

## HEATING AND CIRCULATING OF VENTED VESSELS BY DIRECT STEAM INJECTION

ELMRIDGE 'SE Series' Gas-Jet Steam Spargers are used for heating liquids where steam can be directly injected into vented vessels and tanks. The venturi design of these Steam Spargers provides superior injection performance due to the capability of the Sparger to aggressively circulate tank contents, reducing or eliminating thermal gradients. ELMRIDGE 'SE Series' Gas-Jet Steam Spargers operate on the same basis as our standard line of steam-powered Jet-Apparatus, whereby steam emerges from the Sparger nozzle at high velocity, creating a zone of lower pressure. Tank contents are drawn to this lower pressure zone, where the momentum of the steam is transferred to the liquid, causing the liquid to be 'pumped' as well as heated. Operating characteristics (Sat. Steam / Water), for standard models are shown below, and special units are also available to meet your specifications. Standard materials of construction are Cast Iron, 316 Stainless Steel, Alloy 20, and Hastelloy C®. Other materials are available upon request. Threaded, flanged, or socket weld connections (except Cast Iron).



**Nozzle Steam Capacities (lb/hr) and Time (secX100) Required to Raise the Temperature of One Gallon of water by One Degree F for SE Series Gas-Jet Steam Spargers**

**Table 1**

Model Number		Operating Steam Pressure (psig)							
		20	30	40	60	80	100	120	150
SE10	Steam Flow	136	171	210	285	355	428	500	605
	Time (secX100)	22.05	17.54	14.28	10.52	8.45	7.01	6.00	4.96
SE20	Steam Flow	212	265	326	442	550	665	776	940
	Time (secX100)	14.15	11.32	9.20	6.78	5.45	4.51	3.86	3.19
SE30	Steam Flow	352	440	542	736	915	1105	1290	1560
	Time (secX100)	8.52	6.82	5.53	4.07	3.28	2.71	2.32	1.92
SE40	Steam Flow	590	737	907	1230	1535	1850	2160	2610
	Time (secX100)	5.08	4.07	3.31	2.44	1.95	1.62	1.39	1.15
SE50	Steam Flow	896	1120	1380	1875	2330	2820	3280	3980
	Time (secX100)	3.35	2.68	2.17	1.60	1.29	1.06	0.91	0.75
SE60	Steam Flow	1975	2540	3110	4230	5370	6500	7610	9320
	Time (secX100)	1.52	1.18	0.96	0.71	0.56	0.46	0.39	0.32
SE70	Steam Flow	4390	5487	6750	9152	11388	13769	16067	19463
	Time (secX100)	0.68	0.55	0.44	0.33	0.26	0.22	0.19	0.15
SE80	Steam Flow	8962	11202	13780	18683	23248	28109	32801	39733
	Time (secX100)	0.33	0.27	0.22	0.16	0.13	0.11	0.09	0.08
SE90	Steam Flow	16132	20164	24804	33629	41846	50596	59042	71519
	Time (secX100)	0.19	0.15	0.12	0.09	0.07	0.06	0.05	0.04

**HEATING**

- 1 US Gallon of Water = 8.33 lb
- 1 Imperial Gallon of Water = 10 lb
- 1 cubic Foot of Water = 62.4 lb
- 1 Litre of Water = 2.20 lb

$$\text{Steam Required (lb/hr)} = \frac{\text{Temp. Increase of Water (Deg. F)} \times \text{Weight of Water (lbs)}}{\text{Time Allowed to Heat Tank (hrs)} \times 1000}$$

## APPLICATION EXAMPLE

It is required that a 20,000 US gallon process water storage tank be brought up to temperature at the start-up of plant operations. The heating operation must be completed within a 30 minute time frame. Initially, the water in the tank is at ambient temperature - approximately 70 Deg. F. The required process start-up temperature is 110 Deg. F. Steam is available at 45 psig. The water level in the storage tank is maintained at a depth of approximately 12 feet.

$$\begin{aligned} \text{Steam Required} &= \frac{(110 - 70) \times (20,000 \times 8.33)}{(30 / 60) \times 1000} \\ (\text{lb/hr}) &= 13,328 \text{ lb/hr} \end{aligned}$$

The 12 foot liquid depth in the tank is equivalent to a discharge pressure of:  $\frac{12}{2.308} = 5.2 \text{ psi}$

The differential pressure upon which the Steam Sparger sizing should be based is therefore:  $45 - 5.2 = 39.8 \text{ psi}$

It is typically suggested that a larger quantity of moderate capacity Steam Spargers be used, as opposed to fewer higher capacity Spargers. In most applications, the amplitude of any vibration caused by the steam collapsing is less for smaller Steam Spargers. [Your local ELMRIDGE Technical Representative or one of our Engineers will be happy to help you].

For the present example, we need to provide approximately 13,328 lb/hr of steam at approximately 40 psi (differential). From Table SE-1 on the previous page, we can use a variety of Spargers:

$$\begin{aligned} \text{Model SE40} & \quad \frac{13,328}{907} = 14.7 \text{ (15 Spargers)} \\ \text{Model SE50} & \quad \frac{13,328}{1380} = 9.7 \text{ (10 Spargers)} \\ \text{Model SE60} & \quad \frac{13,328}{3110} = 4.3 \text{ (5 Spargers)} \end{aligned}$$

Depending on the actual tank dimensions and any other defining criteria, it may be decided that (10) ELMRIDGE Model SE50 Gas-Jet Steam Spargers are appropriate.

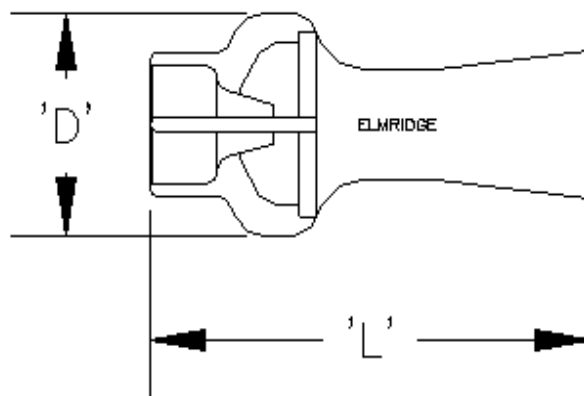
**Table 2** Dimensions

Model Number	Pressure Connection	D (inches)	L (inches)
SE10M	3/8" Male*	1-3/4"	4-1/2"
SE20M	3/4" Male*	2-3/8"	6-3/4"
SE30M	1" Male*	2-7/8"	7-5/8"
SE40M	1-1/2" Male*	4-5/8"	9-7/8"
SE40	1-1/2" Female*	3-3/4"	9-1/2"
SE50	2" **	5-5/8"	12-1/4"
SE60	3" **	8-1/2"	17-5/8"
SE70	4" **	12-1/2"	26-1/4"
SE80	6" ***	17-14"	36-1/2"
SE90	8" ***	22"	48-5/8"

\* NPT or BSPT

\*\* NPT or BSPT Female or 150 # ANSI FF Flange

\*\*\* 150 # ANSI FF Flange only



**HEATING**