

PROOF OF FORMULA 3.524.17

$$\int_0^{\infty} x^3 \frac{\cosh ax}{\sinh bx} dx = 2 \left(\frac{\pi}{2b} \sec \frac{\pi a}{2b} \right)^4 \left(1 + 2 \sin^2 \frac{\pi a}{2b} \right)$$

Entry 3.524.8 states that

$$\int_0^{\infty} x^3 \frac{\cosh ax}{\sinh bx} dx = \frac{\pi}{2b} \left(\frac{d}{da} \right)^3 \tan \frac{\pi a}{2b}.$$

The result comes from performing the differentiation.