### RCB-4.56 TUBE BUNDLE VIBRATION

Shell side flow may produce excitation forces which result in destructive tube vibrations. Existing predictive correlations are inadequate to insure that any given design will be free of such damage. The vulnerability of an exchanger to flow induced vibration depends on the flow rate, tube and baffle materials, unsupported tube spans, tube field layout, shell diameter, and inlet/outlet configuration. Section 6 of these Standards contains information which is intended to alert the designer to potential vibration problems. In any case, and consistent with Paragraph G-5, the manufacturer is not responsible or liable for any direct, indirect, or consequential damages resulting from vibration.

## RCB-4.6 IMPINGEMENT BAFFLES AND EROSION PROTECTION

The following paragraphs provide limitations to prevent or minimize erosion of tube bundle components at the entrance and exit areas. These limitations have no correlation to tube vibration and the designer should refer to Section 6 for information regarding this phenomenon.

### RCB-4.61 SHELL SIDE IMPINGEMENT PROTECTION REQUIREMENTS

An impingement plate, or other means to protect the tube bundle against impinging fluids, shall be provided when entrance line values of $\rho V^2$ exceed the following: non-abrasive, single phase fluids, 1500 (2232); all other liquids, including a liquid at its boiling point, 500 (744). For all other gases and vapors, including all nominally saturated vapors, and for liquid vapor mixtures, impingement protection is required. $V$ is the linear velocity of the fluid in feet per second (meters per second) and $\rho$ is its density in pounds per cubic foot (kilograms per cubic meter). A properly designed diffuser may be used to reduce line velocities at shell entrance.

### *RCB-4.62 SHELL OR BUNDLE ENTRANCE AND EXIT AREAS

In no case shall the shell or bundle entrance or exit area produce a value of $\rho V^2$ in excess of 4,000 (5953) where $V$ is the linear velocity of the fluid in feet per second (meters per second) and $\rho$ is its density in pounds per cubic foot (kilograms per cubic meter).

#### *RCB-4.621 SHELL ENTRANCE OR EXIT AREA WITH IMPINGEMENT PLATE

When an impingement plate is provided, the flow area shall be considered the unrestricted area between the inside diameter of the shell at the nozzle and the face of the impingement plate.

#### *RCB-4.622 SHELL ENTRANCE OR EXIT AREA WITHOUT IMPINGEMENT PLATE

For determining the area available for flow at the entrance or exit of the shell where there is no impingement plate, the flow area between the tubes within the projection of the nozzle bore and the actual unrestricted radial flow area from under the nozzle or dome measured between the tube bundle and shell inside diameter may be considered.

#### *RCB-4.623 BUNDLE ENTRANCE OR EXIT AREA WITH IMPINGEMENT PLATE

When an impingement plate is provided under a nozzle, the flow area shall be the unrestricted area between the tubes within the compartments between baffles and/or tubesheet.

#### *RCB-4.624 BUNDLE ENTRANCE OR EXIT AREA WITHOUT IMPINGEMENT PLATE

For determining the area available for flow at the entrance or exit of the tube bundle where there is no impingement plate, the flow area between the tubes within the compartments between baffles and/or tubesheet may be considered.

### RCB-4.63 TUBE SIDE

Consideration shall be given to the need for special devices to prevent erosion of the tube ends under the following conditions:

(1) Use of an axial inlet nozzle.

(2) Liquid $\rho V^2$ is in excess of 6000 (8928), where $V$ is the linear velocity in feet per second (meter per second), and $\rho$ is its density in pounds per cubic foot (kilograms per cubic meter).

  