
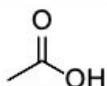

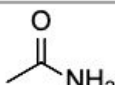
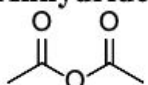
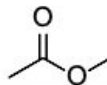



Appendix D: IR Absorption Frequencies of Common Functional Groups

Functional Group	Type of Vibration	Characteristic Absorptions (cm ⁻¹)	Strength/Shape
Alcohol	R-OH		
O-H	(stretch, H-bonded)	3200-3600	strong, broad
O-H	(stretch, free)	3500-3700	strong, sharp
C-O	(stretch)	1050-1150	strong
Alkane			
C-H	stretch	2850-3000	strong
Alkene	C=C		
=C-H	stretch	3010-3100	medium
C=C	stretch	1620-1680	variable
Alkyne	C≡C		
C-H	stretch	3300	strong, sharp
C≡C	stretch	2100-2260	variable, not present in symmetrical alkynes
Amine	-NR₂		
N-H	stretch	3300-3500	medium (primary amines have two bands; secondary have one band, often very weak)
C-N	stretch	1080-1360	medium-weak
N-H	bending	1600	medium
Aromatic			
C-H	stretch	3000-3100	medium-weak
C=C	stretch	1400-1600	medium-weak, multiple bands
Analysis of C-H out-of-plane bending can often distinguish substitution patterns			
Carbonyl	<u>See detailed information on carbonyl IR on next page</u>		
C=O	stretch	1670-1820	strong
(conjugation moves absorptions to lower wave numbers)			
Ether	R-O-R		
C-O	stretch	1000-1300 (1070-1150)	strong
Nitrile	-C≡N		
-C≡N	stretch	2210-2260	medium
Nitro	-NO₂		
N-O	stretch	1515-1560 & 1345-1385	strong, two bands

IR Absorption Frequencies of Functional Groups Containing a Carbonyl (C=O)

Functional Group	Type of Vibration	Characteristic Absorptions (cm ⁻¹)	Strength/Shape
Carbonyl			
C=O	stretch	1670-1820	strong
(conjugation moves absorptions to lower wave numbers)			
Acid 			
C=O	stretch	1700-1725	strong
O-H	stretch	2500-3300	strong, very broad
C-O	stretch	1210-1320	strong
Aldehyde 			
C=O	stretch	1740-1720	strong
=C-H	stretch	2820-2850 & 2720-2750	medium, two peaks
Amide 			
C=O	stretch	1640-1690	strong
N-H	stretch	3100-3500	unsubstituted have two bands
N-H	bending	1550-1640	
Anhydride 			
C=O	stretch	1800-1830 & 1740-1775	two bands
Ester 			
C=O	stretch	1735-1750	strong
C-O	stretch	1000-1300	two bands or more
Ketone 			
acyclic	stretch	1705-1725	strong
cyclic	stretch	3-membered - 1850 4-membered - 1780 5-membered - 1745 6-membered - 1715 7-membered - 1705	strong
α,β-unsaturated (conjugated)	stretch	1665-1685	strong