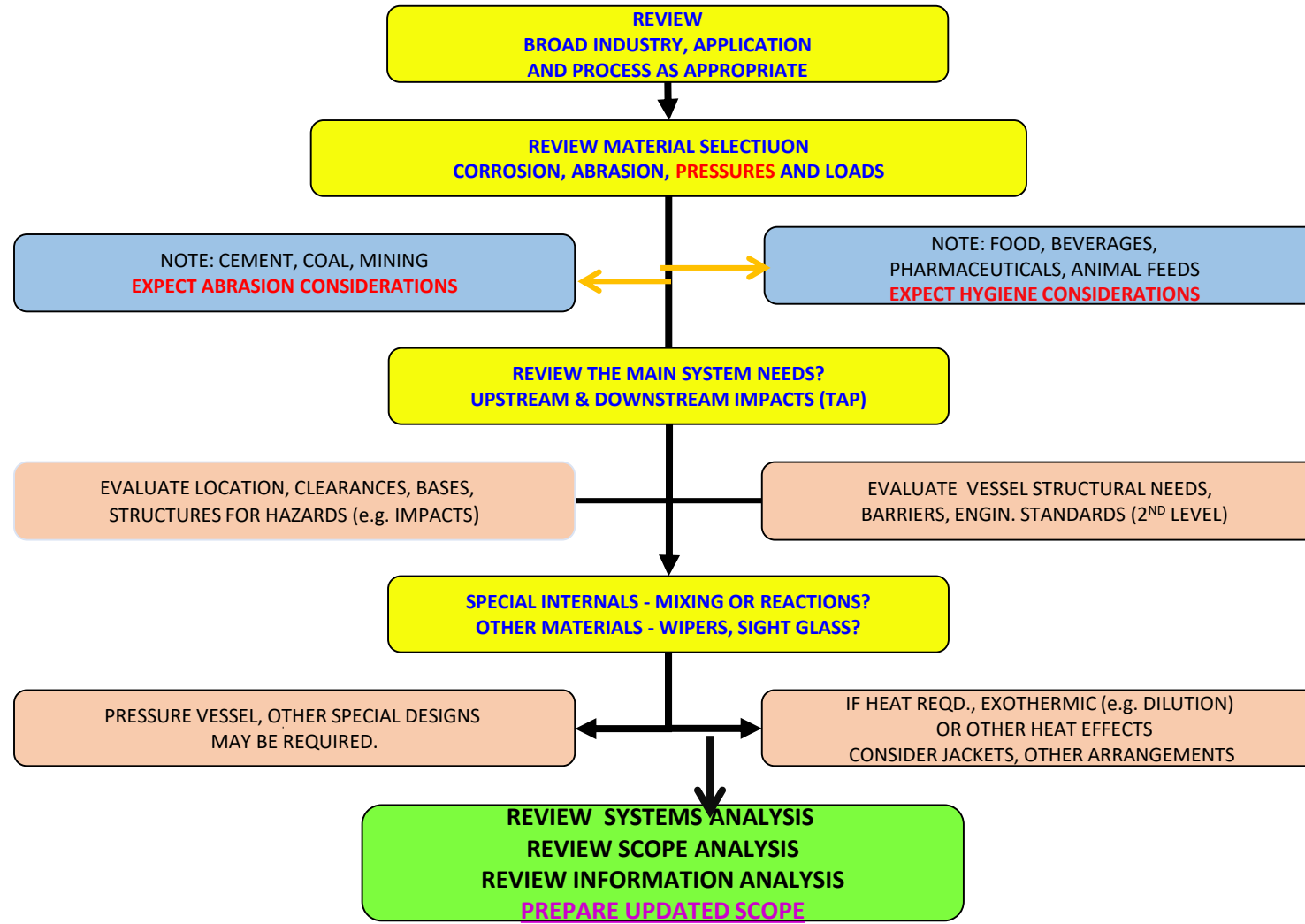
MASTER DESIGN – MATERIAL SELECTION CHECKLIST 3

UNDERSTANDING SECOND LEVEL DESIGN FACTORS IN MATERIALS SELECTION

- STRUCTURAL SUPPORTS
- COMPOSITES (Focus on Polymers)
- ALLOYS (Focus on Metals)
- BARRIERS
- DESIGNED FAILURE LIMITS
- ENGINEERING STANDARDS

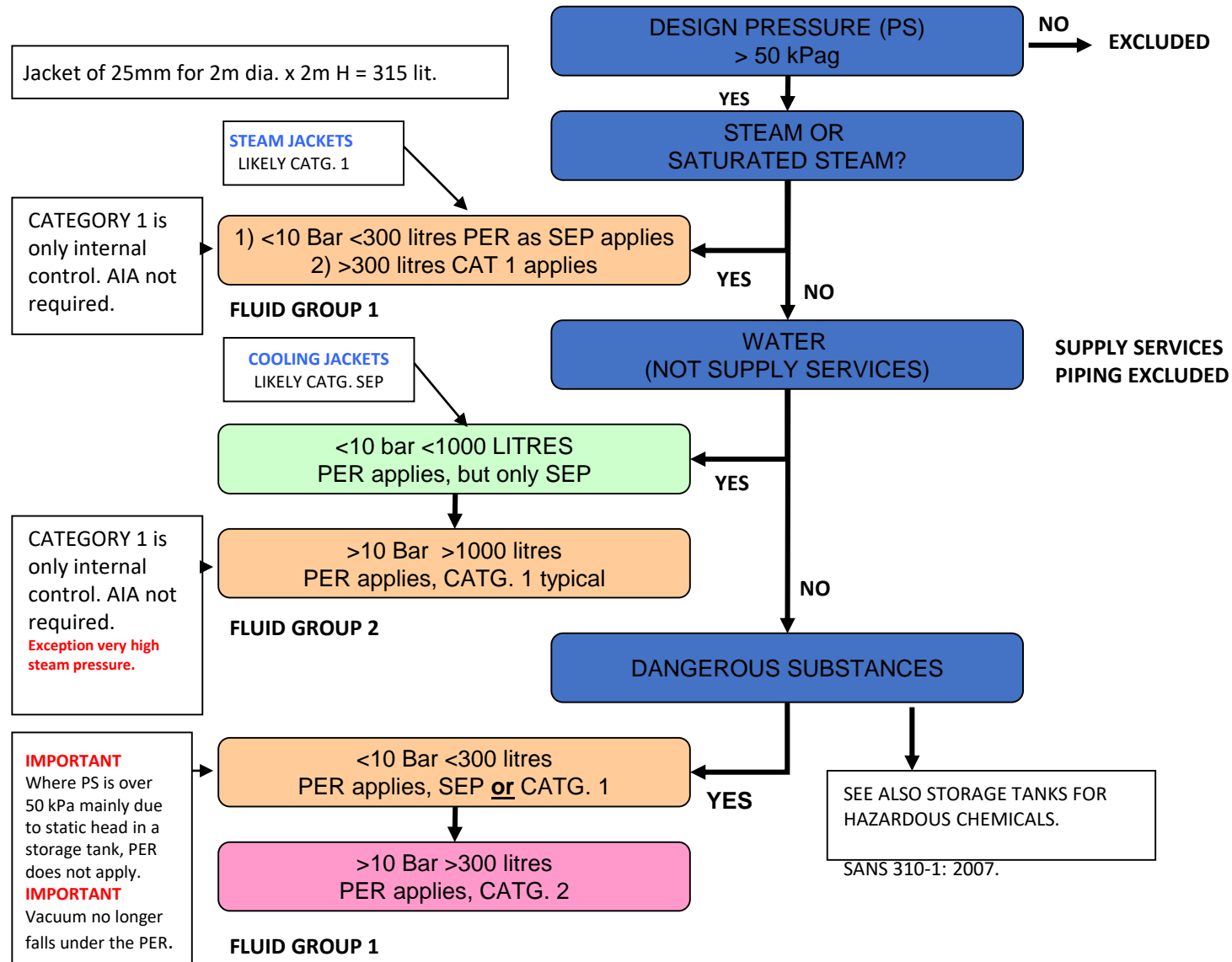
MASTER DESIGN – MATERIAL SELECTION **CHECKLIST 4**

SUMMARY MATERIAL SELECTION



MASTER DESIGN – MATERIAL SELECTION CHECKLIST 5

PRESSURE EQUIPMENT REGULATIONS AND SANS 347 for VESSELS



MASTER DESIGN – TANK DESIGN
CHECKLIST 6

MAIN DESIGN TOPICS - ASME VIII

- Temperature and pressure ranges
- Material design and Material classes
- Shell thickness design
- Bottom and head or lid thickness design; other design considerations
- Nozzles design; manhole design
- Vent design details
- Other specialized design details

MASTER DESIGN – TANK DESIGN CHECKLIST 7

OVERALL DESIGN CHECKLIST

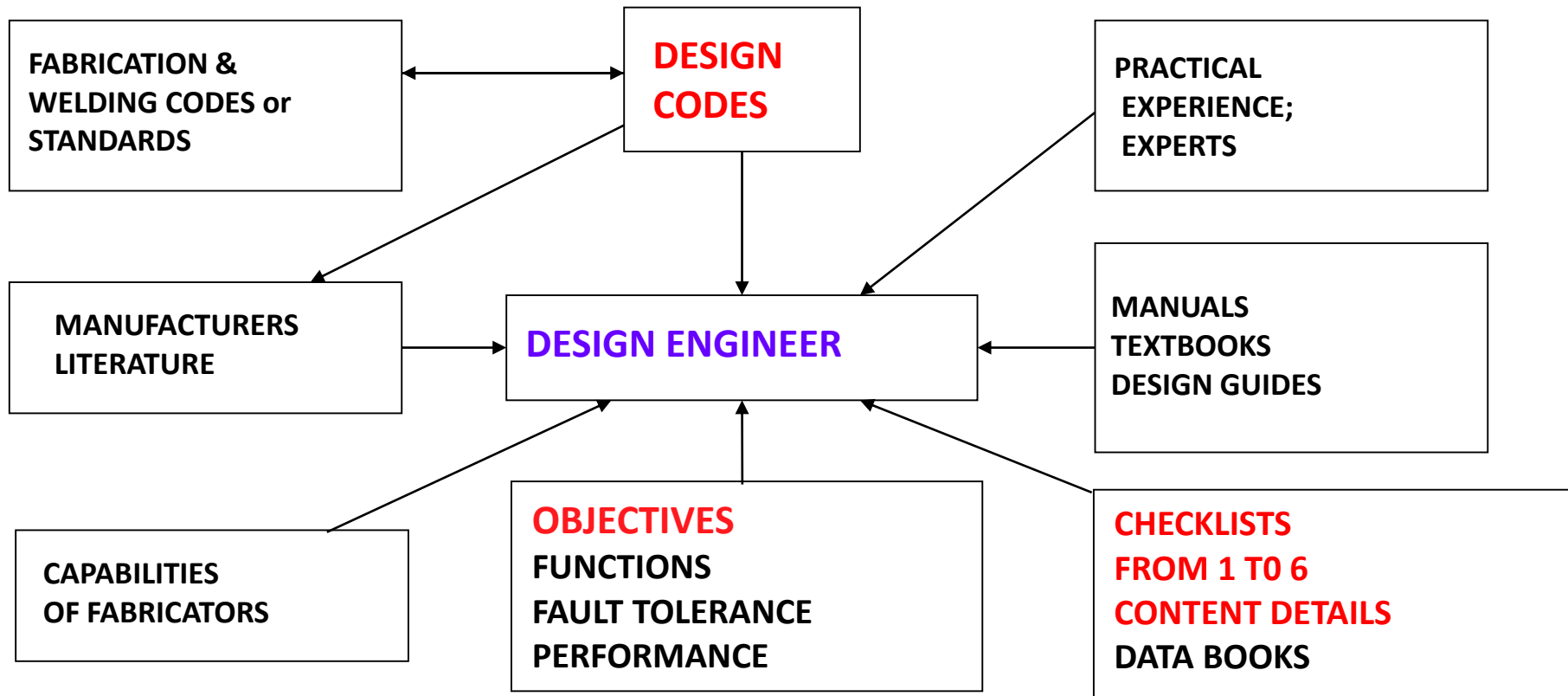
SANS 310-1:2007

(Storage tank facilities for hazardous chemicals)

- **Use SANS 310-1:2007 as a master overall checklist**
- **Even if the product is not hazardous, this is an excellent master tank design checklist**
- **Risk assessment techniques are listed which are also relevant to non-hazardous stored products**

MASTER DESIGN – TANK DESIGN CHECKLIST 8

FINAL REVIEW CHART



MASTER DESIGN – TANK DESIGN CHECKLIST 9

OUTLINE OF RANGES OF MAIN STANDARDS – METAL VESSELS

| Deg. Celsius | | | | SA P.E.R. Regulations apply over 50 kPa guage. SANS 347 applies. | | | | | | |
|--|---------|---------|----|--|----|----|-----|--------|--|--|
| 343 | | | | 343 Degrees Celsius Carbon Steel w/o impact testing | | | | | | |
| 320 | | | | | | | | | | |
| 300 | | | | | | | | | | |
| 280 | | | | | | | | | | |
| 260 | | | | | | | | | | |
| 240 | | | | | | | | | | |
| 220 | | | | | | | | | | |
| 200 | | | | | | | | | | |
| 180 | API 650 | | | | | | | ASME 8 | | |
| 160 | | | | | | | | | | |
| 140 | | | | | | | | | | |
| 121 | | | | | | | | | | |
| 100 | | | | | | | | | | |
| 80 | | | | | | | | | | |
| 60 | | API 620 | | | | | | | | |
| 40 | | | | | | | | | | |
| 20 | | | | | | | | | | |
| 0 | | | | | | | | | | |
| kPag | 0 | 18 | 40 | 50 | 60 | 80 | 101 | | | |
| -29 | | | | -29 Degrees Celsius Carbon Steel w/o impact testing | | | | | | |
| -40 | | | | | | | | | | |
| -60 | | | | | | | | | | |
| -80 | | | | | | | | | | |
| -100 | | | | | | | | ASME 8 | | |
| -120 | | | | | | | | | | |
| -140 | | | | | | | | | | |
| -160 | | | | | | | | | | |
| -180 | | | | | | | | | | |
| -195 | | | | -195 Degrees Celsius Austenitic SS w/o impact testing | | | | | | |
| | | | | SA P.E.R. Regulations apply over 50 kPa guage. SANS 347 applies. | | | | | | |
| NB: ALL DESIGN PARAMTERS ARE TO STILL BE VERIFIED AGAINST DETAIL IN RELEVANT STANDARD. | | | | | | | | | | |

CHECKLIST 10

FIBRE-GLASS VESSELS CATEGORIZATIONS

| Table 2. Minimum categories of vessel or tank | | | |
|---|-----------------|-------------|--------------------|
| | Category I | Category II | Category III |
| Contents * Toxic Highly corrosive Corrosive Flammable Others | X X X | | X X |
| Chemical compatibility of liner with process fluid Known long-term compatibility based on service experience Compatibility based on related performance data Only specimen data (dip coupons) available | X | X | X |
| Design temperature, T $T < 60\text{ °C}$ and $T \leq (\text{HDT} - 40\text{ °C})$ $T > 60\text{ °C}$ and $T \leq (\text{HDT} - 40\text{ °C})$ $T > (\text{HDT} - 40\text{ °C})$ and $T \leq (\text{HDT} - 20\text{ °C})$ | X | X | X |
| Design pressure and/or vacuum Static head only < ± 5 mbar‡ (above static head) > ± 5 mbar (above static head) | X | X | X |
| Size of vessel or tank (capacity) < 10 m ³ 50 m ³ ≤ capacity ≤ 10 m ³ > 50 m ³ | X | X | X |
| Geometry and supports Flat bottom full support Any other, e.g. legs, skirts, saddles, rings and frames | | X | X |
| Other criteria If item is critical to safety | X | | |
| <p>*Description of contents classification</p> <p>Toxic. The contents could present a significant risk to health of persons exposed.</p> <p>Highly corrosive. The contents could severely burn, blind, disfigure or maim an individual.</p> <p>Corrosive. The contents could cause damage to the skin or eye.</p> <p>Flammable. The contents have a flash point equal to or less than 55 °C.</p> <p>Others. The contents are not considered to burn, blind or injure individuals.</p> <p>†Heat distortion temperature of resin (see 6.4.2).</p> <p>‡1 mbar = 100 N/m² = 100 Pa.</p> | | | |

CHECKLIST 11