

- Both TDR and non contact RADAR measure the distance to the product and derive the level in mm from this and then convert this level to volume.
- The conversion of this level to volume is a potential area for error and is dependant on accurate tank dimensions, which include:
  - Tank Height in mm (both external and internal)
  - Tank diameter in mm (both external and internal)
  - Lagging thickness top, sides and bottom
  - Bottom of the draw off in mm from the tank bottom
  - Bottom of the Vent / Overflow position in mm from the tank top
- All of the above provide the necessary information to allow the calculation of the AWC (Available Working Capacity), the SWC (Safe Working Capacity) the Measurement Derived Alarm at 90% of AWC (Amber) and the Ultimate High Level set-point at 92.5% of AWC (Red).
- Tank Volume for a cylindrical vertical tank is calculated as follows: -
  - $Tonnage = \pi r^2 \times h \times 0.92$  (Tonnage = Pi x Radius<sup>2</sup> x height x density (RBA conversion figure is 0.92))
  - For a 100 m<sup>3</sup> tank, 3.5 metre diameter 10,394 mm tall, Draw-off 500 mm from the bottom, Overfill / Vent Pipe 200 mm from the top.
  - Nominal Tank Capacity**
    - $1.75^2 \times 3.14159 \times 10.394 = 100.002 \text{ m}^3$  Nominal capacity x 0.92 = **92.002 Tonnes**
  - Unavailable Tank Capacity**
    - $1.75^2 \times 3.14159 \times 0.7 = 6.735 \text{ m}^3$  Unavailable capacity x 0.92 = **6.196 Tonnes**
  - Available Working Tank Capacity**
    - Nominal Capacity – Unavailable Capacity = Available Working Capacity
    - $92.002 - 6.196 =$  **85.806 Tonnes**
  - Safe Working Tank Capacity**
    - Available Working Capacity - 10% = Safe Working Capacity
    - $85.806 - 10\% =$  **77.225 Tonnes**
- All of the above considerations listed assume a CLEAN tank with accurate drawings, however please be aware:
  - The age, usage and PEN grade can have an effect on the above figures and therefore the accuracy of the conversion of a 'Level' reading into tonnes.
  - For example with a uniform build-up of 50 mm the tank capacity can change:
    - Nominal Tank Capacity = 86.818 Tonnes - 5.184 T**
    - Available Working Capacity = 80.971 Tonnes - 4.835 T**
    - Safe Working Tank capacity = 72.877 Tonnes - 4.348 T**
- The above figures can also be affected if :
  - There are no drawings available of the tanks and the internal tank size has to be estimated by measuring the outside of the tank and assuming a set thickness of lagging (estimation of lagging thickness could bring about similar errors to those experienced with coating of the internal walls of the tank if the tank diameter is estimated incorrectly).
  - Overflow / vent pipe is inside the lagging and if no exact measurement can be made of its location this will have a direct impact on the Available and Safe Working Tank Capacities.
- The volume calculation for horizontal tanks has the possibility of greater inaccuracies due to the estimation of tank dimensions and any internal build-up on the tank walls because the bitumen across the tank has a larger surface area and therefore a larger volume for a small change in level compared with a vertical tank.
- It should be noted that the level of bitumen can be measured accurately but the conversion to volume can contain inaccuracies due to the reasons indicated. Bitumen contents should therefore be considered to be displayed in approximate tonnes.
- Following the recommendations in the RBA's 'Guidance for Safe Bitumen Tank Management' and the 'Possible Model for the Display of Tankside Information' (pg 20) should provide protection against overspills.

