^{13}C-NMR ABSORPTIONS OF MAJOR FUNCTIONAL GROUPS

The table below lists the range of ^{13}C chemical shifts δ in parts per million relative to tetramethylsilane, in descending order, for various functional groups. Examples of simple compounds for each family are given to illustrate the correlations. The shifts for the carbons of interest, which are italicized, are given in parentheses; when two or more values appear, they refer to the sequence of italicized carbon atoms from left to right in the formula.

References

1. Yoder, C. H. and Schaeffer, C. D., Jr., *Introduction to Multinuclear NMR: Theory and Application*, Benjamin/Cummings, Menlo Park, CA, 1987.
2. Silverstein, R. M., Bassler, G. C., and Morrill, T. C., *Spectrometric Identification of Organic Compounds*, John Wiley & Sons, New York, 1981.
3. Brown, D. W., A Short Set of ^{13}C NMR Correlation Tables, *J. Chem. Educ.*, 62, 209, 1985.

δ (ppm)	Group	Family	Example (δ of italicized carbon)	
220-165	>C=O	Ketones	$(CH_3)_2\mathit{C}O$	(206.0)
			$(CH_3)_2CH\mathit{C}OCH_3$	(212.1)
		Aldehydes	$CH_3\mathit{C}HO$	(199.7)
		α,β-Unsaturated carbonyls	$CH_3CH{=}CH\mathit{C}HO$	(192.4)
			$CH_2{=}CH\mathit{C}OCH_3$	(169.9)
		Carboxylic acids	$H\mathit{C}O_2H$	(166.0)
			$CH_3\mathit{C}O_2H$	(178.1)
		Amides	$H\mathit{C}ONH_2$	(165.0)
			$CH_3\mathit{C}ONH_2$	(172.7)
		Esters	$CH_3\mathit{C}O_2CH_2CH_3$	(170.3)
			$CH_2{=}CH\mathit{C}O_2CH_3$	(165.5)
140-120	>C=C<	Aromatic	C_6H_6	(128.5)
		Alkenes	$\mathit{C}H_2{=}CH_2$	(123.2)
			$\mathit{C}H_2{=}\mathit{C}HCH_3$	(115.9, 136.2)
			$\mathit{C}H_2{=}\mathit{C}HCH_2Cl$	(117.5, 133.7)
			$CH_3CH{=}\mathit{C}HCH_2CH_3$	(132.7)
125-115	-CN	Nitriles	$CH_3\text{-}\mathit{C}N$	(117.7)
80-70	-CC-	Alkynes	$H\mathit{C}\mathit{C}H$	(71.9)
			$CH_3\mathit{C}\mathit{C}CH_3$	(73.9)
70-45	-C-O	Esters	$\mathit{C}H_3OO\mathit{C}H_2CH_3$	(57.6, 67.9)
		Alcohols	$HO\mathit{C}H_3$	(49.0)
			$HO\mathit{C}H_2CH_3$	(57.0)
40-20	-C-NH_2	Amines	$\mathit{C}H_3NH_2$	(26.9)
			$CH_3\mathit{C}H_2NH_2$	(35.9)
30-15	-S-CH_3	Sulfides (thioethers)	$C_6H_5\text{-}S\text{-}\mathit{C}H_3$	15.6
30-(-2.3)	-C-H	Alkanes, cycloalkanes	$\mathit{C}H_4$	(-2.3)
			$\mathit{C}H_3CH_3$	(5.7)
			$\mathit{C}H_3\mathit{C}H_2CH_3$	(15.8, 16.3)
			$\mathit{C}H_3\mathit{C}H_2\mathit{C}H_2CH_3$	(13.4, 25.2)
			$\mathit{C}H_3\mathit{C}H_2\mathit{C}H_2\mathit{C}H_2CH_3$	(13.9, 22.8, 34.7)
		Cyclohexane		(26.9)