Table of IR Absorptions

| *Functional Group* | *Characteristic Absorption(s)*(cm-1) | *Notes* |
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| Alkyl C-H Stretch | 2950 - 2850 (m or s) | Alkane C-H bonds are fairly ubiquitous and therefore usually less useful in determining structure. |
| Alkenyl C-H Stretch Alkenyl C=C Stretch | 3100 - 3010 (m) 1680 - 1620 (v) | Absorption peaks above 3000 cm-1 are frequently diagnostic of unsaturation |
| Alkynyl C-H Stretch Alkynyl C=C Stretch | ~3300 (s) 2260 - 2100 (v) |  |
| Aromatic C-H Stretch Aromatic C-H Bending Aromatic C=C Bending | ~3030 (v) 860 - 680 (s) 1700 - 1500 (m, m) |  |
| Alcohol/Phenol O-H Stretch | 3550 - 3200 (broad, s) | See ["Free vs. Hyrdogen-Bonded Hydroxyl Groups"](http://www.chem.ucla.edu/~webspectra/irintro.html#hydroxyl) in the [Introduction to IR Spectra](http://www.chem.ucla.edu/~webspectra/irintro.html) for more information |
| Carboxylic Acid O-H Stretch | 3000 - 2500 (broad, v) |  |
| Amine N-H Stretch | 3500 - 3300 (m) | Primary amines produce two N-H stretch absorptions, secondary amides only one, and tertiary none. |
| Nitrile C=N Stretch | 2260 - 2220 (m) |  |
| Aldehyde C=O Stretch Ketone C=O Stretch Ester C=O Stretch Carboxylic Acid C=O Stretch Amide C=O Stretch | 1740 - 1690 (s) 1750 - 1680 (s) 1750 - 1735 (s) 1780 - 1710 (s) 1690 - 1630 (s) | The carbonyl stretching absorption is one of the strongest IR absorptions, and is very useful in structure determination as one can determine both the number of carbonyl groups (assuming peaks do not overlap) but also an estimation of which types. |
| Amide N-H Stretch | 3700 - 3500 (m) | As with amines, an amide produces zero to two N-H absorptions depending on its type. |

*All figures are for the typical case only -- signal positions and intensities may vary depending on the particular bond environment*

| **Typical Infrared Absorption Frequencies** | | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Stretching Vibrations** | | | **Bending Vibrations** | | |
| **Functional Class** | **Range (cm-1)** | **Intensity** | **Assignment** | **Range (cm-1)** | **Intensity** | **Assignment** |
| **Alkanes** | 2850-3000 | str | CH3, CH2 & CH 2 or 3 bands | 1350-1470 1370-1390 720-725 | med med wk | CH2 & CH3 deformation CH3 deformation CH2 rocking |
| [**Alkenes**](http://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/Spectrpy/InfraRed/irspec1.htm#ir2) | 3020-3100 1630-1680  1900-2000 | med var  str | =C-H & =CH2 (usually sharp)  C=C (symmetry reduces intensity)  C=C asymmetric stretch | 880-995 780-850 675-730 | str med med | =C-H & =CH2 (out-of-plane bending) cis-RCH=CHR |
| **Alkynes** | 3300 2100-2250 | str var | C-H (usually sharp) C≡C (symmetry reduces intensity) | 600-700 | str | C-H deformation |
| [**Arenes**](http://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/Spectrpy/InfraRed/irspec1.htm#ir3) | 3030 1600 & 1500 | var med-wk | C-H (may be several bands) C=C (in ring) (2 bands) (3 if conjugated) | 690-900 | str-med | C-H bending & ring puckering |
| [**Alcohols & Phenols**](http://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/Spectrpy/InfraRed/irspec1.htm#ir4) | 3580-3650 3200-3550 970-1250 | var str str | O-H (free), usually sharp O-H (H-bonded), usually broad C-O | 1330-1430 650-770 | med var-wk | O-H bending (in-plane) O-H bend (out-of-plane) |
| [**Amines**](http://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/Spectrpy/InfraRed/irspec1.htm#ir4c) | 3400-3500 (dil. soln.) 3300-3400 (dil. soln.) 1000-1250 | wk wk med | N-H (1°-amines), 2 bands N-H (2°-amines) C-N | 1550-1650 660-900 | med-str var | NH2 scissoring (1°-amines) NH2 & N-H wagging (shifts on H-bonding) |
| [**Aldehydes & Ketones**](http://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/Spectrpy/InfraRed/irspec1.htm#ir5) | 2690-2840(2 bands) 1720-1740 1710-1720  1690  1675  1745  1780 | med str str  str str str str | C-H (aldehyde C-H) C=O (saturated aldehyde)  C=O (saturated ketone)  aryl ketone α, β-unsaturation cyclopentanone cyclobutanone | 1350-1360 1400-1450  1100 | str str med | α-CH3 bending α-CH2 bending C-C-C bending |
| [**Carboxylic Acids**](http://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/Spectrpy/InfraRed/irspec1.htm#ir4b)**&**[**Derivatives**](http://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/Spectrpy/InfraRed/irspec1.htm#ir5b) | 2500-3300 (acids) overlap C-H 1705-1720 (acids) 1210-1320 (acids)  1785-1815 ( acyl halides)  1750 & 1820 (anhydrides)      1040-1100  1735-1750 (esters)      1000-1300  1630-1695(amides) | str str med-str  str str str str str str | O-H (very broad) C=O (H-bonded)  O-C (sometimes 2-peaks)  C=O C=O (2-bands)     O-C C=O     O-C (2-bands) C=O (amide I band) | 1395-1440        1590-1650  1500-1560 | med        med med | C-O-H bending        N-H (1¡-amide) II band N-H (2¡-amide) II band |
| **Nitriles  Isocyanates,Isothiocyanates, Diimides, Azides & Ketenes** | 2240-2260  2100-2270 | med  med | C≡N (sharp)  -N=C=O, -N=C=S -N=C=N-, -N3, C=C=O |  | | |