1. Titanium-aluminum alloy thermal conductivity

To calculate the thermal conductivity of these aluminum-titanium alloys, you can use Wiedmann-Franz law:

$$k_{\mathrm{el}} = \frac{\pi^2}{3}\left(\frac{k_B}{e}\right)^2 \sigma_e T$$

where $k_e l$ is the electrical component of the thermal conductivity, k_B and e are Boltzmann's constant and the electron charge, σ_e is the electrical conductivity and T the temperature. The constant $\frac{\pi^2}{3}\left(\frac{k_B}{e}\right)^2$ is written as L and equal to $2.45 \times 10^{-8} \frac{\mathrm{Wohm}}{\mathrm{K}^2}$.

On pages 197-198 of Poirier and Geiger,[1] there is another equation specific to titanium-aluminum alloys:

$$k = AL\sigma_e T + B$$

where A and B are experimentally-fitted constants, equal to 0.997 and $2.7 \frac{\mathrm{W}}{\mathrm{m \cdot K}}$ respectively. Because this applies to alpha and alpha+beta titanium alloys, and aluminum is an alpha stabilizer, it's a good bet this works for these alloys. (You weren't required to find this value in that text, this just illustrates that the experimentally-fitted A and B constants give close to the same answer as the plain Wiedmann-Franz law.)

Al content, a/o	ρ_e, $\mu\mathrm{ohm \cdot cm} (= 10^{-8} \mathrm{ohm \cdot m})$	$L\sigma_e T$, $\frac{\mathrm{W}}{\mathrm{m \cdot K}}$	$AL\sigma_e T + B$, $\frac{\mathrm{W}}{\mathrm{m \cdot K}}$
0	112	17.5	20.1
3	140	14.0	16.7
6	165	11.9	14.6
11	190	10.3	13.0
33	210	9.3	12.0

It's worth noting how much the electrical resistivity rises, and the thermal conductivity falls, when aluminum is added, even for a low-conductivity metal like titanium. Copper and aluminum are even more sensitive to the presence of foreign elements, which is why people go to great lengths to purify those elements for electrical and thermal applications requiring high conductivity.

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[1] D.R. Poirer and G.H.Geiger, *Transport Phenomena in Materials Processing,* TMS, Pittsburgh, 1994.