



Chord Studies

374 Chords, including information on:

Triads
Sixths
Sevenths
Ninths

Chord Adjustments in Just Intonation

Intervals and their Derivations
from Equal Temperament

Compiled by Nikk Pilato

TRIADS

Triads are three-note chords that can be stacked *in thirds* (therefore, a chord such as C-F-G is not technically a triad, but rather a *trichord*). The three components of a triad are the **root**, the **third**, and the **fifth**. There are four possible combinations of triads:

- **Major** (M3 + m3, ex: C-E-G) → Can be expressed as C, CM, or CΔ
- **Minor** (m3 + M3, ex: C-E \flat -G) → Can be expressed as Cm, or C-
- **Diminished** (m3 + m3, ex: C-E \flat -G \flat) → Can be expressed C $^{\circ}$
- **Augmented** (M3 + M3m ex: C-E-G \sharp) → Can be expressed C+

SIXTH CHORDS

A sixth chord can also be interpreted as a minor seventh chord in first inversion. Whether it should be regarded as a sixth or as a minor seventh will primarily depend on its harmonic function and context within the music. In *modern music*, a sixth chord is **any** triad with an added sixth above the root.

- **Major Sixth** (major triad + a M6, ex: C-E-G-A)
- **Minor Sixth** (minor Triad + a M6, ex: C-E \flat -G-A)

There are also “special” sixth chords, such as:

- **Neapolitan Sixth**: First inversion chord of a major triad built on the flat second (ex: In C Major, this would be F-A \flat -D \flat , where D \flat would be the flat second. The F in the bass would be the first inversion). It is notated bII^6 or N^6 . Its main function is to prepare the dominant, often substituting for the IV, ii, or ii^6 chords. It is particularly common in minor keys.
- **Augmented Sixth**: Instead of a M6, these chords have an *augmented* sixth present, along with a major third. Note that the augmented sixth refers to a note above the *bass* of the chord, not the *root* of the chord. There are three possible variants:

- **Italian** (It^{+6} or It^6): $\text{b}6 + 1 + \sharp 4$ (ex: in c minor: A \flat -C-C-F \sharp . Root is doubled).
- **French** (Fr^{+6} or $\text{Fr}^{\frac{4}{3}}$): $\text{b}6 + 1 + 2 + \sharp 4$. Similar to the Italian chord, but with an added second above the root (ex: in c minor: A \flat -C-D-F \sharp).
- **German** (Gr^{+6} or $\text{Ger}^{\frac{6}{5}}$): $\text{b}6 + 1 + \text{b}3 + \sharp 4$. Similar to the Italian chord, but with an added flat third above the root (for example, in c minor: A \flat -C-E \flat -F \sharp). The chord contains the same notes as a dominant seventh chord, but functions differently in tonal music.

Triads and Sixths

| | Major | Minor | Diminished | Augmented | Major 6th | Minor 6th |
|------------|-------|-------|------------|-----------|-----------|-----------|
| C \flat | | | | | | |
| C# | | | | | | |
| D \flat | | | | | | |
| D \sharp | | | | | | |
| E \flat | | | | | | |
| E \sharp | | | | | | |
| F \flat | | | | | | |
| F# | | | | | | |
| G \flat | | | | | | |
| G \sharp | | | | | | |
| A \flat | | | | | | |
| A \sharp | | | | | | |
| B \flat | | | | | | |
| B \sharp | | | | | | |

Note: For easiest reading, some \flat and \times notes are substituted by their enharmonics.

SEVENTH CHORDS

A seventh chord is a triad with an added note. The added note can be a major, a minor, or diminished seventh above the root. There are eight possible types of *tertian* 7th chords, seven of which are in common usage (the eighth would essentially be the same as a Major Triad with a doubled root).

- **Seventh** (aka Dominant 7th): When not otherwise specified, the name "seventh chord" usually refers to a Major Triad + minor seventh.
(ex: C-E-G-B \flat) → can be expressed: Cdom⁷, C7, or C⁷.
- **Major Seventh**: A Major Triad + a Major seventh.
(ex: C-E-G-B) → can be expressed: Cmaj⁷, CM7, or C Δ ⁷.
- **Minor-Major Seventh**: A minor triad + a Major seventh.
(ex: C-E \flat -G-B) → can be expressed: Cmin^{maj7}, C Δ ⁷, C-^{M7}, or Cm^{M7}.
- **Minor Seventh**: A minor triad + a minor seventh.
(ex: C-E \flat -G-B \flat) → can be expressed: Cmin⁷, Cm⁷, C-⁷.
- **Augmented-Major Seventh**: An Augmented triad + a Major seventh.
(ex: C-E-G \sharp -B) → can be expressed: Caug^{maj7}, C+^{M7}, or CM7⁺⁵.
- **Half-Diminished Seventh**: A diminished triad + a minor seventh.
(ex: C-E \flat -G \flat -B \flat) → can be expressed: Cmin^{7dim5}, C \circ ⁷, Cmin7^{b5}, C-7^{b5}.
- **(Fully) Diminished Seventh**: A diminished triad + a diminished seventh.
(ex: C-E \flat -G \flat -B $\flat\flat$) → can be expressed: Cdim⁷, or C \circ ⁷.

The following seventh chords are not tertiary (they include the interval of a diminished or augmented third), but are used often enough to learn:

- **Augmented Seventh**: Augmented triad + a minor seventh.
(ex: C-E-G \sharp -B \flat) → can be expressed: Caug⁷, C+⁷, C7 \sharp ⁵, or C7⁺⁵.
- **Seventh Flat Five**: Essentially a dominant seventh chord, but with a flatted fifth.
(ex: C-E-G \flat -B \flat) → can be expressed: C^{7b5}, Cdom^{7dim5}.
- **Diminished Major Seventh**: A diminished triad + a Major seventh.
(ex: C-E \flat -G \flat -B) → can be expressed: Cdim^{Maj7}, or C \circ ^{7 (addMaj7)}

Seventh Chords

| | Dominant | Major | Minor Major | Minor | Augmented Major | Augmented | Half Diminished | Diminished |
|------------|----------|-------|-------------|-------|-----------------|-----------|-----------------|------------|
| C \flat | | | | | | | | |
| C \sharp | | | | | | | | |
| D \flat | | | | | | | | |
| D \flat | | | | | | | | |
| D \sharp | | | | | | | | |
| E \flat | | | | | | | | |
| E \flat | | | | | | | | |
| F \flat | | | | | | | | |
| F \sharp | | | | | | | | |
| G \flat | | | | | | | | |
| G \flat | | | | | | | | |
| G \sharp | | | | | | | | |
| A \flat | | | | | | | | |
| A \flat | | | | | | | | |
| A \sharp | | | | | | | | |
| B \flat | | | | | | | | |
| B \flat | | | | | | | | |

NINTH CHORDS

Ninth chords are built by adding the interval of a ninth to a seventh chord. A common practice is to omit the fifth when voicing ninth chords. The three most common forms of ninth chords are:

- **Ninth** (aka Dominant 9th): When not otherwise specified, the name "ninth chord" may refer to a dominant seventh + an added ninth.
(ex: C-E-G-B \flat -D) → can be expressed: Cdom⁹, C9, or C⁹
- **Major Ninth**: A major seventh chord + an added major ninth.
(ex: C-E-G-B-D) → can be expressed: Cmaj⁹, CM⁹, or C Δ ⁹
- **Minor Ninth**: A minor seventh chord + an added major ninth.
(ex. C-E \flat -G-B \flat -D) → can be expressed: Cmin⁹, Cm⁹, C-⁹.

Additionally, though much less frequent, you may find the following forms:

- **Minor-Major Ninth**: a minor-major seventh chord + an added major ninth.
(ex. C-E \flat -G-B-D) → can be expressed: Cmin^{maj9}, C-^{M9}, or Cm^{M9}.
- **Augmented-Major Ninth**: Augmented major seventh + a major ninth.
(ex. C-E-G \sharp -B-D) → can be expressed: Caug^{maj9}, or C+^{M9}.
- **Augmented Ninth**: Augmented seventh + a major ninth.
(ex. C-E-G \sharp -B \flat -D) → can be expressed: Caug⁹, C+⁹, C9 \sharp ⁵, or C9⁺⁵
- **Half-Diminished Ninth**: A half-diminished seventh + minor ninth.
(ex. C-E \flat -G \flat -B \flat -D \flat) → can be expressed: C \emptyset ^{b9}
- **Diminished Ninth**: A diminished seventh + a minor ninth.
(ex. C-E \flat -G \flat -B \flat -D \flat) → can be expressed: Cdim^{dim9}, or C^{ob9}.
- **Seventh Flat Nine**⁺: A dominant seventh + a minor ninth.
(ex: C-E-G-B \flat -D \flat) → can be expressed C7^{b9}
- **Seventh Sharp Nine**: A dominant seventh + an Augmented ninth.
(ex: C-E-G-B \flat -D \sharp) → can be expressed C7 \sharp ⁹

Ninth Chords

| | Dominant | Major | Minor Major | Minor | Augmented Major | Augmented | Half Diminished | Diminished |
|----|----------|-------|----------------|-------|--------------------|-----------|-----------------|------------|
| C♭ | | | | | | | | |
| C♯ | | | | | | | | |
| D♭ | | | | | | | | |
| D♯ | | | | | | | | |
| E♭ | | | | | | | | |
| E♯ | | | | | | | | |
| F♭ | | | | | | | | |
| F♯ | | | | | | | | |
| G♭ | | | | | | | | |
| G♯ | | | | | | | | |
| A♭ | | | | | | | | |
| A♯ | | | | | | | | |
| B♭ | | | | | | | | |
| B♯ | | | | | | | | |

ADJUSTMENTS & TUNING

There are two main types of Temperament (Tuning) Systems likely to be encountered by performing musicians: **Just Temperament** (sometimes called “pure” tuning because it occurs naturally as a result of harmonic ratios), and **Equal Temperament** (the system used by keyboard instruments and some fretted string instruments to divide the octave into twelve equal pitches). These are by no means the only temperaments available, but they are the most common.

Just Temperament (JT) occurs naturally as a result of the harmonic series. Every note in the scale is related by rational numbers. With Just Temperament, tuning is dependent on the scale you are using. In this tuning, notes are related to each other by ratios of small integers such as the octave (2:1), the perfect fifth (3:2), the perfect fourth (4:3), etc. The Just Scale is based on the octave and an attempt to have as many “nice” intervals as possible. Semitones **are not** equally spaced. This sort of tuning is often used by ensembles (bands, choirs, orchestras) with the ensemble members *listening* to each other and matching their pitches.

Equal Temperament (ET) was developed for keyboard instruments, which cannot make quick intonation adjustments when traveling to different key areas. ET is a compromise tuning system. It uses constant frequency multiples between each note of the chromatic scale and divides the octave into equal semitones. This allows the instrument to sound equally good (or equally bad) in any key chosen.

Although the resulting notes in each of the two temperaments are close, there are enough discrepancies to result in severe intonation deficiencies. For this reason, instrumentalists (and vocalists) must constantly adjust their pitches dependant on their instrument’s tendencies and their position in any given sustained chord. For example, all things being equal (i.e., a perfectly in-tune instrument) a trumpet player who is the fifth of a Major Triad in one measure and the third of the same Major Triad in the next measure would have to raise his pitch very slightly (two cents*) for the fifth, then lower the pitch significantly (fourteen cents) for the third, all in order to have all the surrounding chord pitches ring in true harmonic ratios.

While this sounds like a complicated task, many professional musicians do this so quickly and efficiently that they rarely think about what they are doing anymore. With practice and a lot of listening, a performer’s role in a chord can be ascertained more and more quickly, resulting in better-sounding chords and intervals.

The following chart shows the chord and interval adjustments necessary in order to make chords “ring true” in their correct harmonic ratios. For more information on the subject, it is recommended to consult the two following resources:

- *How Equal Temperament Ruined Harmony* by Ross Duffin.
- *The Physics of Sound* by Richard Berg and David Stork.

* Cents are a logarithmic unit of measure used to divide an octave into 12 semitones/half-steps of 100 cents each.

Chord Adjustments

in Just Intonation

The following adjustments are based on the root of the chord (in this case, "C") which is an equal-tempered pitch.

The adjustments (given in cents) indicate the difference necessary for that note to be in tune with the chord (as opposed to the given equal tempered pitch). The adjustments are applicable to all chords, regardless of starting pitch*

| Major Triad (CM) | Minor Triad (Cm) | Diminished Triad (C°) | Augmented Triad (C+) |
|---|--|--|--|
| +2 -14 | +2 +16 | -17 +16 | -4 -14 |
| Major Sixth (C6) | Minor Sixth (cm6) | Dominant Seventh (C7) | Major Seventh (CM7) |
| -16 +2 -14 | +19 +2 +16 | -31 +2 -14 | -12 +2 -14 |
| Minor-Major Seventh (CmMaj7 or Cm#7) | Minor Seventh (Cm7) | Augmented-Major Seventh (CM7#5 or C+M7) | Augmented Seventh (C+7 or C7#5) |
| +11 +2 +16 | +18 +2 +16 | +26 -4 -14 | -31 +2 -14 |
| Half-Diminished Seventh (Cø7 or Cm7b5) | (Fully) Diminished Seventh (C°7 or Cdim7) | Seventh Flat Five (C7b5) | Diminished Major Seventh (C°M7 or C°#7) |
| +18 -17 +16 | +19 -17 +16 | -31 +3 -14 | +16 -17 +16 |
| Dominant Ninth (C9) | Major Ninth (CM9) | Minor Ninth (Cm9) | Dominant 7b9 (C7b9) |
| +4 -31 +2 -14 | +4 -12 +2 -14 | +4 +18 +2 +16 | +5 -31 +2 -14 |

Intervals

and their deviations from Equal Temperament

| Minor Second | Major Second | Minor Third | Major Third |
|----------------|------------------|------------------|---------------|
| +12 | +4 | +16 | -14 |
| Perfect Fourth | Augmented Fourth | Diminished Fifth | Perfect Fifth |
| -2 | +17 | -17 | +2 |
| Minor Sixth | Major Sixth | Minor Seventh | Major Seventh |
| +14 | -16 | +18 | -12 |

*Note that some intervals have multiple adjustments, dependant on their function in a chord.