**Design Considerations**

Below is an explanation of the design considerations associated with auto propane vessels. Also included are any code requirements.

**DESIGN PRESSURE:**
The B149.5 code and NFPA 58 requires that all tanks be designed for 250 psig unless used within the enclosed portion of a vehicle in which case the design pressure is 312 psig. By using a higher design pressure than required by code you will have a greater wall thickness than otherwise required. This additional wall thickness will result in a safer tank, better able to withstand corrosion, fatigue, impact and other external forces. Not only is the tank safe with the additional wall thickness, the areas where attachments are welded to the tank are better able to withstand the external loads due to the additional wall thickness. The majority of tanks fabricated by SLEEGERS Engineering Inc. are designed for 312 psig. It is our recommendation that all tanks be designed for 312 psig although it would rarely, if ever, see such an internal pressure with resulting stress.

**INTER-TANK CONNECTIONS:**
Connections between the tanks should serve a couple of purposes: transfer of the vapour and liquid, and structural integrity of the tank system. By using several connections between the tanks, the unit load per connection is reduced, corresponding in a reduction of stress at the joints. This reduced stress reduces the possibility of cracks and leaks.

The connections between tanks should incorporate a geometry that allows for a uniform distribution of the stress at the joint and also, for easy welding with no excessive weld build up. By having sharp corners in the inter-tank connections, notch effects are allowed, which dramatically increase the stress level at the joint. In addition, excessive weld build up results in an enbrittlement of the parent material near the weld. This brittle material can fail and crack. One way to achieve this is to have the connection between the two tanks enter the two tanks as close to perpendicular to the tank wall as possible.

It should be noted that during service the tanks are rigidly mounted in the vehicle frame, which flexes. This flexing is transmitted to the tanks and it is the interconnections that must absorb the relative motion. These interconnections must be ridged enough to maintain tank configuration and be flexible enough to allow this motion without failing and cracking. A severe case of the above is an accident. In this case, the tanks will most likely be forced together. The interconnections must absorb this change in configuration without failing or rupturing. It is here that the flexibility of the interconnections, and the number of connections is most critical. By using several flexible connections, the unit loads are kept to a minimum, while the tanks are allowed to come together so that the set of tanks acts as a single tank. Methods of achieving this combination of strength and flexibility include using a curved section of pipe. This gives a good combination of strength and flexibility as well as addressing the connections geometry problems of the previous paragraph.

Currently, this is not a code requirement, just good engineering practice, however changes are proposed to CSA B51 to address this situation.

**BRACKETS:**

The design of brackets is similar to guards. They must be strong enough to maintain the position of the tank and yet not do any damage to the tank in the event they fail. The B149.5 code requires that all brackets have a minimum strength of 20g in the vertical and 8g in either plane in the horizontal. NFPA 58 has lower standards. **Brackets on tanks to be used in Canada are designed to B149.5 while brackets on tanks to be used in U.S.A. are designed to NFPA 58 unless otherwise instructed by the customer**. In addition, the attachment of the bracket to the tank must be at least as strong as the bracket. It makes no sense to have a strong bracket, which will not stay with the tank. As with guards the weak link here should be the bolts to ensure the pressure integrity of the tank.

L brackets are supplied as an accessory for installation. SLEEGERS Tanks Inc does not warrant that these brackets will meet code installation requirements in all cases since installation practices vary by shop and vehicle. If an installer wants a specific installation checked he can contact SLEEGERS Tanks Inc with the particulars of the installation and SLEEGERS Tanks Inc will review installation relative to the the required standards.

**FLOAT GAUGE:**

The float gauge usually represents the largest opening in the auto propane tank and is the only opening that is not protected by either a #54 drill opening or an excess flow valve as required by B149.5 of NFPA 58. As such, failure of this fitting has the greatest potential for the release of propane. Consequently, as much as possible should be done to ensure the pressure integrity of the opening. Points, which should be considered, are corrosion between the opening, tank, gasket, bolts and the gauge. Material chosen for the gasket should be resistant to propane and remain pliable throughout the temperature range, which the tank is exposed to. The head of the gauge and the bolts should be a material that will not corrode preferentially with respect to the bolts or the tank.

Since the opening has no excess flow protection the head of the gauge should be protected so it cannot be readily sheared off in case of an accident. This may be accomplished by recessing the head of the gauge in a protective collar.

At SLEEGERS Engineering Inc. we believe in safety foremost and all of our float gauges are brass headed with stainless steel bolts. This eliminates corrosion between the tank and the head of the float gauge. The use of viton gaskets gives a wider range of temperature resistance. The typical Buna 'N' gasket is susceptible to hardening at lower temperatures, reducing its sealing ability at these lower temperatures. In addition, we mount all of our float gauges in recessed fittings to ensure that the head of the float gauge cannot be sheared off in case of an accident.

**GUARDS:**

While guards are traditionally associated with protecting the valves from accidental damage, they can cause serious damage themselves. Guards should be designed to ensure that they are strong enough to

protect the valves according to B149.5 or NFPA 58, but simultaneously they must not be so strong that the tank will fail before they do. The guard should also have no sharp edges that may cut into the tank. Bolts and other mounting hardware should be designed such that they will fail before the tank wall, much like a shear pin in rotating equipment.

SLEEGERS Engineering Inc.'s guard tabs are designed such that they will preferentially fail before the tank wall does. Further, all our undermount tank valves guards are also protected by using special bolts that will shear at relatively low force. The bolts will hold the guard in place until it is caught on an obstruction, at which point the bolts will fail allowing the guard to fall away from the tank. Also, all our undermount tank guards are flat and do not have any sharp edges that may cut into the tank wall in the event the guard is caught on something.

**NAMEPLATE:**

The ASME and CSA B51 require a nameplate on all pressure vessels. The nameplate is to be attached in a way that it does not promote corrosion of the tank. Further, it must be of sufficient thickness to resist distortion and allow the markings to be easily read. At SLEEGERS Engineering Inc., we us a steel nameplate 0.125" thick mounted above the tank surface, thereby satisfying all of the above points. This extra thickness allows the marking to be indented into the plate far enough that they are easily read. In addition, the thick steel resists damage better. By raising the nameplate above the tank and using the same metal for the vessel and the nameplate, the possibility of corrosion between the tank and nameplate is eliminated.

**VALVE CONNECTIONS:**

Valves are mounted in most cases in NPT style couplings that are available in various ratings. These couplings may distort due to the heat of the welding. At SLEEGERS Engineering Inc., we use a heavier rating of coupling to ensure better sealing at the threads of the valves because of less distortion. These heavier weight couplings are also stronger and less likely to fail through shearing or cracking in the case of an accident.

**CORROSION PROTECTION:**

According to B149.5 all tanks must be covered with a suitable corrosion protection system. This system should resist corrosion, scratches, and abrasion. Good corrosion systems will have established ASTM salt spray ratings in the range of 1000 hrs. or better and also ASTM scratch and gravelometer ratings. Further, these systems should not be susceptible to operator error during application. A good system would give the required performance rating with little room for operator judgement. It is no good to have a perfect system that requires a perfect human to apply it, since that will never be.

Further, due to the harsh environment under the vehicle, it is an excellent idea to re-coat the tank on a regular basis with a reputable corrosion protection system during its service. Most vehicles receive a regular application of a corrosion protection undercoat.

**LIQUID TRAP:**

A liquid trap is recommended any time you have a propane system in which there are vapour appliances withdrawing from a liquid tank on a vehicle in rough terrain. An example would be a canteen truck with

a coffee urn heated by vapour propane withdrawn from the same tank as the vehicle uses for motor fuel. In this case the vehicle is operating in construction sites and liquid propane may splash into the vapour withdrawal line and cause the vapour regulator to freeze in the open position, with a possible fire or explosion. Another example would be a RV.

The liquid trap installs between the tank and the appliance and will capture any slugs of liquid that are in the vapour line before they get to the appliance regulator. These liquid slugs will then vaporize in the liquid trap reducing the withdrawal from the tank, until the liquid in the trap is consumed.