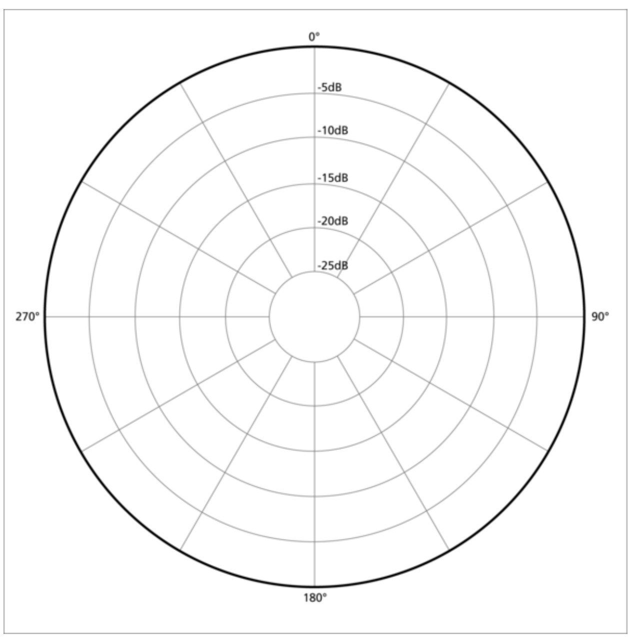
If the overall gain of this mic-amp-loudspeaker feedback loop is $G_{tot} > 1$ <u>and</u> the phase of the mic signal is such that it constructively adds to this feedback process, then acoustic feedback will occur. The electrical gain of the sound system G_{el} must be greater than the acoustical pressure loss $G_{ac} \sim 1/r$ between the loudspeaker and the {pressure} microphone, since $G_{tot} = G_{el} \cdot G_{ac} > 1$ for acoustic feedback to occur.

If the overall gain is just below 1, on the verge of oscillation at one or more frequencies, acoustic feedback can still cause speech/music to sound tinny/weird due to long decay times at those frequencies.

In most auditoriums, acoustic feedback limits the amount of gain that can be obtained from an amplifying sound system. Microphones will always be in the reverberant sound field (since it is uniform throughout the room), and often times mics receive a fairly large amount of direct sound from loudspeakers in the room. Greater sound levels can be tolerated without acoustic feedback by turning down the amplifier gain, but then, the sensitivity to the desired sound will be decreased as well.

Useful gain without acoustic feedback can be achieved by using microphones of high directivity - e.g. cardioid, super- or hyper-cardioid microphones – as opposed to omni-directional microphones, and placing them as far away from the loudspeakers as possible. Polar patterns for four different types of microphones are shown in the figures below:

Omnidirectional Microphone:



Cardioid Microphone: