

1.) Given:

Room 1: 30' x 20' x 10',
concrete floor,
painted concrete block walls,
plaster ceiling,
with a machine making noise which is measured at 90 dB.

What would be the sound intensity level if we added plain carpet to the floor and acoustical tile to the ceiling?

$$NR = 10 \log(a_2/a_1)$$

NR is noise reduction, measured in dB,

a_1 is the original total absorption, in sabins,

a_2 is the resultant absorption after modification, in sabins.

$$a_2 = 30' * 20' * 0.30_{\text{floor}} + 30' * 20' * 0.95_{\text{ceiling}} + (20' * 10' * 2 + 30' * 10' * 2) * 0.05_{\text{wall}}$$
$$= 800 \text{ sabins}$$

$$a_1 = 30' * 20' * 0.00_{\text{floor}} + 30' * 20' * 0.05_{\text{ceiling}} + (20' * 10' * 2 + 30' * 10' * 2) * 0.05_{\text{wall}}$$
$$= 80 \text{ sabins}$$

$$NR = 10 \log (800/80) = 10 \text{ dB}$$

$$IL_{\text{new}} = IL_1 - NR = 90 - 10 = 80 \text{ dB}$$

2.) Would that be a big qualitative difference, and/or would the machine operators still be extremely uncomfortable?

It is significant, but the result certainly isn't silence. The operators could probably endure this sound intensity, but they would impair their hearing over an extended period of time. (The OSHA maximum is <80 dB.)