

## 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).



**Table SE-1** 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

| 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  |

**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:

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

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.

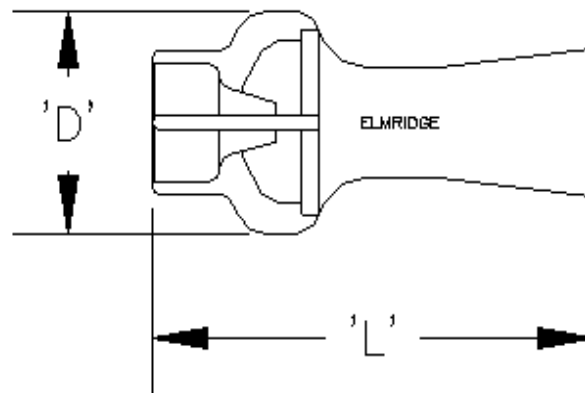
**Table SE-2**

### 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"    |

\*NPT or BSPT

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



**HEATING**