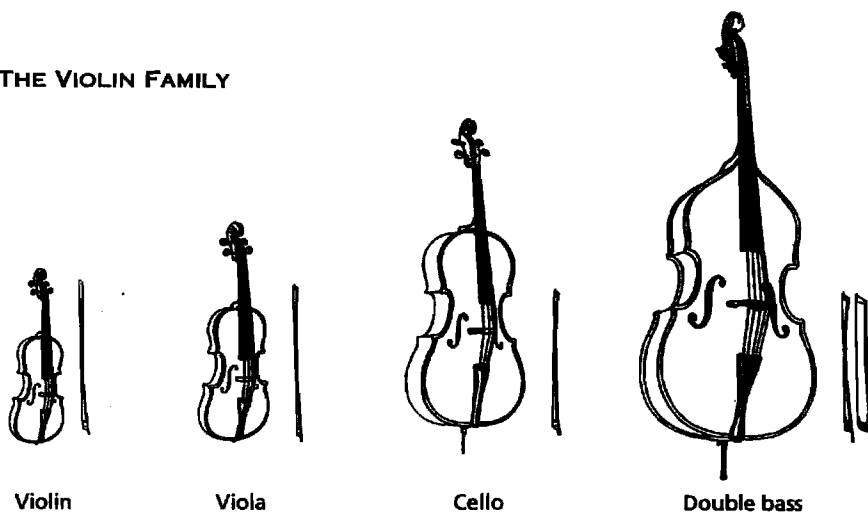


BOWED STRING INSTRUMENTS

THE VIOLIN FAMILY



The modern symphony orchestra is usually divided into four sections or choirs: strings, woodwinds, brass, and percussion. The bowed string choir—violins, violas, cellos, and double basses, technically called *chordophones**—was the first to be developed fully and exploited by composers. This preferential treatment may be explained on two counts: the strings, of all the choirs, reached their present state of technical perfection in construction by 1700; and the “violin family,” as it is sometimes called, has the greatest number of properties in common.

Some other reasons composers have given the violin family priority are:

1. its enormous range, encompassing seven octaves between the double basses and the violins;
2. the homogeneous tone color throughout its entire range, with only slight variations in the different registers;
3. its wide dynamic range, from an almost inaudible *pianissimo* to a most sonorous *fortissimo*;
4. the richness of tone quality, which produces a particular warmth that lends itself to the performance of *espressivo* passages;
5. its versatility in producing different kinds of sound (bowed, plucked, struck, and so on) and performing rapid passages, slow sustained melodies, skips,

*The term for musical instruments that produce sound by means of strings attached between fixed points. (See also p. 449.)

8 THE STUDY OF ORCHESTRATION

trills, double stops, and chordal configurations, as well as special (even extramusical) effects;

6. its ability to sound continuously, unhampered by the player's need to breathe (as distinct from wind instruments).

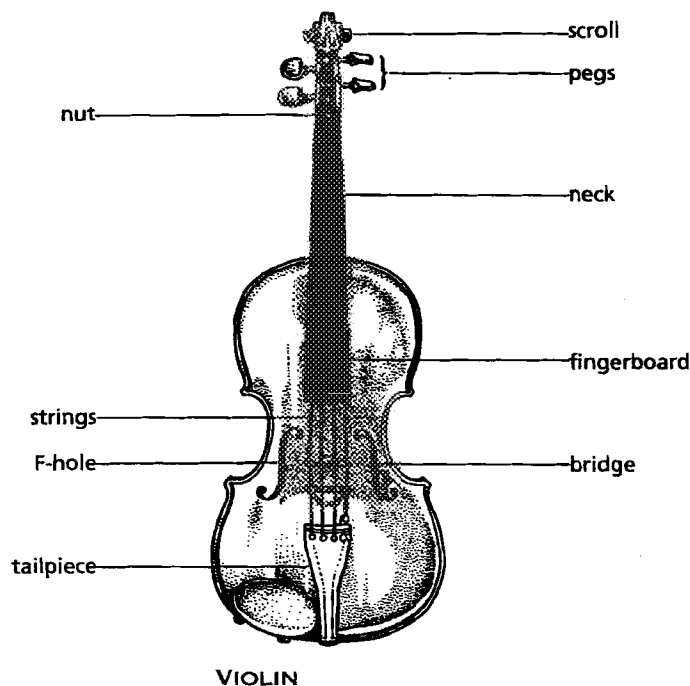
The string section of a full symphony orchestra consists of the following number of players, with two players sharing each stand:

first violins	16 to 18 players	8 or 9 stands
second violins	14 to 16 players	7 or 8 stands
violas	10 to 12 players	5 or 6 stands
cellos	10 to 12 players	5 or 6 stands
double basses	8 to 10 players	4 or 5 stands

CONSTRUCTION

Like a true family, all bowed string instruments have many things in common: the same construction and acoustical properties, similar playing techniques, and even special problems and peculiarities. Discussing these shared characteristics before considering each instrument separately will help clarify the familial status of each instrument, and help illuminate the slight variations and modifications that we will see each member exhibit when the individual instruments are discussed in turn. Since we shall use certain terms to describe the structure of string instruments throughout this book, this chapter introduces the appropriate nomenclature.

Except for the proportions, which will be given as each instrument is considered separately, the construction of all the instruments, as well as the names of the different parts, is identical to that of the violin diagram drawn below.



Each instrument consists of two main parts: the body and the neck. Both are made of wood. The top surface of the body, called the *belly*, the *table*, or the *soundboard*, and the bottom, called the *back*, are both curved. Together with the side-walls, called the *ribs*, they form a hollow box that acts as a resonator and strengthens the vibrations of the strings. The overall shape of the body somewhat resembles the human form; it also appears to have a waist. Inside the body is a *sound post*, which transmits the vibrations of the strings. The neck consists of a long, thin, shaped piece of wood, called the *fingerboard*. At its upper end is a *pegbox*, which holds the tuning pegs, and a small curved section above the pegs, called the *scroll*. Over the fingerboard and

belly are stretched four strings, or in the case of the double bass, sometimes five. The strings, each wound around a tuning peg, pass thence over a small piece of wood, called the *nut*, along the fingerboard, then over another piece of wood, called the *bridge*; they are attached to a third piece of wood or plastic, called the *tailpiece*. A bow rubbed across the string between the place where the fingerboard ends and the bridge is positioned makes the string vibrate, producing a sound. The bridge, which supports the strings, also vibrates and its vibrations pass to the belly and, to a lesser extent, the back. Cutting through the belly are two sound holes, called F-holes because they resemble that letter in the alphabet. They permit the belly of the instrument to vibrate freely, and also provide sound exits from the body of the instrument.

TUNING

Three of the instruments of the violin family, the violin, viola, and cello, are tuned in 5ths, while the fourth, the double bass, is tuned in 4ths.

Here are the pitches of the open strings of the instruments. The term *open strings* refers to the strings as they sound when they are not touched, or stopped, by the fingers of the left hand.

EXAMPLE 2-1. Tuning of the Four Violin Strings



EXAMPLE 2-2. Tuning of the Four Viola Strings



EXAMPLE 2-3. Tuning of the Four Cello Strings



EXAMPLE 2-4. Tuning of the Four Double Bass Strings



A five-stringed double bass has a low C string added by means of a mechanical extension. The standard tuning of a five-stringed bass is:

EXAMPLE 2-5. Tuning of the Five-Stringed Double Bass



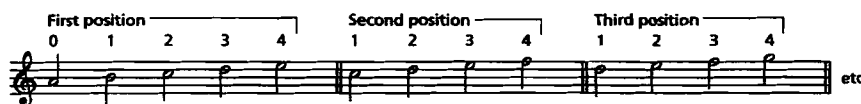
The double bass is the only transposing instrument of the violin family: it sounds one octave lower than written.

CD-ROM
CD-1
FINGERING/
SHIFTING

FINGERING

In order to produce pitches higher than that of an open string, the player presses the left-hand fingers firmly against the fingerboard, thus shortening the vibrating length of the string and consequently raising the pitch. The string itself vibrates only between the bridge and the nut. The left hand therefore moves from a position closest to the nut (*first position*) up the fingerboard toward the place where the bow is drawn across the string (which is between the end of the fingerboard and the bridge). As the hand moves up the fingerboard it shifts from one position to another. The shifting is executed in the manner shown in Example 2-6. Fingering is indicated above the staff: the number 0 denotes an open string, 1 the first finger (the index finger of the left hand), 2 the second finger (the middle finger of the left hand), and so forth.

EXAMPLE 2-6. First, Second, and Third Positions for the Violin and Viola



Here is the fingering for the five basic positions of the violin and the viola, as shown on the A string:

THE FIVE BASIC POSITIONS OF THE VIOLIN AND VIOLA

First Position A String*	Second Position A String	Third Position A String	Fourth Position A String	Fifth Position A String
1st finger • B	1st • C	1st • D	1st • E	1st • F
2nd finger • C	2nd • D	2nd • E	2nd • F	2nd • G
3rd finger • D	3rd • E	3rd • F	3rd • G	3rd • A
4th finger • E	4th • F	4th • G	4th • A	4th • B

The principle of fingering is the same on all the bowed string instruments, but certain details are quite different, particularly for the cello and the double bass; therefore, we will discuss fingering at greater length in the special sections devoted to each instrument in Chapter 3.

*For the complete range of possible pitches produced in the first position on the violin, refer to the chart on p. 52; for the viola, the chart on p. 66; for the cello, p. 77; and for the double bass, p. 85.

DOUBLE, TRIPLE, AND QUADRUPLE STOPS

CD-ROM
CD-1
MULTIPLE STOPS

Two or more notes on adjacent strings played simultaneously are called *multiple stops*. When only two notes are played together, a *double stop* results. There are two kinds of double stops:

1. one or both of the pitches are played on an open string;
2. both pitches are played on stopped strings.

On all string instruments it is possible to play two notes on adjacent strings at the same time by fingering the two pitches and then drawing the bow across both strings.

Chords of three or four pitches, if they occur on adjacent strings, are also possible; these are called *triple stops* and *quadruple stops*. For triple stops, greater bow pressure has to be exerted on the middle string of the three that are played, so that all pitches can sound at the same time. For this reason, the simultaneous attack of three notes can only be accomplished at a relatively loud dynamic level (*f* or *mf*). When piano or pianissimo triple stops are desired, the performer usually has to arpeggiate them slightly. For quadruple stops, the bow is only able to sustain properly two pitches at a time. Therefore, all quadruple stops must be arpeggiated. (The bow used in the seventeenth and eighteenth centuries was more curved than it is today, and it was possible to sustain four-note chords more readily. The wood in the middle of the bow curved outward, away from the strings, unlike the wood on the modern bow, which curves slightly inward, toward the strings.) The most successful triple and quadruple stops contain one or two notes played on open strings, since these have a greater sustaining power.

Here are some examples of simple double, triple, and quadruple stops for each of the four instruments, along with a few examples that are impossible to perform since both pitches would have to be played on the same string. More complete charts for the violin, viola, and cello will be found in Chapter 3.

EXAMPLE 2-7. Violin



EXAMPLE 2-8. Viola



EXAMPLE 2-9. Cello



EXAMPLE 2-10. Double bass: Only double stops that include an open string are practical.



DIVIDED STRINGS

Divisi (It.); *Divisés* (Fr.); *Geteilt* (Ger.)

Since there is more than one player for each string part in a symphony orchestra, double stops are usually divided between the two players on the same stand. The player sitting on the right side of the stand (the "outside") performs the upper notes, while the one sitting on the left side (the "inside") plays the lower notes. To signal this division, the part is marked *divisi*, or its abbreviation, *div*. If the word *divisi* does not appear in the parts, the player would be correct in performing the chord as a double stop. Sometimes the indication *non div.* appears to ensure that each player will perform double stops. When *divisi* is no longer called for, the word *unisoni* appears in the part.

EXAMPLE 2-11. Debussy, *Nocturnes*, "Nuages," mm. 7-15 (strings only)

CD-1/TR. 1

7 **Modéré**

Timp.

Vln. 1

Vln. 2

Vla.

Vlc.

D.B.

8va

Div. a 6

pp

pp

pp

pp

pp

pp

a 3

a 3

The musical score is for a string quartet, specifically focusing on the first and second violins, viola, cello, and double bass. The score is in G major (one sharp) and 4/4 time. It begins at measure 12. The first violin (Vln. 1) and second violin (Vln. 2) parts feature complex triple and quadruple stops, indicated by 'a 3' and 'a 2' markings. The viola (Via.) and cello (Vlc.) parts also play these complex stops, with the cello part marked 'pp' (pianissimo). The double bass (D.B.) part plays a simpler pattern, marked 'pizz.' (pizzicato) and 'pp'. The score is written for five staves, with the first two staves for violins, the third for viola, and the last two for cello and double bass.

When triple or quadruple stops are to be divided, it is helpful to specify how this is to be done.

EXAMPLE 2-12. Dividing Triple and Quadruple Stops

The example shows two musical notations on a single staff. The first notation, labeled 'div.', shows a triple stop (three notes) where each note is played by a different part, indicated by the 'div.' marking. The second notation, labeled 'non div.', shows a quadruple stop (four notes) where all notes are played by the same part, indicated by the 'non div.' marking.

If the composer wants the triple stops to be performed by three different players, the parts should be marked *div. a 3*, or in case of quadruple stops, *div. a 4*. If the division is to occur by stand—that is, first stand play the top note, second stand, the next lower note, and so on—it is best to write out three or four different lines in the part and give the direction “Divide by stand.” The Italian for “by stand” is *da leggit*; French, *par pupitres*; German, *Pultweise* (Pult.).

In the following example, the composer not only has indicated the division by stand to the left of the score, but also has specified *divisi* (*geteilt*) instructions for each stand within the body of the score.

14 THE STUDY OF ORCHESTRATION

CD-1/TR. 2

EXAMPLE 2-13. R. Strauss, *Also sprach Zarathustra*, at 27

In a passage where a composer wants only half the section to play, the part should be marked "half" (in Italian, *la metà*; French, *la moitié*; German, *die Hälfte*). The inside players (those sitting on the left-hand side of the stand) will then remain silent during such a passage. When all are to play again, the word "all" (or *tutti* [It.], *tous* [Fr.], *alle* [Ger.]) must appear in the score.

VIBRATO

Most string performers will use *vibrato* to enhance the beauty of a tone that is sustained for any length of time. Vibrato is accomplished by pressing the finger firmly on the string at the desired pitch while quickly rocking it back and forth on the string. Vibrato also increases the intensity of the pitch without distorting the essential frequency. A composer or orchestrator may ask for *non vibrato*, or *senza* (without) *vibrato*, if a white, pale sound is desired. For obvious reasons an open string cannot have a fingered vibrato, but it can be made to sound as if it were vibrating in either of two ways: by fingering (oscillating) the note one octave higher on the next higher string to set up sympathetic vibrations (which is obviously not possible when the note in question is played on the highest string); or by vibrating the same pitch on the next lower string. The first technique can only be produced on the lower three strings, the second only on the upper three strings.

GLISSANDO AND PORTAMENTO

Glissando

This is another technique common to all string instruments. It is accomplished by sliding one finger on one string from one pitch to another. It is usually indicated by a line connecting two noteheads with or without the word *glissando* (*gliss.*) above the line. When it is done correctly, the glissando is executed in one long (legato) bow stroke, and all the pitches will sound, or at least be touched, between the first and last notes. It is possible to slide upward as well as downward on a string.

Here are two famous examples of the use of glissando in an orchestral passage:

EXAMPLE 2-14. Ravel, *La Valse*, at [30]

CD-ROM
CD-1
GLISSANDO

Mouvement de valse viennoise
sur Sol

Vln. 1

mf espressif

CD-1/TR. 3
INDEX 1/0:00

EXAMPLE 2-15. Bartók, *Music for Strings, Percussion and Celesta*, second movement, 1 m. before [170]

CD-1/TR. 3
INDEX 2/0:13

$\text{♩} = 138$

Vln. 1

mf *f* *mf* *f* *p*

*to be played on the third, the D, string.

Portamento

In many scores the indication *port.* (for *portamento*) occurs where *gliss.* would normally be used to indicate a conscious slide from one pitch to another. *Portamento*, however, constitutes a more natural, expressive method of connecting melody notes that are a great distance apart, and this effect is rarely indicated in the score. When *port.* is found in the score it signifies to the performer to create a minimal slide between the two pitches, whereas *gliss.* usually directs the player to execute the slide with a full volume of sound.

Glissando on More Than One String

If a glissando is to be performed over more than one string, it cannot be a "true" glissando, for the sliding motion must be broken as soon as the open string is reached and then continued on the next string until the desired pitch is attained.

EXAMPLE 2-16. Mahler, *Symphony No. 10*, first movement, mm. 151–152

CD-1/TR. 4

Tempo adagio

Vln. 1

f *gliss.*

Fingered Glissando

One other kind of glissando, called "fingered glissando," is found most often in solo literature or in string solos within an orchestral work. It is sometimes called the "written-out glissando," because every pitch is notated and is meant to be performed as written, as in Example 2-17. When played by the full string section, passages such as this will sound much more like a blurred glissando.

CD-1/TR. 5

EXAMPLE 2-17. Mahler, Symphony No. 7, second movement, 2 mm. before [92]



■ ADDITIONAL PASSAGES FOR STUDY

Bartók, *The Miraculous Mandarin*, first part

Debussy, *Ibéria*, part 2, at [38]

Mahler, Symphony No. 4, third movement, mm. 72-76 (glissando on more than one string)

Ravel, *La Valse*, 3 mm. before [27] (glissando on more than one string)

J. Schwanter, *Aftertones of Infinity*, mm. 18-24

R. Strauss, *Till Eulenspiegel*, mm. 205-209 (fingered glissando)

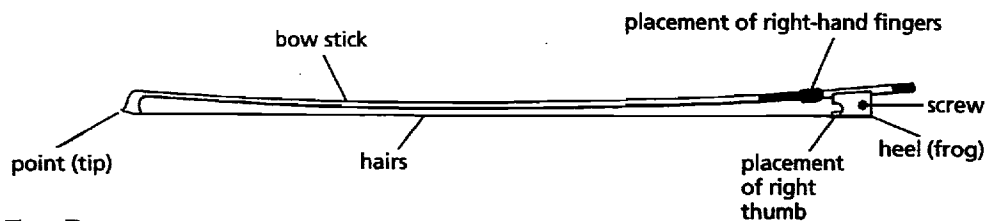
THE BOW

The bow, with which violin-family instruments are played, derives its name from its initial resemblance to the bow used in archery. We find even today Arab and Far Eastern fiddles that are still played with curved bows, similar to those used on European string instruments until the sixteenth century. For the next three hundred years or so, various experiments in Europe brought the shape of the bow closer to what we know today. Corelli, Vivaldi, and Tartini still used bows that were slightly curved outward, away from the hair. The bow's final form—curved inward—was achieved in the bows of François Tourte (1747-1835). These bows, as well as modern bows, have the following parts:

1. A long, tapering *bow stick*, which is curved slightly inward toward the hair. It is usually made of Pernambuco wood.
2. A metal or ivory plate protecting the tip.
3. Horse-tail hair.
4. A metal ferrule (brace) at the frog that encircles the hairs and keeps them evenly spread.
5. A metal screw with which the hair is tightened or loosened.

The tension of the hair is of the utmost importance. When the hair is tightened, the elastic quality of the wood gives the entire bow a resilience that makes it possible to execute any kind of stroke desired.

The specific measurements are proportional so that the bow is balanced toward its middle, allowing for greater agility and control, as well as richer tone quality. The bow is held firmly but flexibly between the four fingers and thumb



THE BOW

in the right hand. There are other bow hand positions, especially for the cello and the double bass, and we shall examine these in detail when we discuss these two instruments in Chapter 3.

BOWING

Bowing refers to the act of drawing the bow across the string. The bow is normally drawn across the string midway between the end of the fingerboard and the bridge. But to alter the sound of the instrument, the player may draw the bow across the string at different places.

Two symbols must be remembered: ▢ for down-bow, drawing the bow from the frog toward* the tip; ∨ for up-bow, drawing the bow from the tip toward the frog.

A passage on any of the string instruments may be bowed effectively in a variety of ways, and even the most experienced players often disagree on exact bowings. Even today, concertmasters and conductors introduce new bowings for well-established works. Bowing decisions are greatly influenced by the style of the music, its character, and the tempo and dynamics at which a particular work or passage is to be performed.

The composer or orchestrator should keep the following bowings in mind, for these, at least, are constant.

Non legato

In a passage with no notated slurs (*non legato*), each pitch is performed by changing the direction of the bow, whether the passage is slow or fast.

EXAMPLE 2-18. Elgar, *Pomp and Circumstance* No. 1, trio



Even though changes of bow direction occur for each of the notes above, a listener does not necessarily perceive these changes since skilled performers can play the successive notes without an audible break between the up- and down-bows.

*The performer does not always use the whole bow (all the way from the frog to the tip and vice versa).

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NON LEGATO

CD-1/TR. 6

CD-ROM
CD-1
LEGATO

Legato

Whenever a passage is slurred, all notes within that slur are performed on one bow, meaning that all are played in one bow direction. This is called *legato* playing. (*Legato* means "bound together.")

CD-1/TR. 7

EXAMPLE 2-19. Schubert, Symphony No. 5, second movement, mm. 1-8

Andante con moto

The musical score for Example 2-19 shows the first eight measures of the second movement of Schubert's Symphony No. 5. The tempo is marked 'Andante con moto'. The score is for Violin 1, Violin 2, Viola, and Violoncello/Double Bass. The first system covers measures 1-4, and the second system covers measures 5-8. The music is in 3/4 time and features a legato passage with slurs and bowing marks (up-bow 'v' and down-bow 'v' with a flag). The first system shows measures 1-4, and the second system shows measures 5-8. The tempo is marked 'Andante con moto'.

Some general observations concerning bowing must be stated:

1. A performer will naturally begin an anacrusis, or upbeat, with an up-bow (v) unless the composer marks the upbeat with a down-bow sign (v with a flag).
2. A very common type of bowing instruction, two adjacent up-bows, occurs on the second beat of the first measure of Example 2-19; these are necessary to have a down-bow on the accented first beat of the next measure. The violinist will play the quarter-note E_b, then stop the bow movement ever so briefly (the dash under the note indicates separation) before playing the eighth-note E_b while still in an up-bow motion.
3. When two vigorous articulations follow one another, two successive down-bows are called for, as in Example 2-20. Here, a down-bow and an up-bow are marked over the long note so that the following attack will be solid. The bow is changed almost immediately to up-bow and is then ready to give a *ff* attack on the triple stop.

EXAMPLE 2-20. Beethoven, *Coriolanus* Overture, mm. 276–286

CD-1/TR. 8

Allegro

276

When this passage is executed well, the bow change will hardly be noticed.

4. A performer can play louder and heavier toward the frog of the bow than toward the tip, because the pressure from the right hand holding the bow is much greater at the frog. Therefore, the most effective way to produce a crescendo is with an up-bow, due to the right hand's ability to increase the pressure on the bow toward the frog. Conversely, diminuendos are often performed with a down-bow.

When bowing a passage, the composer should be aware of these tendencies and, without overmarking the parts, should indicate bow direction only where he or she wishes to counteract the normal habit of the players.

5. One should never mark long phrase slurs in string parts. Such slurs only confuse the performer. The only slurs that should be used are those that designate the notes to be performed on one bow (legato).

There is a limit to how many notes can be played slurred on a single bow stroke. This is largely determined by the tempo and the dynamics governing a particular passage. In a fast but soft passage, a great many notes may be slurred together.

EXAMPLE 2-21. Mendelssohn, *Symphony No. 4*, first movement, mm. 378–388

CD-1/TR. 9

Allegro

378

383

A similar passage in the violas some measures later shows only six notes on a bow, since the dynamic is forte.

EXAMPLE 2-22. Mendelssohn, *Symphony No. 4*, first movement, mm. 461–464

CD-1/TR. 10

Allegro

461

In slow passages, even if the dynamic is soft, special caution must be taken not to overload the bow and thereby make the music physically impossible to perform. This is especially crucial for cellos and basses, whose bows are a bit shorter than those of the violin and viola. For instance, the following passage is impossible to perform as the composer has marked, adhering to both the crescendo marks *and* the slurs, unless, starting at the end of measure 30, it is broken up into several bows.

EXAMPLE 2-23. Liszt, *Les Preludes*, mm. 30-34

Adagio
31

Examples 2-24 and 2-25 give two possible solutions. By dividing the section and staggering the bowing among the players, one can produce a very long and effective legato line, as Example 2-25 demonstrates.

CD-1/TR. 11
INDEX 1 / 0:00

EXAMPLE 2-24. Liszt, *Les Preludes*, mm. 30-34, possible bowing

CD-1/TR. 11
INDEX 2 / 0:18

EXAMPLE 2-25. Liszt, *Les Preludes*, mm. 30-34, possible bowing

Besides the single bow stroke (*non legato*) and the slur (*legato*), there are various special types of bowings. Their execution depends greatly on the speed and dynamics of the passage, as well as on the style and character of the music. For many of these bowings, there is a great diversity of views about the meaning of each term used to describe the bowing and the manner in which the bowing is executed. Concerning the former, the terminology itself is not universally accepted, and quite often there are several names for a particular bowing in a

given language. We have chosen what we consider to be the safest way to classify these bowings, by dividing them into:

1. bowings in which the bow stroke remains on the string;
2. bowings in which the bow is made to bounce off the string.

SPECIAL ON-THE-STRING BOWINGS

Détaché (Fr.)

This basic *non legato* bowing is performed on all bowed string instruments by changing the direction of the bow for each note (see also p. 17). Sometimes referred to as "separate bows," this stroke clearly articulates each pitch without necessarily accenting any one, unless the passage is marked specifically to do so. At a rapid tempo, the middle to upper third of the bow is usually used when performing this stroke *forte* or *mezzo forte*; to produce an even louder sound, the bowing is often executed at or near the frog.

EXAMPLE 2-26. Tchaikovsky, *Romeo and Juliet*, mm. 141–143

CD-1/TR. 12

Allegro giusto 142

Sometimes the composer asks that a passage be played at the tip, which produces a much lighter, more delicate sound. The marking for this effect is: at the point; *a punta d'arco* (It.); *à la pointe* (Fr.); *an der Spitze* (Ger.).

EXAMPLE 2-27. Bartók, *Concerto for Orchestra*, fifth movement, mm. 8–13

CD-1/TR. 13

8 *Allegro con fuoco*

Conversely, composers ask for a passage to be played at the frog to take advantage of the heavy stroke that can be produced there. The marking for this effect is: at the frog; *al tallone* (It.); *au talon* (Fr.); *am Frosch* (Ger.).

CD-1/TR. 14

EXAMPLE 2-28. Gluck, *Iphigenia in Aulis*, Overture, mm. 19–29

Andante

20

au talon *ten.*

ff *ten.* *ff* *ten.*

Vln. 1

Vln. 2

Vla.

Vcl. D.B.

ff *ff* *ff*

25

ten. *ff* *ten.* *ff* *ten.* *ff*

Vln. 1

Vln. 2

Vla.

Vcl. D.B.

ff *ff* *ff*

A very heavy and vigorous effect is commonly achieved using a series of down-bows. These can be played quite fast, with the bow raised between down-bows, and will most often be performed at the frog.

CD-1/TR. 15

EXAMPLE 2-29. Tchaikovsky, *Symphony No. 6*, third movement, mm. 108–112

Allegro molto vivace

108

ff *pp* *ff* *pp*

Vln. 1

Vln. 2

Vla.

Vcl. D.B.

ff *ff* *ff*

Louré (FR.); Portato (IT.)

This essentially legato bowing is accomplished by slightly separating the notes while the bow is being drawn across the string. It can produce a very expressive effect and is used often in accompaniments. This bowing is indicated by dashes under or over each of the noteheads, with slurs to designate the bow changes. We have added bowings in Example 2-30 to show how the passage is to be played. *Louré* is easily played with both up- and down-bows.

**CD-ROM
CD-1
LOURÉ**

EXAMPLE 2-30. Handel, *Messiah*, "Comfort Ye," mm. 1-4 (tenor part not recorded on CD)

CD-1/TR. 16

Larghetto

I

Vln. 1 *p* *sim.*

Vln. 2 *p* *sim.*

Vla. *p* *sim.*

Tenor

Vlc. D.B. *p*

Com-fort ye!

6 4 3 6 6 6 6

Staccato

The word *staccato* is derived from the Italian word *staccare*, meaning to detach or separate. For bowed string instruments, it is best to use the term *staccato* to describe an on-the-string effect only. *Staccato* is indicated by placing a dot over or under the notehead and is most effectively performed at moderate to slow tempos for reasons that will be clarified below. *Staccato* passages can be played loud or soft, and may be performed in one of two ways. Notice the difference in the notation of these two modes of performance.

Separate Bow Staccato

This technique is effected by playing short, separate bow strokes (Examples 2-31 and 2-36).

**CD-ROM
CD-1
SEPARATE BOW
STACCATO**

EXAMPLE 2-31. Separate Bow Staccato*

CD-1/TR. 17

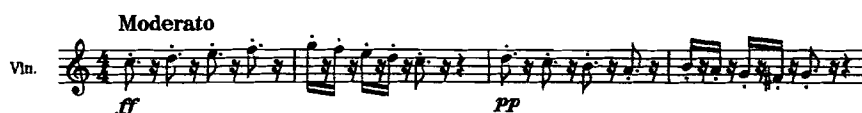
Moderato

Vin.

*Where no other attribution is given, the example is written by the author.

Because staccato bowing separates or leaves a space between the notes, this passage could sound approximately:

EXAMPLE 2-32. Separate Bow Staccato as Played



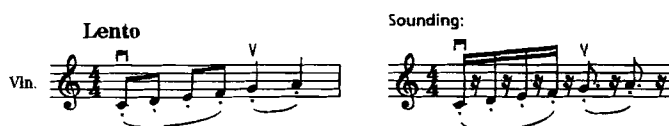
CD-ROM
CD-1
SLURRED
STACCATO

Slurred Staccato

This technique consists of the separation of a series of short notes on one bow (Examples 2-33, 2-34, and 2-35).

CD-1/TR. 18

EXAMPLE 2-33. Slurred Staccato



A *staccato* passage like the following is executed very much like *louré*—on one bow—except that the notes are shorter (staccato) and, therefore, the space between them is longer.

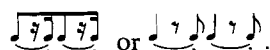
CD-1/TR. 19

EXAMPLE 2-34. Stravinsky, *Symphony in Three Movements*, second movement, at 135



Two other variations of the staccato on one bow are very common.

1. The notation $\text{♩} \text{ ♩} \text{ ♩}$ or $\text{♩} \text{ ♩} \text{ ♩}$ is usually performed:



Notice that in the actual notation the staccato dot is placed under the short note. If both notes were dotted, the long note would be measurably shortened in performance.

CD-1/TR. 20

EXAMPLE 2-35. Hindemith, *Symphonic Metamorphoses*, fourth movement, at A



2. In order to make ♩ sound crisp, light, and soft, the composer often does not use slurs but rather indicates that the passage be played with separate bows. In most cases these strokes would be executed at or toward the tip, with the long note on an up-bow. To make this playing technique absolutely clear to the performer, the composer may add dots above the sixteenth notes. In the following example, we have added up- and down-bowing indications to show how the passage would be played.

EXAMPLE 2-36. Weber, *Euryanthe*, Overture, 27 mm. after Tempo I: *Assai moderato*

CD-1/TR. 21

1st time *ff*
2nd time *pp*

sim.

Notice that all the tempos for the staccato passages have been moderate, for a fast tempo will invariably be played off the string, with a bouncing bow. Such passages are not called staccato, but rather *spiccato* or *saltando*—both terms that will be discussed in the off-the-string section, below.

ADDITIONAL PASSAGE FOR STUDY

Stravinsky, *Orpheus*, "Pas de deux," at 109

Martelé (Fr.); *Martellato* or *Marcato* (It.)

CD-ROM
CD-1
MARTELÉ

The derivation of this term is from the verb "to hammer." In bowing, it indicates a fast, well-articulated, heavy, separate stroke, resembling a *sforzando*. *Martelé* can be performed with any part of the bow: at the tip, in the middle, or toward the frog. The bow does not leave the string, even though there is a stop between the notes and each new stroke is initiated with a heavy accent. Sometimes, instead of a simple dot, the composer places one of the following signs over a note: ♩ or ♩ or ♩ .

EXAMPLE 2-37. Bruckner, Symphony No. 9, second movement, mm. 52–58

CD-1/TR. 22

Lively 53

Vln. 1
Vln. 2
Via.

ff

SPECIAL OFF-THE-STRING BOWINGS

Spiccato (It.)

We have termed the three distinct ways of performing spiccato bowings. All depend on the speed and the dynamic of a particular passage.

CD-ROM
CD-1
CONSCIOUS
SPICCATO

Conscious *Spiccato*

In a slow or moderate tempo the player makes a conscious effort to make the bow bounce. The pressure of the right hand is reduced, and the wrist drops the middle of the bow on the string in a semicircular motion. The notation is similar to that for staccato: dots are placed above or beneath the noteheads. The lightness and speed required in the passage determine whether the player uses a conscious spiccato, as shown in Example 2-38, or a spontaneous spiccato, described below.

CD-1/TR. 23

EXAMPLE 2-38. Stravinsky, *Dumbarton Oaks Concerto*, first movement, at [22]

Tempo giusto (♩ = 152)



CD-ROM
CD-1
SPONTANEOUS
SPICCATO

Spontaneous *Spiccato* (Called *Saltando*)

At a fast tempo the player does not have to make a conscious effort to lift the bow; rather, the short, quick up-down motion controlled by the wrist alone makes the bow bounce spontaneously off the string with every stroke.

CD-1/TR. 24

EXAMPLE 2-39. Rachmaninoff, *Symphonic Dances*, first movement, at [18]



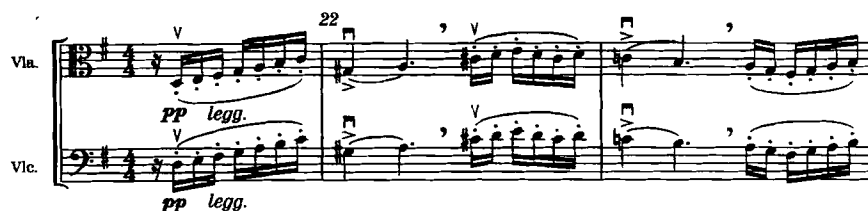
CD-ROM
CD-1
SLURRED
SPICCATO

Slurred *Spiccato*

The following example shows a short series of spiccato notes grouped together in a single bow.

CD-1/TR. 25

EXAMPLE 2-40. Mahler, *Symphony No. 4*, first movement, mm. 21-23



ADDITIONAL PASSAGES FOR STUDY

Beethoven, *Symphony No. 1*, second movement, mm. 154–156 (conscious spiccato)

Rossini, *William Tell*, Overture, mm. 336–343 (spontaneous spiccato)

Jeté (Fr.); Ricochet (Eng.)

CD-ROM
CD-1
JETÉ

The upper third of the bow is thrown on the string so that it will bounce, producing from two to six or more rapid pitches. *Jeté* is usually executed by a downward motion of the bow. However, it can be played up-bow as well.

A word of caution: the more notes desired on one bow stroke, the more impractical *jeté* bowing is. In an orchestral setting, we suggest that no more than three bouncing notes at a time be used in this bowing, even though solo players are perhaps capable of including many more well-articulated notes on a single bow. Since the bows of the cello and double bass are slightly shorter, three, or at most four, notes to a single *jeté* stroke are the limit of what can be played.

EXAMPLE 2-41. Rimsky-Korsakov, *Capriccio espagnol*, third movement, mm. 19–22 (violin solo only recorded)

CD-1/TR. 26

EXAMPLE 2-42. Shostakovich, *Symphony No. 8*, second movement, mm. 67–72

CD-1/TR. 27

ADDITIONAL PASSAGES FOR STUDY

Rimsky-Korsakov, *Capriccio espagnol*, fifth movement, mm. 89–96

Stravinsky, *The Firebird* ballet, from m. 30 on

CD-ROM
CD-1
ARPEGGIANDO

Arpeggiando

A slightly different kind of spiccato is related to *jeté*. This on-the-string bowing may begin with a simple slurring of an arpeggio played over three or four strings at a moderate tempo:

CD-1/TR. 28
INDEX 1 / 0:00

EXAMPLE 2-43. *Arpeggiando*



But at a fast tempo, the bow will spontaneously bounce off the string because of the motion of the right wrist, and an *arpeggiando* will occur naturally. This technique is used most often in solo string and chamber music literature, such as the solo violin passage in Example 2-44, but is also an effective orchestral device (as in the cadenza in the final movement of Rimsky-Korsakov's *Sheherazade*).

CD-1/TR. 28
INDEX 2 / 0:12

EXAMPLE 2-44. Mendelssohn, Violin Concerto, first movement, mm. 328–336

Allegro molto

328 Vln. solo *ff* *poco a poco dimin.*


331 *segue* *al*

334 *pp*

TRILLS AND OTHER COLORISTIC EFFECTS USING THE BOW

CD-ROM
CD-1
TRILL

Trills

As on all instruments, the trill is extensively used on all strings. Trills are executed by holding down the string of the pitch printed in the score with the appropriate finger and playing and releasing the next higher note with the adjacent upper finger as rapidly as possible for the entire value of the printed note. Performing a trill may involve the next higher or next lower note, as the composer specifies. If the trill is played on an open string, it is not so effective, because the quality of an open string is quite different from that of a stopped string. The performance of a trill by sixteen violins or ten violas creates an excitingly blurred rhythmic sensation, very different from the sound made by a single player on one instrument. The notation for the trill is , which is placed above the note.

EXAMPLE 2-45. Hindemith, *Mathis der Maler*, third movement, at 16

CD-1/TR. 29

ellen zurückhalten

Vln. 1

Vln. 2

Vla.

Vlc.

D.B.

pp

p

pp

p

pp

p

pp

p

Tremolos

There are two kinds of tremolo.

Bowed Tremolo

A single pitch is repeated as often as possible during the length of the written note by means of short, quick up- and down-bow strokes. In Example 2-46, Verdi uses the tremolo to create a special, atmospheric effect.

CD-ROM
CD-1
BOWED TREMOLO

CD-1/TR. 30

EXAMPLE 2-46. Verdi, *Requiem*, "Dies irae," mm. 46-51

Other uses of tremolo occur in works such as Bizet's *Carmen*, Berlioz's *Symphonie fantastique*, and Mendelssohn's G-minor piano concerto.

CD-ROM
CD-1
FINGERED
TREMOLO

Fingered Tremolo

An interval of a second or larger is quickly repeated, somewhat like a trill. The composer usually indicates a precise time value for each tremolo, although the notes within the tremolo are not measured. The notes to be alternated should be slurred together to insure the legato movement of the bow.

CD-1/TR. 31

EXAMPLE 2-47. Debussy, *La Mer*, first movement, at [8]

There are cases, however, where a fingered tremolo is bowed *détaché* rather than slurred; in those cases, of course, the slur is omitted.

■ ADDITIONAL PASSAGES FOR STUDY

Berlioz, *Symphonie fantastique*, first movement, at [5]

Bizet, *Carmen*, Overture, at Andante moderato

Debussy, *Nocturnes*, "Sirènes," at [1]

Dvořák, Cello Concerto, at 1, violas

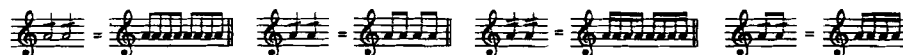
Prokofiev, *Scythian suite*, at [40] (bowed tremolos in the violins and violas); at [43] (fingered tremolos in the violas)

Stravinsky, *The Firebird* ballet, beginning of the Finale

Measured Effects That Are Similar to Tremolos

Passages that are notated with slashes through the notes are not tremolos, since they are measured. This convenient shorthand notation should not be confused with actual tremolos. Example 2-48 gives the actual rhythmic values that are represented by the slashes; Example 2-49 shows this notation in an excerpt from the literature.

EXAMPLE 2-48. Measured Effect, Not a Tremolo



EXAMPLE 2-49. Wagner, *Der fliegende Holländer*, Overture, mm. 319-324

CD-1/TR. 32

A second measured effect that is often deceptively like a tremolo consists of the undulation of two notes on adjacent strings, as shown in Example 2-50.

CD-ROM
CD-1
UNDULATING
TREMOLLO

EXAMPLE 2-50. B. Martini, *Symphony No. 1*, first movement, one m. after [14]

CD-1/TR. 33

Moderato (♩ = 54)

This technique may be performed slurred or detached.

Unusual Placements of the Bow

To vary the tone color, the bow may be drawn across the string at several different points, such as on the fingerboard or on the bridge. To change the color in a different fashion, the wood instead of the hair of the bow may be drawn over the string.

Sul tasto (IT.); *Sur la touche* (FR.); *Am Griffbrett* (GER.)

CD-ROM
CD-1
SUL TASTO

In order to obtain a rather flutelike, soft, and hazy tone, the composer may ask the performer to play with the bow on the fingerboard, as in the following example.

EXAMPLE 2-51. Debussy, *Ibéria*, part 2, at [40]

CD-1/TR. 34

♩ = 92
sur la touche (*espressif et doucement soutenu*)

When the term *flautando* is used instead of *sul tasto*, the player should play *near* but not *on* the fingerboard. The difference is really minimal, and many composers make no distinction between *sul tasto* and *flautando*.

■ ADDITIONAL PASSAGE FOR STUDY

Debussy, *Prélude à "L'après-midi d'un faune,"* mm. 96–98

CD-ROM
CD-1
SUL PONTICELLO

Sul ponticello (It.); *Au chevalet* (Fr.); *Am Steg* (Ger.)

This effect is produced by playing very near or right on the bridge instead of between the fingerboard and the bridge, the regular space allotted for the bow stroke. Since this produces upper partials of a tone that are not usually heard, the pitch takes on an eerie, somewhat glassy timbre.

CD-1/TR. 35

EXAMPLE 2-52. Puccini, *Madama Butterfly*, Act I, 3 mm. before [38]



Sul ponticello is often combined with bowed or fingered tremolo.

■ ADDITIONAL PASSAGE FOR STUDY

R. Strauss, *Sinfonia domestica* (throughout)

CD-ROM
CD-1
COL LEGNO
TRATTO

Col legno (It.); *Avec le bois* (Fr.); *Mit Holz* (Ger.)

Two ways of playing with the wood of the bow are:

***Col legno tratto*.** For this effect, the bow is turned over and the wooden stick is dragged across the string. Since the wood of the bow is less resistant to the string than the hair, the resulting sound is wispy and rather eerie. This technique is most useful for tremolo, as in Example 2-53, although sometimes it is used in legato passages.

CD-1/TR. 36

EXAMPLE 2-53. R. Strauss, *Also sprach Zarathustra*, at [12]



CD-ROM
CD-1
COL LEGNO
BATTUTO

***Col legno battuto*.** Here, the performer strikes the string with the wood of the bow. This effect is more commonly used than *col legno tratto*, and it, too, gives very little pitch definition, except in the extreme high and low registers, depending on which of the strings are struck. Its percussive sound resembles a very dry and short *spiccato*.

EXAMPLE 2-54. Berlioz, *Symphonie fantastique*, fifth movement, mm. 444-455

CD-1/TR. 37

Allegro
frappez avec les bois de l'archet

Vln. 1
Vln. 2
Vla.
Vlc. 1
Vlc. 2
D.B.

frappez avec les bois de l'archet
(col legno battuto)
pizz.
pp pizz.
pp

Every time a special effect, such as *col legno*, *col legno battuto*, or *sul ponticello* is used, you must insert the indication *normale*, *naturale*, or *in modo ordinario* in the score at the point where the player should resume normal bowing. The English word "natural" is sometimes substituted in American scores (for example, see those of Copland, Schuman, and Persichetti).

■ ADDITIONAL PASSAGE FOR STUDY

Mahler, *Symphony No. 1*, third movement, mm. 135-137

COLORISTIC EFFECTS WITHOUT THE BOW

Pizzicato

Another mode of producing pitches on string instruments involves plucking the strings. This playing technique, called *pizzicato*, is used quite frequently.

CD-ROM
CD-1
PIZZICATO



1
7
v
tl
p
tl
n

CD-1/TR. 38

EXAMPLE 2-55. Brahms, *Symphony No. 1*, fourth movement, mm. 1–17

7 string. poco a poco

12

Left-Hand Pizzicato

This effect is much more prevalent in solo literature and chamber music than in orchestral works. When a cross, +, appears above a note, the string is plucked with one of the fingers of the left hand. Often, these are open strings, and the little finger is used to pluck. At other times a whole series of pitches is to be plucked with the left hand. In that case, the finger that is held down to produce the highest pitch plucks the next highest pitch, and so forth, in the following manner:

EXAMPLE 2-56. Left-Hand Pizzicato

spiccato pizz. pizz. pizz. pizz.

all pizz. notes with left hand

Here, the B is played with the bow *spiccato*, then the fourth finger plucks the A; the third finger, the G; the second finger, the F; the first finger, the open E string.

CD-1/TR. 39

EXAMPLE 2-57. Bartók, String Quartet No. 5, third movement, mm. 54–56

Alla bulgarese
a tempo

Vln. 1
Vln. 2
Vla.
Vlc.

mf *mp* *p*

pizz. *pizz.* *pizz.*

arco *mf* *mp* *p*

CD-ROM
CD-1
SNAP PIZZICATO

Snap or Fingernail Pizzicato

These two modes of playing pizzicato are twentieth-century innovations often associated with the works of Béla Bartók. The sign for the snap pizzicato is \diamond , and it is performed by snapping the string against the fingerboard. The sign must be placed above the note that is to be snapped. Fingernail pizzicato is indicated by a \frown , and is executed by pulling the string with the fingernail. In some scores, the term *pizz.* also appears with the special symbol, leaving no doubt as to how this effect should be performed. In many cases, however, *pizz.* does not appear, since the mode of playing is implicit in the snap or fingernail pizzicato sign.

CD-1/TR. 40

EXAMPLE 2-58. Bartók, String Quartet No. 4, fourth movement, mm. 56–63

Allegretto

Vln. 1
Vln. 2
Vla.
Vlc.

mf *mp* *p*

ben marcato *ben marcato*

Pizzicato Chords

When no preference is expressed by the composer or orchestrator (such as the term *non arpegg.*), the performer will strum a chord of three or four notes from the bottom up, creating an arpeggiated effect that can be held to a minimum by incisive, sudden finger strokes. In some cases, *non arpegg.* is specified. The pizzicato chord is performed in the following manner:

EXAMPLE 2-59. Pizzicato Chords

Sometimes the composer wants the chord played from top to bottom, or in the case of a repeated chord, alternating between bottom to top, top to bottom. In

these cases, a directional sign $\uparrow \downarrow$ is placed in front of each chord. Occasionally, the phrase *quasi chitarra* or *a la chitarra* is printed in the part and score, or arrows are placed above the chords.

EXAMPLE 2-60. Bartók, *Concerto for Orchestra*, fifth movement, mm. 5–9

CD-ROM
CD-1
PIZZICATO
CHORDS

CD-1/TR. 41

A word of caution must be added concerning endurance and speed. A long, fast pizzicato passage, played without rests, becomes very fatiguing for the performer. Some string players have perfected a technique of using the index and middle fingers alternately to facilitate a lengthy pizzicato passage. Nevertheless, occasional rests and alternation between first and second violins or violas and cellos helps alleviate any physical discomforts of the players. Here is an example of a successful lengthy pizzicato passage from the orchestral literature; notice the periodic rests that are interspersed:

CD-1/TR. 42

EXAMPLE 2-61. Tchaikovsky, Symphony No. 4, third movement, mm. 1-17

Allegro
pizzicato sempre

1
pizzicato sempre
p

9

For additional pizzicato examples, see the pizzicato movements of Britten, *A Simple Symphony*; Foote, *Suite for Strings in E*; and Debussy, *Ibéria*, part 3.

Pizzicato is similar to staccato and spiccato bowing in that the sound dies away quickly. To indicate that a pizzicato note is to sound as long as possible, composers sometimes write pitches with indeterminate slurs following them and signal a long, "sustained" pizz. with the phrase "let vibrate," *vib.*, or *l.v.*

EXAMPLE 2-62. D. Diamond, Symphony No. 4, second movement, m. 1

CD-1/TR. 43

Adagio ($\text{♩} = 60$)

Vln. 1

Vln. 2

Vla.

Vlc.

D.B.

MUTES

CD-ROM
CD-1
MUTING*Con sordino* (IT.); *Avec sourdine* (FR.); *Mit Dämpfer* (GER.)

All string instruments can be muted. The designation most often used when a mute is called for is *con sordino* ("with mute"). At that point in the score, the player places a small plastic, wooden, or metal object on the bridge, thus absorbing some of the vibrations and obtaining a very soft and smooth sound. When a mute is used, the tone quality is radically altered, and although most muted passages are soft, it is possible to write forte or fortissimo portions of a work for muted strings. The loud muted passage takes on a special quality of restraint and a sound that is more constricted, tenser. The composer or orchestrator should listen carefully to both soft and loud muted passages to recognize and appreciate this peculiar sound.

EXAMPLE 2-63. Weber, *Oberon*, Overture, mm. 13–21

CD-1/TR. 44

Adagio
con sordino

Vln. 1

Vln. 2

Vla.

Vlc.

16

Vln. 1

Vln. 2

Vla.

Vcl. 1

Vcl. 2

D.B. tacet

senza sordino

senza sordino

1.

2.

Senza sordino (IT.); Sans sourdine (FR.); Ohne Dämpfer (GER.)

A special word of caution must be stated in connection with the muting and un-muting of strings: enough time must be allowed so that players can put on or take off the mutes quietly. Some players now use clips that easily slide to the back of the bridge or that attach to it easily. But others still use the older mutes, which need to be placed on the bridge, removed from it, and put away, all of which takes considerably more time to accomplish.

At all times the player must be careful not to divert attention from the music when mutes are put on or taken off. This is especially so in soft passages, as in Example 2-63 above, where the violins must take off their mutes over the violas' softly held notes.

SCORDATURA

The open string of all string instruments can be altered in pitch to create certain coloristic effects or for other practical considerations. This is called *scordatura*, an Italian term meaning mistuning. Each string may be tightened or loosened to produce a pitch other than that of the normal tuning. Scordatura tuning has been used since the seventeenth century to facilitate the playing of difficult passages in remote keys, to obtain unusual chords, and to change the tone color of the instrument. When a scordatura tuning is required, the composer or orchestrator must indicate the tuning of the four strings in both the score and parts either at the beginning of the piece or at the point in the work when the retuning is necessary. Plenty of time must be allowed after the scordatura passage is over if the player is to return to the original tuning, which is signaled by the word *accord* or *accordatura*.

Here are some examples of famous scordatura passages:

CD-1/TR. 45

EXAMPLE 2-64. Saint-Saëns, *Danse macabre*, tuning and mm. 25-32

Tuning

25

Vln. solo

f

sim.

(The "o" here stands for the open string.)

EXAMPLE 2-65. Mahler, Symphony No. 4, second movement, mm. 6–18*

CD-1/TR. 46

In gemächlicher bewegung

Ohne hast

Tuning

Vln. solo

EXAMPLE 2-66. Stravinsky, *Le Sacre du printemps*, last measure

non arpeggiato

Descendez le "la" un demi-ton plus bas

Vlc.

At the end of Stravinsky's *Le Sacre du printemps*, the composer asks the cellos to lower the A string to G \flat so that the final chord can be played. This chord could not be executed if this scordatura were not asked for.

In the Mahler example, scordatura is used coloristically to make the violin sound like a "cheap fiddle"; the straining of all four strings caused by raising each a whole tone removes much of the noble sound we usually associate with the instrument. Scordatura is used much more today for similar reasons. In years past, however, it facilitated playing in difficult keys; for example, a viola would be retuned D \flat -A \flat -E \flat -B \flat and its part written out in D major. This may be observed in the solo viola part of Mozart's *Sinfonia concertante* (K. 364) in E \flat major, where scordatura was thought to facilitate the performance. Another valid musical reason for the retuning is the increased tension on the string that gives the viola much greater brilliance.

HARMONICS

Armonici (IT.); *Harmoniques* (FR.); *Flageolettöne* or *Flageolet* (GER.)

Up until now we have focused on pitches produced either on an open string or sounded by pressing the string tightly against the fingerboard with the finger. All string instruments are capable of two other ways of producing pitches. The first produces a series of pitches called the *natural harmonics*, the second, a series called the *artificial harmonics*.

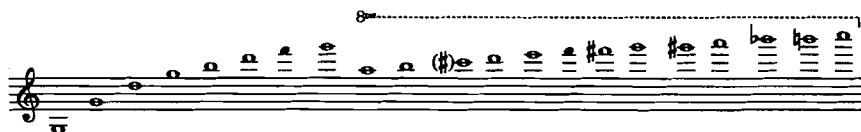
*The additional flats in the key signature are necessary to place the solo violin in the key of the rest of the orchestra, since all pitches must sound a minor second lower than notated.

CD-ROM
CD-1
NATURAL
HARMONICS

Natural Harmonics

Natural harmonics are pitches produced by touching a string lightly at various points called *nodes*,* along the string. On a G string the resulting pitches, called *harmonics* or *partials*, are as follows:

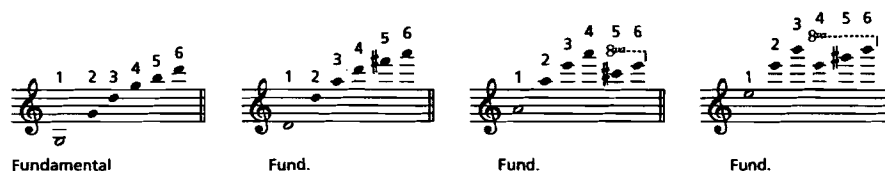
EXAMPLE 2-67. Harmonic series on G



Every pitch produced on any sounding body—whether a string or a vibrating air column—is a combination of the open string, called the *fundamental* or *first harmonic* (or *first partial*), and some overtones (second partial and higher). These notes are usually heard as a single or composite tone. The overtones give individual color or timbre to the fundamental and can be isolated from it on a string instrument by touching the string lightly at different nodes rather than by pressing the string firmly against the fingerboard. When the A string of a viola is lightly touched halfway between the nut and the bridge, for example, the string is prevented from vibrating as a whole. Its vibrating length is actually cut into halves, each sounding an octave higher than the pitch of the open string itself (in a ratio of 2:1). In theory it does not matter whether the bow is drawn across the string at the nut or on the bridge side of the node, since either half of the string gives the higher octave.

On the violin, the natural harmonics can be translated into the following notes:

EXAMPLE 2-68. Natural Harmonics



In Example 2-68, the first six partials (remember that the first is the fundamental) are given because they are the strongest and most successfully produced harmonics. Higher harmonics (up to the seventh or eighth partial) are quite easy to obtain on the viola, cello, and double bass, since the strings are longer and thicker.

Examples 2-69 through 2-72 show where on the lowest string of each string instrument the various natural harmonics can be produced:

1. First partial: The fundamental, of course, is played on the open string.
2. Second partial: Lightly touching the string halfway between the nut and the bridge will produce a pitch an octave higher than the fundamental.

*Nodes are the points of rest between vibrating (or oscillating) portions of a string. If the same node is touched firmly, the resulting pitch would be the same as that of the harmonic, but, of course, with a different timbre.

EXAMPLE 2-69. Natural Harmonics, Second Partial

Violin Sul G or IV	Viola Sul C or IV	Cello Sul C or IV	Double Bass Sul E or IV
			

3. Third partial: This partial can be produced in two different ways:
- Lightly touching the string one-third of its length from the nut or the bridge.
 - Lightly touching the string two-thirds of its length from the nut or the bridge.

EXAMPLE 2-70. Natural Harmonics, Third Partial

Violin Sul G	Viola Sul C	Cello Sul C	Double Bass Sul E
			

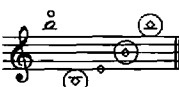
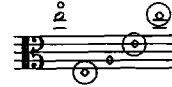

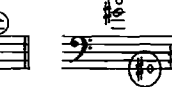
4. Fourth partial: This partial can be obtained in two different ways:
- Lightly touching the string one-fourth of its length from the nut or the bridge.
 - Lightly touching the string three-fourths of its length from the nut or the bridge.

EXAMPLE 2-71. Natural Harmonics, Fourth Partial

Violin Sul G	Viola Sul C	Cello Sul C	Double Bass Sul E
			

5. Fifth partial: This partial may be produced in four different ways, but only options a, c, and d (circled in Example 2-72) are secure enough to employ for orchestral use. Option b is used mainly in solo and chamber music.
- Lightly touching the string one-fifth of its length from the nut (or four-fifths from the bridge).
 - Lightly touching the string two-fifths of its length from the nut (or three-fifths from the bridge).
 - Lightly touching the string three-fifths of its length from the nut (or two-fifths from the bridge).
 - Lightly touching the string four-fifths of its length from the nut (or one-fifth from the bridge).


EXAMPLE 2-72. Natural Harmonics, Fifth Partial

Violin Sul G	Viola Sul C	Cello Sul C	Double Bass Sul E
			

Notation of Natural Harmonics

As can be seen in Examples 2-69 through 2-72, two methods are used to notate harmonics:

1. A small circle over the note intended to sound as a harmonic; or
2. A diamond-shaped note at the pitch where the node producing the desired note can be found on the string.

Notice that in the examples given above, the string on which the various harmonics are to be reproduced is specified. That is because some pitches of the harmonic series on one string are duplicated on another. For example, on the violin, the pitch  could be produced as a harmonic on the G as well as D string. Therefore, the string on which the pitch should be obtained must be specified. If it is to be on the G string, the term *sul G* should be used; or, for those who wish to designate the strings by roman numerals, IV (the lowest string). The following chart gives the roman numerals for each string on the four instruments of the violin family:

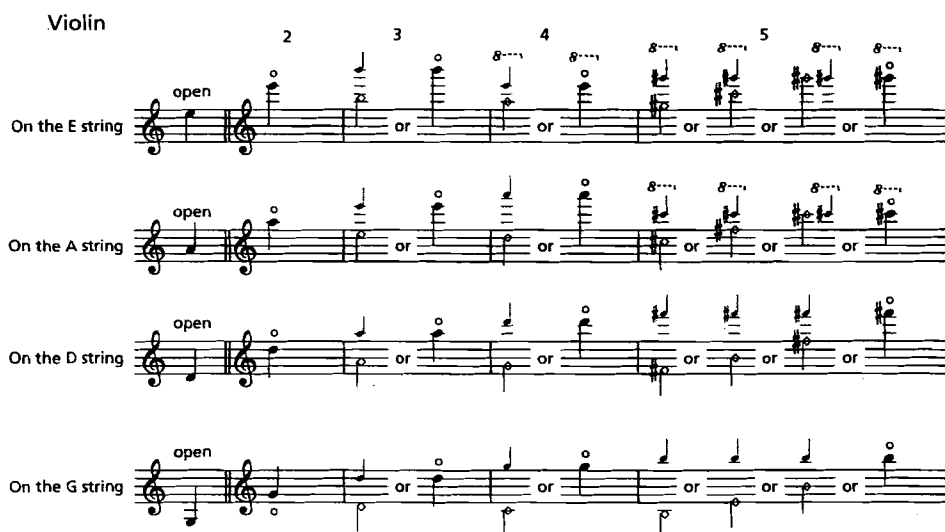
NOMENCLATURE OF THE STRINGS

<i>Violin</i>	<i>Viola</i>	<i>Cello</i>	<i>Double Bass</i>
I = E	I = A	I = A	I = G
II = A	II = D	II = D	II = D
III = D	III = G	III = G	III = A
IV = G	IV = C	IV = C	IV = E

The following chart shows the various ways of notating harmonics up to the fifth partial on all open strings; the small noteheads above the diamond-shaped notes indicate the resulting harmonics. We also provide partials six through ten for the bass, since those partials are possible to produce on this instrument. Since the third, fourth, and fifth harmonics can be notated in at least two ways—the fifth harmonic actually in four—all are shown here.

QUICK REFERENCE TABLE OF NATURAL STRING HARMONICS PRACTICAL FOR ORCHESTRAL SCORING

Violin



On the E string

On the A string

On the D string

On the G string

Viola

2 3 4 5

open

On the A string

open

On the D string

open

On the G string

open

On the C string

Cello

2 3 4 5

open

On the A string

open

On the D string

open

On the G string

open

On the C string

Double Bass

2 3 4 5 6 7 8 9 10

open

On the G string

open

On the D string

open

On the A string

open

On the E string

Artificial Harmonics

Artificial harmonics produce the flutey, silvery sound that is characteristic of natural harmonics, but involve manipulations of the fingers beyond simply lightly touching the open string. The most practical way of producing artificial harmonics is by lightly touching the node the interval of a 4th above a pitch that is stopped by another finger, and we suggest that this method be adopted for orchestral performance. On the violin and viola, the player stops a pitch with the first finger and simultaneously lightly touches the node a 4th above with the fourth finger. This produces a pitch two octaves above the stopped pitch. On the cello, an artificial harmonic can be effected by using the thumb to stop the string and the third or fourth finger to touch the node a 4th above. Since artificial harmonics on the double bass are hard to produce, we do not recommend their use—even though some contemporary composers have called for them in solo music. The necessary stretch of the bassist's hand makes it practically impossible to play them cleanly. Other methods of producing artificial harmonics on the violin and viola, which are used in solo and chamber works, will be discussed in the next chapter in sections devoted to those instruments.

Notation of Artificial Harmonics

1. A normal note with a diamond-shaped note a 4th above it.

EXAMPLE 2-73. Notation of Artificial Harmonics



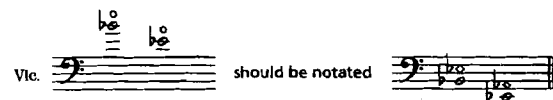
2. A normal note with a diamond-shaped note a 4th above, plus the actual intended note added above in parentheses.

EXAMPLE 2-74. Notation of Artificial Harmonics



3. A small circle above the note that is actually heard as a harmonic. This manner of notation is chancy, for the orchestrator should be responsible for indicating the method of producing the harmonic (that is, touching a 4th above the stopped note) rather than the performer.

EXAMPLE 2-75. Notation of Artificial Harmonics



A question often asked is how high one can or should write artificial harmonics. Although theoretically there is almost no limitation, practically, there is a reasonable limit, especially for orchestral use, as shown in Example 2-76. Artificial harmonics higher than these are insecure and often do not speak.

EXAMPLE 2-76. The Highest Practical Artificial Harmonics



Representative Passages from the Literature

Here are three extended passages that employ harmonics:

EXAMPLE 2-78. Debussy, *Ibéria*, part 1, at [15]

CD-1/TR. 48



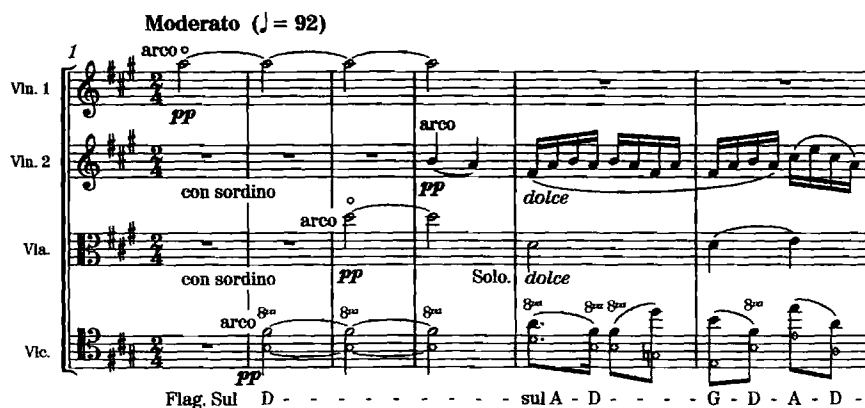
EXAMPLE 2-77. Saint-Saëns, Violin Concerto, second movement, end (last 13 mm. only heard on recording)

CD-1/TR. 47



EXAMPLE 2-79. Borodin, String Quartet No. 1, third movement, Trio, mm. 1-20

CD-1/TR. 49



7

Vln. 1

Vln. 2

Vla.

Vlc.

- - A - - - D - - - G - D - A - D - A - - -

p dolce

12

Vln. 1

Vln. 2

Vla.

Vlc.

Sul A - D - - - G - D - A - D - - A - - -

- - - D - - - G - D - A - - - D - A - - - - D -

17

Vln. 1

Vln. 2

Vla.

Vlc.

- - - D - - - G - D - A - D - A - - - E - - - A

- - - G - D - A - - -

■ ADDITIONAL PASSAGES FOR STUDY

Barber, *Medea*, "Dance of Vengeance," at [31]

Berg, *Wozzeck*, Act I, Scene 2, just before [230], and Act III, Scene 5, 1 m. before [380]

Copland, *Symphony No. 3*, second movement, mm. 100–106 (first violins); see also Example 3-18

Ravel, *Shéhérazade*, 3 mm. after [5]

Rimsky-Korsakov, *Sheherazade*, second movement, *Vivace scherzando*

Schoenberg, *Violin Concerto*, first movement, mm. 212–225 (extensive use in solo part)


Webern, Six Pieces for Orchestra, Op. 6, No. 5; see also Example 3-19
 Webern, Five Pieces for Orchestra, Op. 10, second movement

CONTEMPORARY STRING TECHNIQUES


During the past forty years, a great number of innovations in string technique have been added to the vocabulary. There are so many modifications, in fact, that entire volumes are devoted to a discussion of these newer techniques. Here, it is only possible to mention some of the most important and codify in terms of notation those most commonly used. Such books as David H. Cope's *New Directions in Music* (McGraw-Hill), Gardner Read's *Contemporary Instrumental Techniques* (Schirmer Books), and Kurt Stone's *Music Notation in the Twentieth Century* (W. W. Norton) can be consulted for a more complete discussion of these techniques.


Some of the most important contemporary innovations in string technique are the following. The notational signs included in this list are those most commonly used*:

1. Playing on the wrong side of the bridge—that is, the tailpiece, not the fingerboard



 playing all four strings behind the bridge

 three strings

 two strings

 one string only


One can also play *col legno* behind the bridge.

2. Playing the tailpiece with the bow hair or striking it with the wood of the bow . (If the performers are to strike the tailpiece with the wood of the bow, the word *battute* should precede the passage.)
3. Knocking, rapping, or tapping on the body of the instrument either with one's fingers or knuckles. This is usually requested on the score in a foot note and further explained there. Usual notation: 

4. Performing wide vibratos, as represented by the notation: 

5. Bowing on a harmonic node with great pressure in order to produce notes well below the open string of the instrument (called subharmonics or undertones).

6. Playing, in any mode specified, the highest note on a particular string

 (here on the G string); or if this sign is used without designating a string, simply playing the highest note on the instrument.

*For an excellent example of practical guidance regarding the use of new notation in an orchestral score, see Example 5-32a, p. 149.

7. Fingering a passage without drawing the bow across the strings, as in Foss's *Time Cycle*, second movement (1 measure before 95). This gives a quiet, ghostly sound, with almost inaudible pitches and the slight sound of the fingers slapping down on the strings.
8. Executing pizzicatos with plectrums or hair combs.
9. Playing half harmonics by either touching the string lightly not at a harmonic node or touching it more firmly than usual at a harmonic node. This effect sounds somewhat like *sul tasto*.

Many harmonics that have been considered unplayable on the double bass are now being performed in solo and chamber music literature, but they would be dangerous to use in orchestral writing.

10. Bowing near the nut rather than the bridge "on the wrong side of the left hand" in order to produce a viol-like sound. This technique is typical of George Crumb and some other recent composers. The fingering, of course, would be reversed; Crumb even asks that the beginning pitch be marked on the fingerboard with a chalk mark. This effect is required in his *Black Angels*, a work for amplified string quartet. It should not be casually used in orchestral works, however, because few players would be able to produce it.

When any of these devices is used in an orchestral score or, for that matter, anywhere in a work, whether solo, chamber, or orchestral, a verbal description of the desired sounds, as well as the exact technique by which the sounds may be realized, must be included in the score. In the interest of maximum communication between composer and performer, we suggest that the procedures outlined in Kurt Stone's *Music Notation in the Twentieth Century* be adopted.