The following paper explains the key steps for selecting a voice coil motor, its associated power electronics and power supply.

1) Force Calculation

Force is equal to Mass times Acceleration;

$F = m^* a$

Acceleration is the second derivative of the position.

Assuming a sinusoidal type of motion with the amplitude of X, in meter, and frequency of f in Hz,

$x(t) = X \sin(\omega * t)$

$\omega = 2 * \Pi * f$

The equation for velocity is;

$v(t) = X^* \omega \cos(\omega * t)$

The equation for acceleration is;

$a(t) = - X^* \omega^2 * \sin(\omega * t)$

Then, force, in Newton, is

$F = - X^* m^* \omega^2 * \sin(\omega * t)$ where m is the moving mass in Kg.

$F_{peak} = m^* X^* \omega^2$

$F_{rms} = 0.7 * m^* X^* \omega^2$

$F_{rms} = 0.7 * m^* X^* (2 * \Pi * f)^2$

$F_{rms} = 27.6 * m^* X^* f^2$

The above equation shows the required force to move a mass of m, in Kg, for a distance of X in, meter, at a frequency of f in Hz.

Example;

Let m = 0.1 Kg, X = 0.01 m and f = 10 Hz.

The required force to move this mass is equal to;

$F = 27.6 * 0.1 * 0.01 * 100$

F = 2.76 Newton

If the motion is not sinusoidal, the value for the acceleration is the slope of the velocity. For example, if the velocity profile is trapezoidal,

acceleration = maximum velocity / ramping period

2) Voice Coil Motor Selection

The voice coil motor should be able to generate the required force. The voice coil motor manufacturers specify the continuous force of the motor. This is the force that motor generates at 100% duty cycle. If the required force is not required at all times, a smaller motor may be selected. Care must be taken that the average power dissipation by the motor does not exceed the motor rating.

3) Power Consumption by the Motor

Current through the Motor = Force / Force Constant

$I = F / K_f$

Power Consumed by the Motor = Resistance of the Motor. (Current through the Motor)^2

$P = R * I^2$

4) Power Supply Selection

Minimum Voltage of the Power Supply = Resistance of the Motor. Current through the Motor + Velocity * Back EMF Constant of the Motor

$V_{ps} = R * I + K_e * \text{Velocity}$

In MKS system K_e in Volt / meter / second is numerically equal to K_f in N / Amp.

Please note that the required voltage due to the inductance of the motor is not considered in the above equation.