Vapor Savings Unloading Tank Cars

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Liquefied petroleum gas may be transferred mechanically in either of two ways: with a liquid pump or with a vapor compressor. The pump will move liquid only, and will not remove the vapor content from a tank. The compressor will remove the liquid and a large part of the vapor content from a tank, but will not develop the high pressures required for the fast filling of small tanks. Therefore, in many plants, both a pump and a compressor are required.

In a bulk plant where a great many tank cars are unloaded, the matter of saving the vapor content in tanks being unloaded into storage is important, as otherwise the vapor left in the car goes back to the supplier when the car is returned. Some LPG suppliers attempt to make a credit allowance for vapor returned in cars, but since it is difficult, if not impossible, to make an accurate allowance, many suppliers make none. If a large number of tank cars are unloaded, and if the supplier allows little or no credit for the vapor content, a dealer should look into the possibility of installing a compressor whenever it can be shown that the compressor unit will pay for itself by the savings accrued from the vapor unloaded.

A good compressor cannot unload liquid from tank cars any faster than a good pump of equal capacity. The problem of whether to use a compressor thus boils down to the economics in vapor saving, and the purpose of this article is to offer tables that will enable those who must consider this problem to get a reasonably accurate estimate of the amount of savings they can expect to receive by installing a compressor.

A natural mistake that is frequently made in estimating the savings of vapor recovered, is to assume that *all* the vapor can be drawn from the tank by the compressor. This is a misleading assumption, as drawing all of the vapor from a tank requires that it be pulled down to a perfect vacuum. This is impossible to do even with the most expensive experimental laboratory-type equipment. Actually, it is agreed that there is a practical limit of pressure reduction beyond which it is not economical to operate the compressor unit. Opinions differ on just what the practical limit is, but concensus places it somewhere between 15 and 40 lb.

The series of four tables presented herewith show savings which may be accomplished in four cases. Table I indicates the savings if gauge pressures are reduced to 45 psig; Table II shows savings at 30 psig; Table III lists the values for 15 psig; Table IV is for O psig. As an illustration of how these tables are to be used, suppose propane is being handled at a temperature of 60° F, and the compressor is to be shut off when a gauge pressure of 45 psig has been reached. Check with Table I. Note a saving of 582 lb or 137 gal. The table helps further by figuring the money value of this fuel. Suppose the cost is 10 cents per gal. delivered. The table shows a saving of $13.70. At 12 cents per gal. the saving would be $16.40, etc. Use the delivered cost, that is, freight included.

With single-car savings of this order, a gross savings of $1300 to $1600 per 100 cars unloaded could be expected. The expense of running the compressor would depend upon how long it takes to unload the vapor. If

TABLE I.

PRESSURE REDUCED TO 45 PSI GAGE BY COMPRESSOR
(There are no savings with Butane for any temperature, at this pressure reduction)

TYPE LIQUID AND TEMPERATURE OF CAR (°F.)	POUNDS SAVED	EQUIVALENT GALLONS AT 60° F.	MONEY VALUE OF FUEL SAVED, AT VARIOUS DELIVERED COSTS PER GALLON 4¢	6¢	8¢	10¢	12¢	14¢	16¢	18¢	20¢
PROPANE, – 40°	0	0	0	0	0	0	0	0	0	0	0
PROPANE, – 20°	0	0	0	0	0	0	0	0	0	0	0
PROPANE, 0°	0	0	0	0	0	0	0	0	0	0	0
PROPANE, 20°	0	0	0	0	0	0	0	0	0	0	0
PROPANE, 40°	242	57	2.30	3.40	4.60	5.70	6.80	8.00	9.10	10.30	11.40
PROPANE, 60°	582	137	5.50	8.20	11.00	13.70	16.40	19.20	21.90	24.70	27.40
PROPANE, 80°	1004	237	9.50	14.20	18.90	23.70	28.40	33.20	37.90	42.70	47.40
PROPANE, 100°	1534	361	14.40	21.60	28.90	36.10	43.30	50.50	57.70	64.90	72.20

TABLE II.

PRESSURE REDUCED TO 30 PSI GAGE BY COMPRESSOR
(There are no savings with Butane for temperatures lower than 100°, at this pressure reduction)

TYPE LIQUID AND TEMPERATURE OF CAR (°F.)	POUNDS SAVED	EQUIVALENT GALLONS AT 60° F.	MONEY VALUE OF FUEL SAVED, AT VARIOUS DELIVERED COSTS PER GALLON 4¢	6¢	8¢	10¢	12¢	14¢	16¢	18¢	20¢
BUTANE, 1000	103	22	0.90	1.30	1.80	2.20	2.60	3.10	3.50	4.00	4.40
PROPANE, – 40°	0	0	0	0	0	0	0	0	0	0	0
PROPANE, – 20°	0	0	0	0	0	0	0	0	0	0	0
PROPANE, 0°	0	0	0	0	0	0	0	0	0	0	0
PROPANE, 20°	132	31	1.20	1.90	2.50	3.10	3.70	4.30	5.00	5.60	6.20
PROPANE, 40°	412	97	3.90	5.80	7.80	9.70	11.60	13.60	15.50	17.50	19.40
PROPANE, 60°	769	181	7.20	10.90	14.50	18.10	21.70	25.40	29.00	32.60	36.20
PROPANE, 80°	1190	280	11.20	16.80	22.40	28.00	33.60	39.20	44.80	50.40	56.00
PROPANE, 100°	1715	403	16.10	24.20	32.30	40.30	48.30	56.40	57.70	64.90	72.20

TABLE III.

PRESSURE REDUCED TO 15 PSI GAGE BY COMPRESSOR
(There are no savings with Butane for temperatures lower than 80°, at this pressure reduction)

TYPE LIQUID AND TEMPERATURE OF CAR (°F.)	POUNDS SAVED	EQUIVALENT GALLONS AT 60° F.	MONEY VALUE OF FUEL SAVED, AT VARIOUS DELIVERED COSTS PER GALLON 4¢	6¢	8¢	10¢	12¢	14¢	16¢	18¢	20¢
BUTANE, 80°	107	23	0,90	1.40	1.80	2.30	2.80	3.20	3.70	4.10	4.60
BUTANE, 100°	336	72	2.90	4.30	5.80	7.20	8.60	10.10	11.50	13.00	14.40
PROPANE, – 40°	0	0	0	0	0	0	0	0	0	0	0
PROPANE, – 20°	0	0	0	0	0	0	0	0	0	0	0
PROPANE, 0°	106	25	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00
PROPANE, 20°	323	76	3.00	4.60	6.10	7.60	9.10	10.60	12.20	13.70	15.20
PROPANE, 40°	603	142	5.70	8.50	11.40	14.20	15.60	19.90	22.70	25.60	28.40
PROPANE, 60°	960	225	9.00	13.50	18.00	22.50	27.00	31.50	36.00	40.50	45.00
PROPANE, 80°	1380	324	13.00	19.40	25.90	32.40	38.90	45.30	51.80	58.30	64.80
PROPANE, 100°	1900	447	17.90	26.80	35.70	44.70	53.60	62.50	71.40	80.30	89.20

TABLE IV.

PRESSURE REDUCED TO 0 PSI GAGE BY COMPRESSOR
(There are no savings with Butane for temperatures lower than 60°, at this pressure reduction)

TYPE LIQUID AND TEMPERATURE OF CAR (°F.)	POUNDS SAVED	EQUIVALENT GALLONS AT 60° F.	MONEY VALUE OF FUEL SAVED, AT VARIOUS DELIVERED COSTS PER GALLON 4¢	6¢	8¢	10¢	12¢	14¢	16¢	18¢	20¢
BUTANE, 60°	164	35	1.40	2.10	2.80	3.50	4.20	4.90	5.60	6.30	7.00
BUTANE, 80°	313	67	2.70	4.00	5.40	6.70	8.00	9.40	10.70	12.10	13.40
BUTANE, 100°	668	143	5.70	8.60	11.40	14.30	17.20	20.00	22.90	25.80	28.60
PROPANE, - 40°	17	4	0.20	0.20	0.30	0.40	0.50	0.60	0.60	0.70	0.80
PROPANE, - 20°	136	32	1.30	1.90	2.60	3.20	3.80	4.50	5.10	5.80	6.40
PROPANE, 0°	297	70	2.80	4.20	5.60	7.00	8.40	9.80	11.20	12.60	14.00
PROPANE, 20°	515	121	4.80	7.30	9.70	12.10	14.50	16.90	19.40	21.80	24.20
PROPANE, 40°	790	186	7.40	11.10	14.90	18.60	22.30	26.00	29.80	33.50	37.20
PROPANE, 60°	1139	268	10.70	16.10	21.40	26.80	32.20	37.50	42.80	48.20	53.60
PROPANE, 80°	1555	366	14.60	22.00	29.30	36.60	43.90	51.20	58.60	65.80	73.20
PROPANE 100°	2080	489	19.60	29.40	39.10	48.90	58.70	68.50	78.30	88.10	97.80

it takes two hours to do this, about $1 could be figured for the electricity and $6 for the operator's time per load. Compressor depreciation, maintenance, oil, etc., should also be allowed for, perhaps at a rate of $2 to $4 per load, depending upon the make and model. Thus, while there is a gross savings of $1300 to $1600, there is an extra expense of $900 to $1100 on a 100-car basis. A net saving of only $200 to $700 results. Whether this would eventually pay for the compressor and its installation requires examination and study.

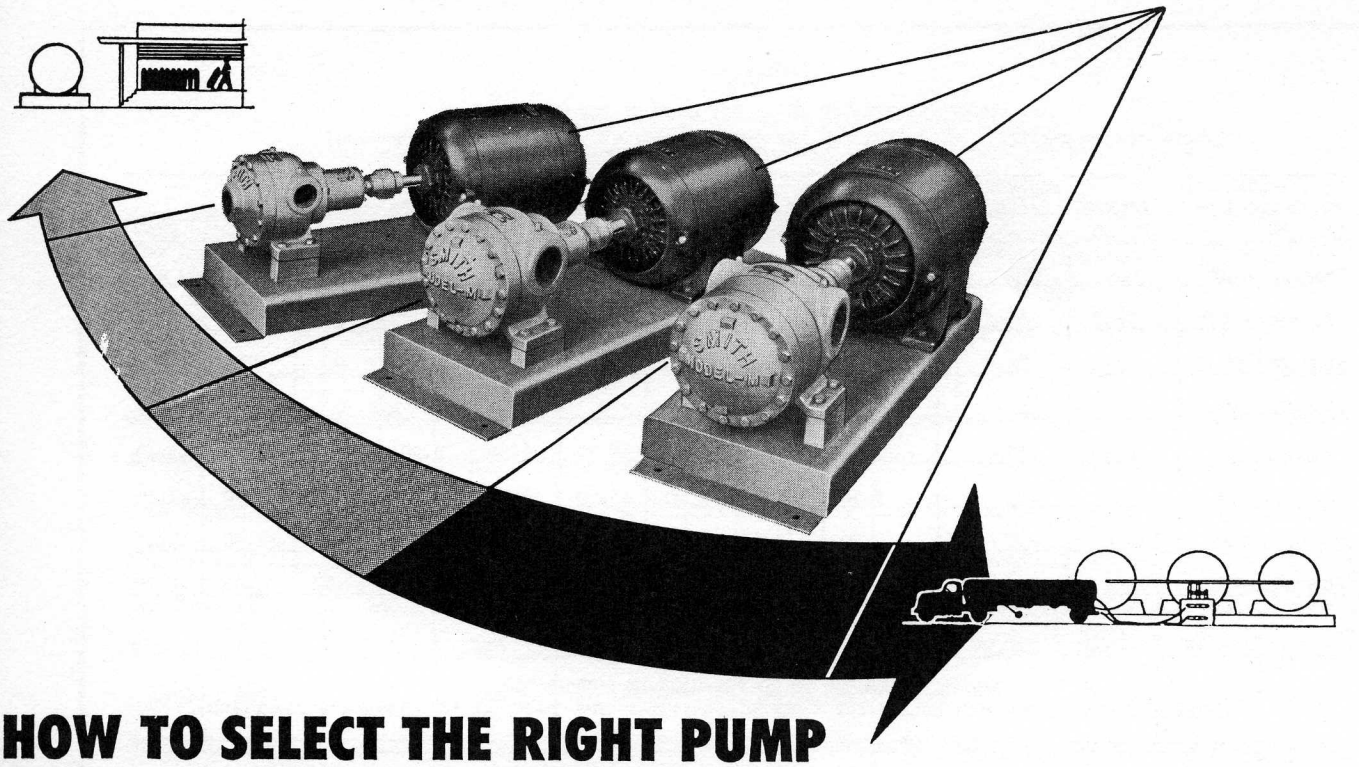
What would happen if it were decided to run the compressor until the pressure in the car was down to 30 psig? Reference to Table II shows that 769 lb or 181 gal. would be saved, having a total value of $18.10 at 10 cents per gal. Thus, an increased saving of $4.40 results. Would this extra operation pay? To determine this, it would be necessary to know how long it takes for the compressor to reduce pressure from 45 to 30 psig, and to see if the compressor power and upkeep costs, together with the time of the unloading man, were worth less than $4.40 for this period. The length of time involved would be determined best by trial after the compressor had been installed. New, large-capacity units in good condition can do this job in a matter of minutes. A worn unit could take an hour. In a long period of time like this, the extra pressure reduction could not be justified. Further reference to the other tables (III and IV) will show an additional saving of $4.40 if pressure is reduced to 15 psig, and an additional $4.30 if pressure can be lowered to 0 psig. The advisability of these extra running periods could also be determined by trial.

Always keep in mind that in these examples we are considering particularly straight propane at a temperature of 60° F, and at a cost of 10 cents per gal. delivered. This is only one of a great many possibilities covered by each table. Try working out other examples for other temperatures common in your operations, at the price you pay. Lower temperatures with propane mean greatly reduced savings. In many parts of the country, it actually *costs* money to operate a compressor in the winter months, when, unfortunately, the load is usually greatest. With butane, it never pays to operate a compressor, except at unusually high summer temperatures. On the other hand, warm areas of our country, such as the Southwest, definitely make for profitable compressor operation in locations where the cost of fuel is comparatively high. ■

Footnote to Tables

These tables have been calculated from the figures in Handbook Butane-Propane Gases, third edition, pages 26 and 27, following the assumption that LPG vapors behave as perfect gases. Heat transfer has not been taken into account. This can act in different ways, and is impossible to calculate, due to the time function and other variables involved. We are also aware that LPG vapors do not behave as perfect gases. However, these tables are as accurate as is necessary for good estimating, and are more comprehensive than most that have been available heretofore. We also believe that the values given are no more inaccurate than the usual inaccuracies present in measuring pressures and temperatures with the type of gauging equipment available at the average bulk plant.

We would like to point out that for ease in conversion of the figures, the tables are calculated for 10,000 water-gallon tanks. If cars having 11,000 water-gallon tanks are received, multiply all figures by 1.1. For 12,000 water-gallon tanks, multiply by 1.2, etc.



HOW TO SELECT THE RIGHT PUMP

FOR *Your* BULK PLANT SERVICE

The size of pump to select for your bulk plant will depend upon the amount of pumping to be done, the types of services to be handled, and the importance of speed in transferring. It is also necessary to consider the limitation to be placed on expenditures, as installation and operating costs are much higher for large pumps than for smaller models.

For small bulk plants, the 35 GPM Model MC-1044H pump is a good choice. When properly installed, it will transfer into storage and load delivery trucks at about 2000 gallons per hour. It will fill up to 4 cylinders on a manifold in from 3 to 5 minutes.

For the average bulk plant, the 50 GPM Model MC-2 pump will transfer into storage and load delivery trucks at about 3000 gallons per hour. It will fill up to 6 cylinders on a manifold in from 3 to 5 minutes.

Where very fast transfer into storage is required, and sufficient output to load two delivery trucks at the same time is desired, the 100 GPM Model MC-3 should be specified. When properly installed with 3″ piping and valves, this pump will deliver about 6000 gallons per hour. The MC-3 has too large an output to be economical in cylinder filling service unless about 12 cylinders are filled simultaneously on a manifold.

Smith Precision Pumps cover a range of capacities from 4 to 150 GPM. There are six sizes of pumps for direct connection to electric motor drive at 1800 RPM, and four sizes for truck mounting, to be operated at the lower speeds of 500 or 900 RPM. Write to us for further details, and for installation suggestions.

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