6.56. Model: We will model the container as a particle of mass m. The steel cable of the crane will be assumed to have zero mass.

Visualize:

Pictorial representation

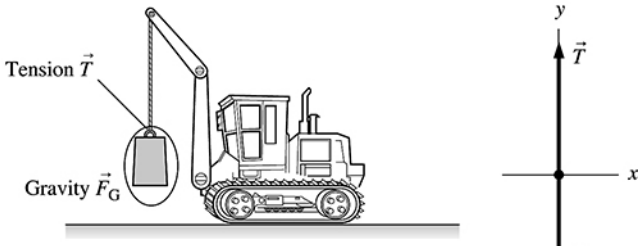
Known

$m = 4500$ kg

$T_{max} = 50{,}000$ N

$v_{max} = 3.0$ m/s

$a_{max} = 1.0$ m/s^2



Solve: As long as the container is stationary or it is moving with a constant speed (zero acceleration), the net force on the container is zero. In these cases, the tension in the cable is equal to the gravitational force on the container:

$$T = mg = 44{,}000 \text{ N}$$

The cable should safely lift the load. More tension is required to accelerate the load. Newton's second law is

$$(F_{net})_y = \Sigma F_y = (F_G)_y + (T)_y = -mg + T = ma_y$$

The crane's maximum acceleration is $a_{max} = 1.0$ m/s^2. So the maximum cable tension is

$$T_{max} = mg + ma_{max} = 48{,}600 \text{ N}$$

This is less than the cable's rating, so the cable must have been defective.