

Copper Alloys in Music

Pure copper has exceptionally high thermal and electrical conductivity; it is easily cut, bent and formed, but it is too soft for many uses. Alloying copper with other metals provides many of the most important alloys that are used today. The best known alloys are brass and bronze, which have been used for thousands of years.

Bronze in Music

You may have heard of the brass section in an orchestra, which includes trumpets, horns and trombones. Brass is an alloy of copper and zinc. There is effectively a 'bronze section' too, since bronze is widely used in percussion.

Bronze is an alloy of copper and tin used for making bells, cymbals and gongs. This type of bronze is called 'bell metal'. Other bronzes are used in piano and guitar strings.

Bronze cymbals

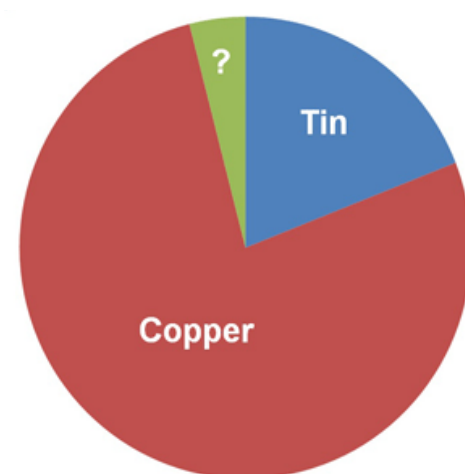
The best cymbals are cast from bronze, then rolled, pressed into shape and hammered to create unique sound quality. One of the most famous cymbal makers was Avedis Zildjian, who made cymbals in the early seventeenth century in Constantinople. The Zildjian company is now based in the USA and is one of the oldest private companies in history. [Click here](#) for a link to the video [How it's Made: Cymbals](#).



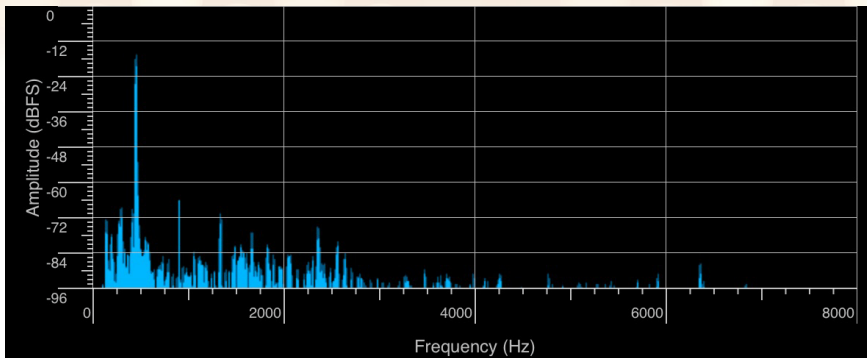
This is an oscilloscope trace from an iPhone app. It shows loudness against time. Pure frequencies produce smooth lines. This is a human voice singing a note.



Cymbals for drum kits are thin and light to make the sounds that musicians want when playing with sticks. (Courtesy of Zildjian.)



The bronze used to make cymbals is 80% copper, just under 20% tin and a few percent of other metals (silver, gold or phosphorous). Cymbal makers keep the alloy mix secret.



This is a frequency spectrum for a musical instrument. You can see a main peak at 500 Hz, but there are other peaks (called harmonics). This graph is from an iPhone app called *Spectrum View +* by Oxford Wave Research.

Did you know?

The Zildjian cymbal-making company was founded in Constantinople in 1623!

Avedis Zildjian I was an Armenian alchemist in the city of Constantinople in the early seventeenth century. While attempting to create gold by combining base metals, he discovered an alloy of copper, tin, and traces of silver that had unique sound qualities.

In 1618, Avedis used his secret alloy to create cymbals of spectacular clarity and power. The sound of the instruments was so extraordinary that the Sultan invited Avedis to live at court (Topkapi Palace) to make cymbals for the Sultan's elite Janissary Bands.

As Avedis' reputation grew, the Sultan gave him the name 'Zildjian' in Armenian (Zilciyan in Turkish), a word meaning 'son of cymbal maker.'



Orchestral cymbals are heavier than those in drum kits for clashing together. This is Cynthia Yeh, Principal Percussionist with the Chicago Symphony Orchestra. (Courtesy of Todd Rosenberg.)



Bronze bells cast in the Whitechapel Foundry in London. The classic bell shape produces sound with a narrow range of frequencies. (Courtesy of Whitechapel Foundry.)

Did You Know?

The Whitechapel Foundry also made Big Ben. The bell cracked because the hammer was too large, and it is still cracked today. A smaller hammer is now used to strike the bell in a different place.

Questions and Activities

- 1. Most instruments produce notes that have recognisable pitch or frequency. Is this true for bells? What about for cymbals?**
- 2. There are free oscilloscope apps for phones and tablets that use the devices' built-in microphone to analyse sounds and display a trace. Use an app to compare the oscilloscope traces of instruments including a cymbal and a bell.**
- 3. There are also low-cost apps that turn your device into a frequency spectrum analyser. Compare the sounds made by a triangle, bell and cymbal. Compare the number of frequencies showing as sharp peaks.**
- 4. Bronze is used to make bells as well as cymbals. Can you think of words that describe the sounds of bells and cymbals? Write them down in two columns. Make those sounds into the oscilloscope app on your phone and compare the traces.**

[Click here for answers](#)

Copper Development Association is a non-profit organisation that provides information on copper's properties and applications, its essentiality for health, quality of life and its role in technology. It supports education through a collection of resources spanning biology, chemistry and physics. These materials have been developed in conjunction with the Association for Science Education, and reviewed by teachers.

For more resources, visit www.copperalliance.org.uk/education.