Underground LPG Storage Tank Installation Worksheet

PLEASE NOTE: ***The following information is being provided as a guide ONLY. It is recommended that you contact a licensed engineer to properly design all UST installations.***

SECTION 1 – UST SIZING

UST's must be properly sized for their intended use. An undersized UST will not be able to vaporize the fuel necessary to supply all of the appliances connected to it. This can result in a dangerous situation. There are three factors that are required to properly size an UST:

TOTAL DEMAND — The total demand of all existing and anticipated future gas appliances must be accounted for when sizing an UST. The total fuel demand for the installation can be determined by adding all of the btuh ratings (found on the appliance data plates) of all existing and anticipated future gas appliances that will be supplied by the UST.

FROST DEPTH — The maximum anticipated soil frost penetration depth for the UST installation location must be known when sizing an UST.

Total BTU load per hour: _____ Maximum frost depth: _____

INSTALLATION TYPE ☐ Mounded (see TABLE 2) ☐ Buried (see TABLE 3)

Minimum size UST required: _____

Refer to SECTION 4 for information on selecting the proper size UST.

SECTION 2 – CATHODIC PROTECTION

ALL UST'S MUST BE CATHODICALLY PROTECTED. Cathodic protection protects steel USTs from corrosion which is the natural electrochemical process that results in the deterioration of a material because of its reaction with its environment. The UST being cathodically protected must be electrically isolated from all other metallic structures or piping systems. Generally UST electrical isolation is accomplished by the use of dielectric unions or non-metallic piping systems.

PLEASE NOTE: All cathodic protection systems are required to be periodically inspected to verify their functionality.

Type of Cathodic Protection System being installed:

☐ Sacrificial Anode (see TABLE 1)

☐ Impressed Current (Consult with a corrosion engineer for design information on impressed current systems.)

Type of anode required: _____

Number of anodes required: _____

Weight of required anodes: _____

Refer to SECTION 4 for information on cathodic protection.

SECTION 3 – BUOYANCY

If the UST is being installed in a flood-prone area or an area where the highest anticipated ground water level is above the depth of the bottom of the UST it is at risk of rising out of the ground due to floatation. This is a dangerous situation that must be prevented by securing the UST with straps that are engineered to withstand the buoyancy force of the UST to a foundation that is engineered to prevent floatation of the UST

Is the UST is being installed in a flood-prone area or in an area where the highest anticipated groundwater level is above the depth of the bottom of the UST?

☐ YES (see TABLE 4) ☐ NO (skip this section)

Minimum size concrete slab required: _____

Refer to SECTION 4 for information on buoyancy countermeasures

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SECTION 4 – USEFUL INFORMATION

The following publications provide information on corrosion protection of containers and piping systems:

- API Publication 1632, *Cathodic Protection of Underground Petroleum Storage Tanks and Piping Systems,* 1983
- Underwriters Laboratories of Canada, ULC S603.1-M, *Standard for Galvanic Corrosion Protection Systems for Steel Underground Tanks for Flammable and Combustible Liquids*
- National Association of Corrosion Engineers Standard RP-01-69, Recommended Practice, *Control of External Corrosion of Underground or Submerged Metallic Piping Systems*
- National Association of Corrosion Engineers Standard RP-02-85, Recommended Practice, *Control of External Corrosion on Metallic Buried, Partially Buried, or Submerged Liquid Storage Systems*
- Underwriters Laboratories Inc., UL 1746, *External Corrosion Protection Systems for Steel Underground Storage Tanks*

TABLE 1 – Sacrificial anode requirements for UST's

Sacrificial Anode Requirements for Soils with Known Ranges of Electrical Resistivity				
Container Water Capacity (gallons)	**Soil Resistivity**			
	Less than 2.5K	**2.5K to 4.0K**	**4.0K to 10.0K**	**10.0K to 20.0K**
120/150	1 ea. 9 lb. H	1 ea. 9 lb. G	1 ea. 20 lb. G	2 ea. 20 lb. G
250	1 ea. 17 lb. H	1 ea. 17 lb. G	1 ea. 20 lb. G	3 ea. 20 lb. G
500	1 ea. 17 lb. H	1 ea. 17 lb. G	1 ea. 20 lb. G	4 ea. 20 lb. G
1,000	2 ea. 17 lb. H	2 ea. 17 lb. G	2 ea. 20 lb. G	6 ea. 20 lb. G

NOTE: lb. = pound(s) H = Alloy/Magnesium Anode G = Galvomag Anode

NOTE: Table 1 acquired from Certified Employee Training Program 4.1.5 IG (1-2004)

TABLE 2 – Vaporization rate of *BURIED* UST's

Estimated Maximum Continuous btuh Output For *BURIED* UG Tanks						
Soil Frost Line Depth (inches)	**Container Water Capacity (gallons)**					
	250	320	500	1,000	12,000	18,000
12	350,000	450,000	550,000	960,000	5,500,000	6,500,000
18	345,000	440,000	530,000	925,000	5,400,000	6,400,000
24	340,000	420,000	500,000	905,000	5,200,000	6,200,000
30	315,000	390,000	490,000	875,000	5,000,000	5,950,000
36	300,000	375,000	480,000	865,000	4,900,000	5,880,000
42	290,000	350,000	460,000	850,000	4,850,000	5,850,000
48	260,000	320,000	425,000	830,000	4,800,000	5,800,000
54	245,000	295,000	400,000	750,000	4,750,000	5,750,000
60	225,000	275,000	375,000	700,000	4,725,000	5,700,000
66	205,000	260,000	325,000	640,000	4,700,000	5,650,000
72	180,000	240,000	305,000	605,000	4,600,000	5,600,000

Buried depth of tank based on 28- inch riser. Btuh output based on tank 25% liquid filled. Btuh estimates based on minimum depths below grade to tank bottom for:

Underground Container Water Capacity (gallons)	Depth From Grade To Bottom Of Container
250 & 320	5 feet
500	5 feet, 6 inches
1,000	5 feet, 9 inches
12,000 & 18,000	10 feet, 4 inches (based on 96 inch diameter tank)

NOTE: Table 2 acquired from Certified Employee Training Program 4.1.6 IG (1-2004)

TABLE 3 – Vaporization rate of *MOUNDED* UST's

Estimated Maximum Continuous btuh Output For *MOUNDED* UG Tanks						
Soil Frost Line Depth (inches)	**Container Water Capacity (gallons)**					
	250	320	500	1,000	12,000	18,000
12	250,000	320,000	450,000	940,000	5,500,000	6,500,000
18	210,000	270,000	385,000	800,000	5,400,000	6,400,000
24	195,000	250,000	350,000	695,000	5,200,000	6,200,000
30	180,000	220,000	315,000	625,000	5,000,000	5,950,000
36	160,000	200,000	280,000	565,000	4,900,000	5,880,000
42	148,000	189,000	255,000	525,000	4,850,000	5,850,000
48	136,000	169,000	230,000	485,000	4,800,000	5,800,000
54	122,000	149,000	210,000	435,000	4,750,000	5,750,000
60	97,000	135,000	185,000	400,000	4,725,000	5,700,000
66	82,000	110,000	160,000	350,000	4,700,000	5,650,000
72	74,000	95,000	150,000	315,000	4,600,000	5,500,000

Buried depth of tank based on 14- inch riser. Btuh output based on tank 25% liquid filled. Btuh estimates based on minimum depths below grade to tank bottom for:

Underground Container Water Capacity (gallons)	Depth From Grade To Bottom Of Container
250 & 320	2 feet
500	2 feet, 4 inches
1,000	2 feet, 7 inches
12,000 & 18,000	7 feet, 9 inches (based on 96 inch diameter tank)

NOTE: Table 3 acquired from Certified Employee Training Program 4.1.6 IG (1-2004)

TABLE 4 – Buoyancy countermeasures for UST's

Concrete Slab Requirements to Prevent the Flotation of UST's															
Container Water Capacity (gallons)	**Depth of soil covering container**														
	0 ft.			**0.5 ft.**			**1.0 ft.**			**1.5 ft.**			**2.0 ft.**		
	L	**W**	**D**	**L**	**W**	**D**	**L**	**W**	**D**	**L**	**W**	**D**	**L**	**W**	**D**
120	6 ft.	2 ft.	8 in.	6 ft.	2 ft.	8 in.	6 ft.	2 ft.	6 in.	6 ft.	2 ft.	6 in.	6 ft.	2 ft.	4 in.
250	8 ft.	3 ft.	10 in.	8 ft.	3 ft.	8 in.	8 ft.	3 ft.	8 in.	8 ft.	3 ft.	6 in.	8 ft.	3 ft.	6 in.
320	9 ft.	3 ft.	10 in.	9 ft.	3 ft.	10 in.	9 ft.	3 ft.	8 in.	9 ft.	3 ft.	8 in.	9 ft.	3 ft.	6 in.
500	10 ft.	4 ft.	12 in.	10 ft.	4 ft.	10 in.	10 ft.	4 ft.	10 in.	10 ft.	4 ft.	8 in.	10 ft.	4 ft.	8 in.
1000	16 ft.	4 ft.	14 in.	16 ft.	4 ft.	12 in.	16 ft.	4 ft.	12 in.	16 ft.	4 ft.	10 in.	16 ft.	4 ft.	10 in.

Buoyancy Force Exerted on an UST					
	Container Water Capacity (gallons)				
	120	**250**	**320**	**500**	**1000**
Buoyancy Force (lbs.)	1,505	3,136	4,014	6,271	12,542

Based on the following: FEMA "Principles and practices for the Design and Construction of Flood Resistant Building Utility Systems (November 1999)"

Weight of fresh water = 62.4 lbs. per cubic ft. Weight of clean sand and gravel (moist) covering container = 30 lbs. per cubic foot Safety factor = 1.5
Weight of concrete = 150 lbs. per cubic foot

Container water capacity (gallons)	Weight of container	Container dimensions (OL x OD)
120	252 lbs.	5 ft. 5 7/8 in. x 24 in.
250	472 lbs.	7 ft. 2 ½ in. x 31.5 in.
320	588 lbs.	8 ft. 11 ¾ in. x 31.5 in.
500	921 lbs.	9 ft. 10 in. x 37.42 in.
1000	1731 lbs.	15 ft 10 7/8 in. x 40.96 in.