

**KOMAX** SYSTEMS·INC

MIXING BY DESIGN

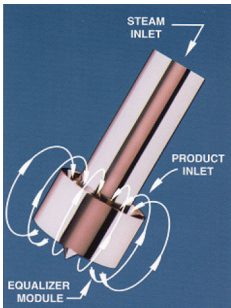


**SCEPTER™ TANK STEAM HEATER**

## THE **KOMAX SCEPTER™** SERIES OF TANK STEAM HEATERS

### **What Do They Do?**

This versatile series of heaters is designed for the direct injection of steam into tanks for heating water-compatible products in a quiet, vibration-free, and 100% efficient fashion. In addition, they develop a strong stirring action to help keep any solids or particulates in suspension. This stirring action also produces a uniform temperature throughout the tank volume allowing accurate thermostatic control.



### **How Are They Built?**

Constructed of type 316 stainless steel, the standard SCEPTER™ heaters are available in one inch through ten inch pipe sizes. They can be mounted in a tank from above, below, or with a sideport configuration. They are available with threaded pipe connections for the steam from one inch through three inch pipe sizes. 150lb RFSO flanged connections are available on all sizes.

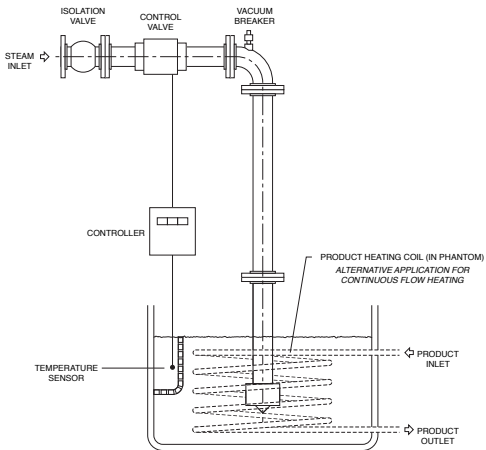
### **How Do They Work?**

Each unit uses the well-known Komax EQUALIZER™ module. The product in the tank enters the EQUALIZER™ module around the periphery of the steam inlet pipe and is captured by the steam momentum. Product and steam are divided and pre-mixed by elements in each of the EQUALIZER™ holes. A set of multiple impingement mixing zones is developed at the module exit, which completes the contacting of steam and product without shock or vibration. No auxiliary air supply is required.



STEAM/WATER IMPINGEMENT  
REGIONS MARKED THUS -||-

## TYPICAL INSTALLATION



### NUMBERING SYSTEM

Standard units in type 316 stainless steel are numbered as follows:

**SC-03-F-024**

- Overall length in inches
- 150 lb RFSO flange. Use T for NPS-threaded connection
- NPS pipe size - 3" shown
- SCEPTER™ series identifier

Special part numbers for non-standard units are issued by the factory.

## TANK HEATING DESIGN CALCULATIONS

We wish to heat an open tank with a Scepter heater. What size Scepter shall we use?  
The sizing choice requires two assumptions.

- 1) The typical velocity of steam in the Scepter steam inlet pipe will lie in the range of 50 to 400 ft/second.
- 2) The effective pressure seen by the steam exiting the Scepter steam pipe is made up of the sum of the atmospheric pressure, the pressure drop through the Scepter, and pressure due to the immersion depth of the Scepter below the liquid surface. A typical effective total value is  $14.7 + 1.3 + 4.0 = 20_{EF}$  psia. Steam tables tell us that at this pressure the enthalpy of saturated steam  $V_g = 1156$  BTU/lb.

Let volume of tank =  $V$  gallons

Velocity of steam =  $v$  ft/sec.

Steam pipe I.D. =  $D$  inches

Total mass of steam required =  $M$

Rise in temp. =  $\Delta T$  °F

Heating time =  $H$  hours

Total BTU required =  $V \times 8.3 \times \Delta T = M \times 1156$  so  $M = 0.0072V \Delta T$

Steam velocity  $v = 22.6 \times 0.0072V \Delta T / 20_{EF} D^2$

Rearranging gives  $D = (0.0081 \times V \times \Delta T / H \times v)^{0.5}$  inches

In this expression for the steam velocity we use an approximation for the specific volume of the steam equal to  $444/P_A$  where  $P_A$  = absolute steam pressure.

*Example:*

$V = 500$  gallons,  $\Delta T = 50^\circ\text{F}$ ,  $H = 0.25$  hr,  $v = 150$  ft/sec

$D = (0.0081 \times 500 \times 50 / 0.25 \times 150)^{0.5} = 2.32"$

A 2.0" dia. steam pipe would be appropriate. It would give us a steam velocity of:

$22.6 \times .0072 \times 500 \times 50 / .25 \times 2.0^2 = 203$  ft/sec which is acceptable.

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