Mild Synthesis of Substituted 1,2,5-Oxadiazoles Using 1,1' Carbonyldiimidazole as a Dehydrating Agent

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Supporting Information

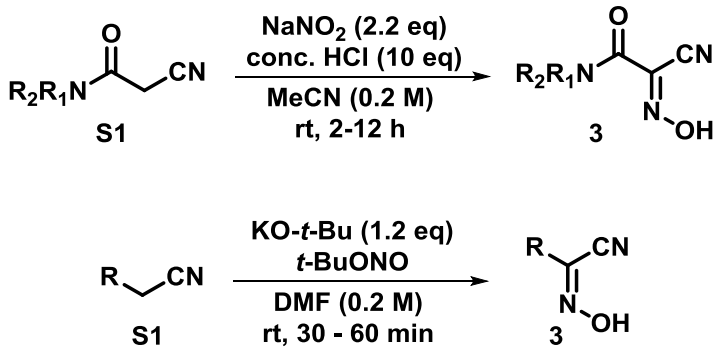
General Information

Unless otherwise noted, all reagents were purchased from commercial suppliers and used without further purification. Unless otherwise noted, all reactions were conducted in standard glassware without special precaution to exclude air or moisture. Thin layer chromatography (TLC) analysis of reaction mixtures was performed using Merck KGaA silica gel 60 F_{254} TLC plates and visualized using UV light and/or potassium permanganate solution. Column chromatography was conducted using a Teledyne Isco CombiFlash system equipped with disposable RediSep R_f silica columns. Nuclear magnetic resonance (NMR) spectra were recorded using Bruker 500 and 400 MHz spectrometers. ^{1}H and ^{13}C chemical shifts are reported in parts per million (ppm) downfield of tetramethylsilane (TMS) and referenced to residual solvent peak ($CHCl_3$; δH = 7.26 ppm and δC = 77.0 ppm, DMSO; δH = 2.50 and δC = 39.5 ppm). Multiplicities are reported using the following abbreviations: s = singlet, d = doublet, t = triplet, q = quartet, app d = apparent double, app t = apparent triplet, m = multiplet, br = broad resonance. Solvent abbreviations are reported as follows: EtOAc = ethyl acetate, hexs = hexanes, DCM = dichloromethane, MeOH = methanol, THF = tetrahydrofuran, DMF = N,N-dimethylformamide, Et_3N = trimethylamine. Ultra-performance liquid chromatography (UPLC) analysis was conducted using an Agilent 1290 Infinity II using a Waters Acquity C18 UPLC column (2.1 x 100 mm, 1.7 μm). Cyano-oxime **3m** has been previously reported.[1]

Note: Although there were no incidents during the preparation of this manuscript, due to the energetic nature of the compounds described herein, caution should be exercised during their handling and manipulation. It is recommended that cyano-oximes, *bis*-oximes and furazans not be ground (e.g. in a mortar and pestle) as they may be shock-sensitive and that care be taken to avoid contact between these compounds and metal objects (e.g. spatulas during weighing). It is recommended that reactions be conducted behind a blast shield and that sufficient venting is provided for larger-scale CDI-induced cyclodehydration reactions due to the concomitant off-gassing.

Synthesis of Substrates

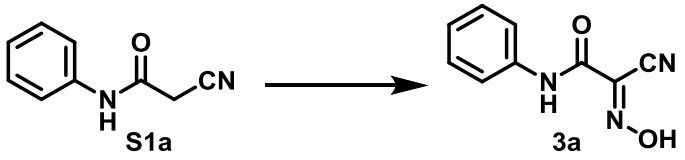
Scheme S1. Synthesis of cyano-oximes



General Procedure A: A 100-mL round-bottomed flask equipped with a magnetic stir bar was charged with the nitrile substrate (1.0 eq) and MeCN (0.2 M). To the stirred mixture was added concentrated HCl (10.0 eq). In a separate 1 dram vial, sodium nitrite (2.2 eq) was dissolved in H_2O (7 M with respect to sodium nitrite). The resulting aqueous solution was added dropwise to the stirred reaction mixture at room temperature and stirred for 2-12 h. Upon complete consumption of the starting material, as judged by UPLC analysis, the reaction mixture was diluted with H_2O and transferred to a separatory funnel. The aqueous layer was extracted with EtOAc (x3). The combined organics were washed with brine (x1), dried (Na_2SO_4) and concentrated *in vacuo*. The crude residue was purified by column chromatography on silica gel using EtOAc/Hexs as eluent.

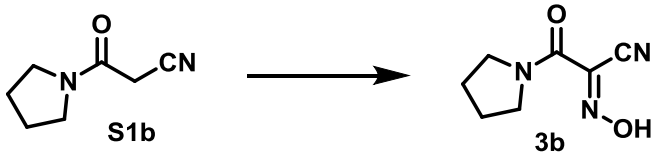
General Procedure B: A 100-mL round-bottomed flask equipped with a magnetic stir bar was charged with the nitrile substrate (1.0 eq) and DMF (0.2 M). The atmosphere was purged with N_2 and the mixture was cooled to 0 ^oC using and ice water bath. To the stirred mixture was added potassium *tert*-butoxide (1.6 M in THF, 1.2 eq), resulting in a color change from colorless to yellow. After 5 min, *tert*-butyl nitrite (2.0 eq) was added, resulting in a deep red color, and the reaction mixture was allowed to warm to room temperature. Upon complete consumption of the starting material, as judged by UPLC analysis (typically 30-60 min), 1 N HCl was added until the red color faded and the mixture was transferred to a separatory funnel. The aqueous layer was extracted with EtOAc (x2). The combined organics were washed with H_2O (x3), brine (x1), dried (Na_2SO_4) and concentrated *in vacuo*. The crude residue was purified by column chromatography on silica gel using EtOAc/Hexs as eluent.

N-hydroxy-2-oxo-2-(phenylamino)acetimidoyl cyanide (3a)



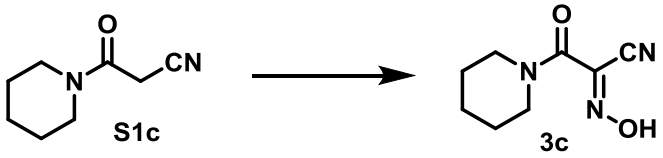
Subjection of **S1a** (1.97 g, 12.3 mmol) to General Procedure A gave the title compound (1.7 g, 8.99 mmol, 73 % yield) as a yellow solid after column chromatography on silica gel using Hexs/EtOAc as eluent (4:1 to 1:1). **^{1}H NMR** (500 MHz, DMSO-d_6) δ 14.63 (s, 1H), 10.41 (s, 1H), 7.69 (d, J = 8.0 Hz, 2H), 7.36 (app t, J = 7.7 Hz, 2H), 7.15 (t, J = 7.3 Hz, 1H). **^{13}C NMR** (126 MHz, DMSO) δ 157.3, 138.0, 129.1, 129.1, 125.0, 121.3, 109.3. **HRMS** (ESI) found $[M+H]^+$ 190.0619, $C_9H_8N_3O_2$ requires 190.0616.

(E)-N-hydroxy-2-oxo-2-(pyrrolidin-1-yl)acetimidoyl cyanide (3b)



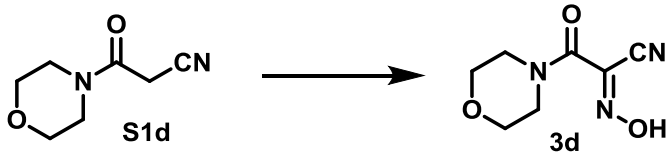
Subjection of **S1b** (1.0 g, 7.24 mmol) to General Procedure A gave the title compound (1.18 g, 7.06 mmol, 98 % yield) as a white solid after column chromatography on silica gel using Hexs/EtOAc as eluent (4:1 to 1:1). **^{1}H NMR** (500 MHz, DMSO-d_6) δ 14.28 (s, 1H), 3.62 (t, J = 6.5 Hz, 2H), 3.43 (t, J = 6.7 Hz, 2H), 1.87-1.81 (m, 4H). **^{13}C NMR** (126 MHz, DMSO) δ 157.5, 129.5, 109.7, 48.8, 47.4, 26.2, 23.8. **HRMS** (ESI) found $[M+H]^+$ 168.0772, $C_7H_{10}N_3O_2$ requires 168.0773.

(E)-N-hydroxy-2-oxo-2-(piperidin-1-yl)acetimidoyl cyanide (3c)



Subjection of **S1c** (1.0 g, 6.57 mmol) to General Procedure A gave the title compound (1.10 g, 6.07 mmol, 92 % yield) as a white solid after column chromatography on silica gel using Hexs/EtOAc as eluent (4:1 to 1:1). **^{1}H NMR** (500 MHz, DMSO-d_6) δ 14.20 (s, 1H), 3.56-3.50 (m, 4H), 1.65-1.60 (m, 2H), 1.55-1.51 (m, 4H). **^{13}C NMR** (126 MHz, DMSO) δ 157.8, 127.5, 109.8, 48.1, 43.7, 26.5, 25.6, 24.2. **HRMS** (ESI) found $[M+H]^+$ 182.0935, $C_8H_{12}N_3O_2$ requires 182.0930.

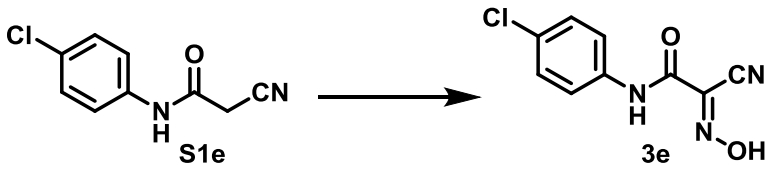
(E)-N-hydroxy-2-morpholino-2-oxoacetimidoyl cyanide (3d)



Subjection of **S1d** (1.0 g, 6.49 mmol) to General Procedure A gave the title compound (1.12 g, 6.13 mmol, 94 % yield) as a white solid after column chromatography on silica gel using Hexs/EtOAc as eluent (4:1 to 1:1). **^{1}H NMR** (500 MHz, DMSO-d_6) δ 14.29 (s, 1H), 3.64 – 3.54

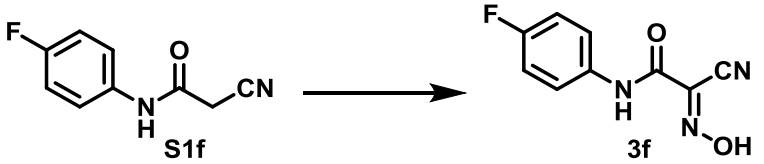
(m, 8H). **^{13}C NMR** (126 MHz, DMSO) δ 158.2, 127.4, 109.77, 66.5, 66.2, 47.6, 43.2. **HRMS** (ESI) found $[M+H]^+$ 184.0718, $C_7H_{10}N_3O_3$ requires 184.0722.

(E)-2-((4-chlorophenyl)amino)-N-hydroxy-2-oxoacetimidoyl cyanide (3e)



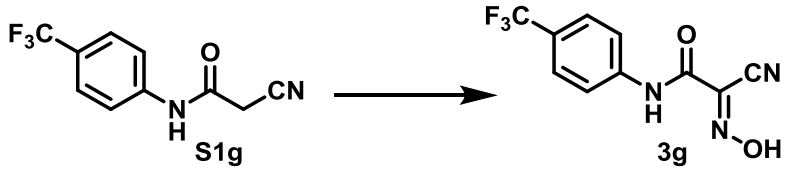
Subjection of **S1e** (2.0 g, 10.28 mmol) to General Procedure A gave the title compound (2.15 g, 9.61 mmol, 94 % yield) as a white solid after column chromatography on silica gel using Hexs/EtOAc as eluent (4:1 to 1:1). **^{1}H NMR** (500 MHz, DMSO-d_6) δ 14.66 (s, 1H), 10.55 (s, 1H), 7.74 (d, J = 8.5 Hz, 2H), 7.42 (d, J = 8.6 Hz, 2H). **^{13}C NMR** (126 MHz, DMSO) δ 157.4, 137.0, 129.1, 129.0, 128.7, 122.8, 109.3. **HRMS** (ESI) found $[M+H]^+$ 222.0078, $C_9H_7ClN_3O_2$ requires 222.0071.

(E)-2-((4-fluorophenyl)amino)-N-hydroxy-2-oxoacetimidoyl cyanide (3f)



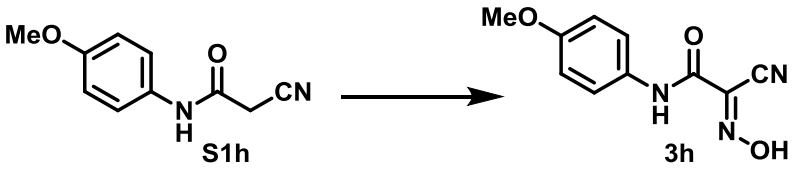
Subjection of **S1f** (0.880 g, 4.94 mmol) to General Procedure A gave the title compound (0.453 g, 2.19 mmol, 44 % yield) as a white solid after column chromatography on silica gel using Hexs/EtOAc as eluent (2:1 to 1:1). **^{1}H NMR** (500 MHz, DMSO-d_6) δ 14.64 (s, 1H), 10.48 (s, 1H), 7.71 (m, 2H), 7.20 (app t, J = 8.7 Hz, 2H**).** **^{13}C NMR** (126 MHz, DMSO) δ 159.2 (d, J = 241.7 Hz), 157.3, 134.4 (d, J = 2.7 Hz), 129.0, 123.3 (d, J = 8.1 Hz), 115.8 (d, J = 22.4 Hz), 109.3. **HRMS** (ESI) found $[M+H]^+$ 208.0528, $C_9H_7FN_3O_2$ requires 208.0522.

(E)-N-hydroxy-2-oxo-2-((4-(trifluoromethyl)phenyl)amino)acetimidoyl cyanide (3g)



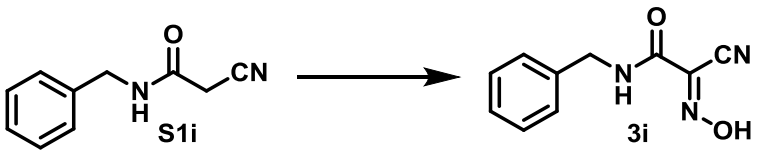
Subjection of **S1g** (1.0 g, 4.38 mmol) to General Procedure A gave the title compound (1.05 g, 4.08 mmol, 93 % yield) as a white solid after column chromatography on silica gel using Hexs/EtOAc as eluent (3:1 to 1:1). **^{1}H NMR** (500 MHz, DMSO-d_6) δ 14.74 (s, 1H), 10.76 (s, 1H), 7.94 (d, J = 8.3 Hz, 2H), 7.73 (d, J = 8.3 Hz, 2H). **^{13}C NMR** (126 MHz, DMSO) δ 157.9, 141.8, 129.0, 126.5 (q, J = 3.8 Hz), 124.9 (q, J = 32.1 Hz), 124.7 (q, J = 272.0 Hz), 121.1, 109.2. **HRMS** (ESI) found $[M+H]^+$ 258.0490, $C_{10}H_7F_3N_3O_2$ requires 258.0490.

(E)-N-hydroxy-2-((4-methoxyphenyl)amino)-2-oxoacetimidoyl cyanide (3h)



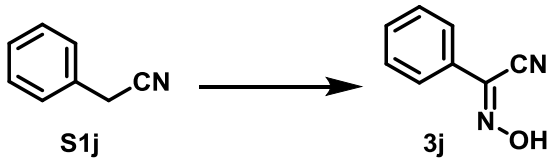
Subjection of **S1h** (1.0 g, 5.26 mmol) to General Procedure A gave the title compound (0.700 g, 3.19 mmol, 61 % yield) as a white solid after column chromatography on silica gel using Hexs/EtOAc as eluent (4:1 to 1:1). **^{1}H NMR** (500 MHz, DMSO-d_6) δ 14.56 (s, 1H), 10.30 (s, 1H), 7.59 (d, J = 8.9 Hz, 2H), 6.93 (d, J = 8.9 Hz, 2H), 3.74 (s, 3H). **^{13}C NMR** (126 MHz, DMSO) δ 156.9, 156.6, 131.0, 129.1, 122.9, 114.3, 109.4, 55.7. **HRMS** (ESI) found $[M+H]^+$ 220.0728, $C_{10}H_{10}N_3O_3$ requires 220.0722.

(E)-2-(benzylamino)-N-hydroxy-2-oxoacetimidoyl cyanide (3i)



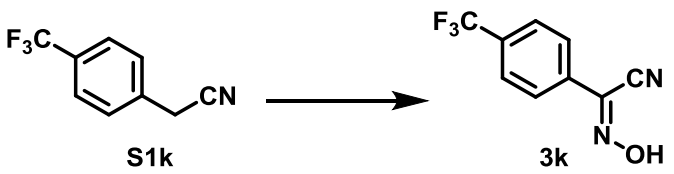
Subjection of **S1i** (1.63 g, 9.33 mmol) to General Procedure A gave the title compound (0.764 g, 3.76 mmol, 40 % yield) as a white solid after column chromatography on silica gel using Hexs/EtOAc as eluent (4:1 to 1:1). **^{1}H NMR** (500 MHz, DMSO-d_6) δ 14.49 (s, 1H), 9.08 (t, J = 5.8 Hz, 1H), 7.34-7.24 (m, 5H), 4.39 (d, J = 6.2 Hz, 2H). **^{13}C NMR** (126 MHz, DMSO) δ 158.6, 139.1, 128.8, 128.6, 127.7, 127.4, 109.4, 42.9. **HRMS** (ESI) found $[M+H]^+$ 204.0773, $C_{10}H_{10}N_3O_2$ requires 204.0773.

(Z)-N-hydroxybenzimidoyl cyanide (3j)



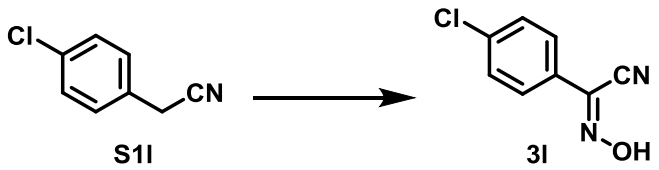
Subjection of **S1j** (1.0 g, 8.54 mmol) to General Procedure B gave the title compound (0.777 g, 5.20 mmol, 61 % yield) as a white solid after column chromatography on silica gel using Hexs/EtOAc as eluent (100 % Hexs to 4:1 Hexs/EtOAc). **^{1}H NMR** (500 MHz, DMSO-d_6) δ 13.77 (s, 1H), 7.76 – 7.69 (m, 2H), 7.56 – 7.49 (m, 3H). **^{13}C NMR** (126 MHz, DMSO) δ 131.6, 131.3, 130.0, 129.7, 126.0, 110.6. **HRMS** (ESI) found $[M+H]^+$ 147.0567, $C_8H_7N_2O$ requires 147.0558.

(Z)-N-hydroxy-4-(trifluoromethyl)benzimidoyl cyanide (3k)



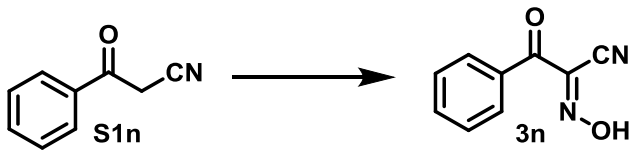
Subjection of **S1k** (1.0 g, 5.40 mmol) to General Procedure B gave the title compound (0.949 g, 4.32 mmol, 80 % yield) as a white solid after column chromatography on silica gel using Hexs/EtOAc as eluent (100 % Hexs to 4:1 Hexs/EtOAc). **^{1}H NMR** (500 MHz, DMSO-d_6) δ 14.16 (s, 1H), 7.93 (d, J = 8.3 Hz, 2H), 7.87 (d, J = 8.4 Hz, 2H). **^{13}C NMR** (126 MHz, DMSO) δ 133.9, 131.0 (q, J = 32.3 Hz), 130.7, 130.2, 126.8, 126.6 (q, J = 3.8 Hz), 124.3 (q, J = 272.8 Hz). **HRMS** (ESI) found $[M-H]^-$ 213.0266, $C_9H_4FN_2O$ requires 213.0276.

(Z)-4-chloro-N-hydroxybenzimidoyl cyanide (3l)



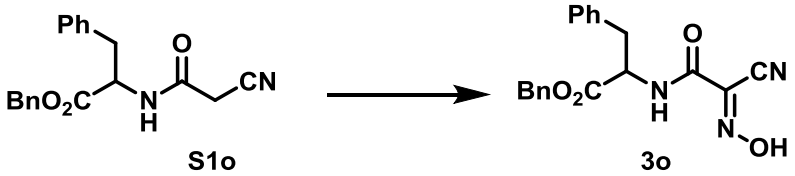
Subjection of **S1l** (1.0 g, 6.60 mmol) to General Procedure B gave the title compound (1.03 g, 4.83 mmol, 73 % yield) as a white solid after column chromatography on silica gel using Hexs/EtOAc as eluent (100 % Hexs to 4:1 Hexs/EtOAc). **^{1}H NMR** (500 MHz, DMSO-d_6) δ 13.90 (s, 1H), 7.73 (d, J = 8.7 Hz, 2H), 7.58 (d, J = 8.7 Hz, 2H). **^{13}C NMR** (126 MHz, DMSO) δ 135.9, 130.8, 129.8, 128.9, 127.7, 110.3. **HRMS** (ESI) found $[M-H]^-$ 178.9987, $C_8H_4ClN_2O$ requires 179.0012.

(E)-N-hydroxy-2-oxo-2-phenylacetimidoyl cyanide (3n)



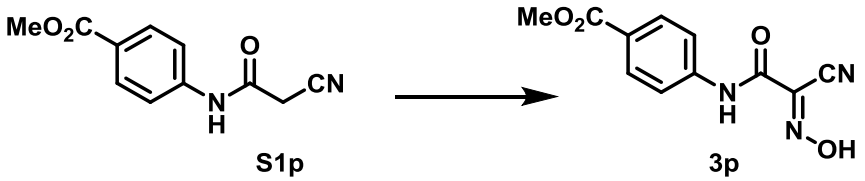
Subjection of **S1n** (1.0 g, 6.89 mmol) to General Procedure A gave the title compound (1.13 g, 6.49 mmol, 94 % yield) as a white solid after column chromatography on silica gel using Hexs/EtOAc as eluent (4:1 to 1:1). **^{1}H NMR** (500 MHz, DMSO-d_6) δ 15.06 (s, 1H), 7.92 (d, J = 7.2 Hz, 2H), 7.68 (t, J = 7.4 Hz, 1H), 7.54 (app t, J = 7.8 Hz, 2H). **^{13}C NMR** (126 MHz, DMSO) δ 186.0, 135.2, 134.0, 133.6, 130.7, 128.7, 109.5. **HRMS** (ESI) found $[M-H]^-$ 173.0320, $C_9H_5N_2O_2$ requires 173.0351.

benzyl (E)-(2-cyano-2-(hydroxyimino)acetyl)phenylalaninate (3o)



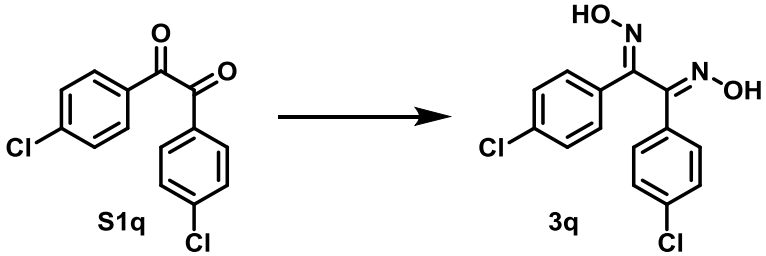
Subjection of **S1o** (1.61 g, 5.0 mmol) to General Procedure A gave the title compound (0.829 g, 2.36 mmol, 47 % yield) as a white solid after column chromatography on silica gel using Hexs/EtOAc as eluent (4:1 to 1:2). **^{1}H NMR** (400 MHz, DMSO-d_6) δ 8.89 (d, J = 8.0 Hz, 1H), 7.41 – 7.29 (m, 5H), 7.29 – 7.18 (m, 5H), 5.15 (s, 2H), 4.68 (ddd, J = 9.5, 8.1, 5.5 Hz, 1H), 3.22 - 3.02 (m, 2H). **^{13}C NMR** (126 MHz, DMSO) δ 171.0, 158.8, 137.6, 136.2, 129.6, 128.9, 128.7, 128.6, 128.3, 127.9, 127.1, 109.1, 66.8, 54.5, 36.2. **HRMS** (ESI) found $[M+H]^+$ 352.1290, $C_{19}H_{18}N_3O_4$ requires 352.1297.

methyl (E)-4-(2-cyano-2-(hydroxyimino)acetamido)benzoate (3p)



Subjection of **S1p** (1.45 g, 6.62 mmol) to General Procedure A gave the title compound (0.911 g, 3.69 mmol, 56 % yield) as a white solid after column chromatography on silica gel using Hexs/EtOAc as eluent (1:1). **^{1}H NMR** (500 MHz, DMSO-d_6) δ 14.74 (s, 1H), 10.73 (s, 1H), 7.96 (d, J = 8.8 Hz, 2H), 7.87 (d, J = 8.9 Hz, 2H), 3.84 (s, 3H). **^{13}C NMR** (126 MHz, DMSO) δ 166.2, 157.8, 142.5, 130.6, 129.0, 125.6, 120.6, 109.2, 52.4. **HRMS** (ESI) found $[M+H]^+$ 248.0668, $C_{11}H_{10}N_3O_4$ requires 248.0671.

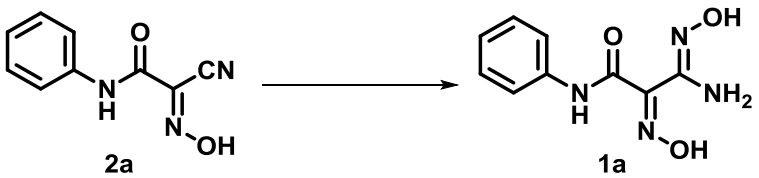
(1E,2E)-1,2-bis(4-chlorophenyl)ethane-1,2-dione dioxime (3q)



A 20-mL vial equipped with a magnetic stir bar was charged with diketone **S1q** (1.0 g, 3.58 mmol), hydroxylamine hydrochloride (1.99 g, 28.7 mmol, 8.0 eq), and pyridine (6 mL). The solution was heated at 100 ^{o}C for 72 h at which point UPLC indicated complete consumption of the starting material. The reaction mixture was cooled to rt and diluted with ice cold water and neutralized with 1 N HCl. The aqueous layer was extracted with EtOAc (x2). The combined organics were washed with brine (x1), dried (Na_2SO_4) and concentrated to afford the title compound (0.861 g, 2.79 mmol, 78 % yield) as a white solid. **^{1}H NMR** (500 MHz, DMSO-d_6) δ

11.70 (s, 2H), 7.48 (app q, *J* = 8.8 Hz, 8H). **^{13}C NMR** (126 MHz, DMSO) δ 149.95, 134.4, 132.0, 129.4, 127.7. **HRMS** (ESI) found $[M+H]^+$ 309.0200, $C_{14}H_{11}Cl_2N_2O_2$ requires 309.0197.

(2E,3Z)-3-amino-2,3-bis(hydroxyimino)-N-phenylpropanamide



A 20-mL vial equipped with a magnetic stir bar was charged with cyano-oxime **2a** (0.500 g, 2.64 mmol) and THF (10 mL). To the resulting homogeneous solution was added 50 wt % aqueous hydroxylamine (0.227 mg, 3.44 mmol) and the mixture was heated at 50 ^{o}C. Upon complete consumption of the starting material, as determined by UPLC analysis, the reaction mixture was cooled to room temperature and diluted with H_2O (10 mL). The aqueous layer was extracted with IPAC (x2). The combined organics were washed with brine (x1), dried (Na_2SO_4) and concentrated *in vacuo*. The crude residue was purified by column chromatography on silica gel using DCM/MeOH as eluent (100 % DCM to 20:1 DCM/MeOH) to afford the title compound (0.423 g, 1.90 mmol, 72 % yield) as a pale yellow solid. **^{1}H NMR** (500 MHz, DMSO-d_6) δ 11.69 (s, 1H), 10.33 (s, 1H), 10.32 (s, 1H) 7.64 (d, *J* = 7.7 Hz, 2H), 7.30 (app tt, *J* = 7.9 Hz, 2H), 7.06 (t, *J* = 7.4 Hz, 1H), 5.37 (s, 2H). **^{13}C NMR** (126 MHz, DMSO) δ 160.7, 148.4, 147.4, 139.3, 129.1, 123.8, 119.4. **HRMS** (ESI) found $[M+H]^+$ 221.0669, $C_9H_{11}N_4O_3$ requires 221.0675.

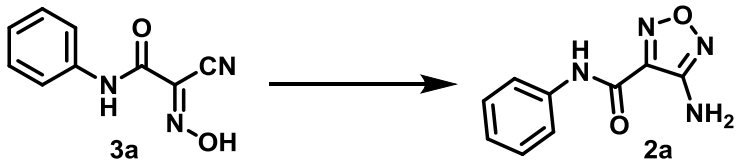
Synthesis of Furazans

General Procedure C: A 2-dram vial equipped with a magnetic stir bar was charged with the appropriate cyano-oxime (1.5 mmol, 1.0 eq.) and THF (5.6 mL, 0.25 M). To the resulting homogeneous solution was added 50 % aqueous hydroxylamine (0.129 g, 1.95 mmol, 1.3 eq.). The mixture was heated at 35 C until UPLC analysis indicated complete consumption of the starting material (typically 12-16 h). The reaction mixture was cooled to rt and 1,1'-carbonyldiimidazole (0.365 g, 2.25 mmol, 1.5 eq.) was added portionwise. Upon cessation of gas evolution, the reaction mixture was sampled and typically judged to be complete by UPLC analysis. The reaction mixture was concentrated *in vacuo* and purified directly by column chromatography on silica gel using Hexs/EtOAc as eluent.

General Procedure D: A 2-dram vial equipped with a magnetic stir bar was charged with the appropriate cyano-oxime (1.5 mmol, 1.0 eq) and MeOH (5.6 mL, 0.25 M). To the resulting homogeneous solution was added 50 % aqueous hydroxylamine (0.198 g, 3.0 mmol, 2.0 eq.). The mixture was heated at 40 C until UPLC analysis indicated complete consumption of the starting material (typically 12 h). The reaction mixture was cooled to rt, transferred to a 20-mL vial and concentrated *in vacuo* to remove methanol. The crude residue was concentrated two additional times with CH_2Cl_2 until a white solid was obtained. The white solid was dissolved in

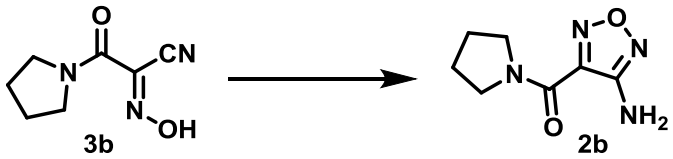
THF (5.6 mL, 0.25 M) and CDI (0.365 g, 2.25 mmol, 1.5 eq.) was added, the vial was capped and the mixture stirred at room temperature. Upon complete consumption of the intermediate *bis*-oxime, as judged by UPLC analysis (typically 30 min), the reaction mixture was concentrated and purified directly by column chromatography on silica gel using Hexs/EtOAc as eluent.

4-amino-N-phenyl-1,2,5-oxadiazole-3-carboxamide (2a)



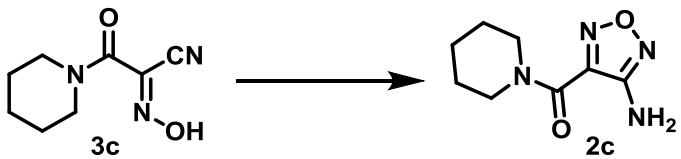
Subjection of cyano-oxime **3a** (2.0 g, 9.32 mmol) to General Procedure C gave the title compound (1.71 g, 8.38 mmol, 90 % yield). Note: rather than subjecting crude product to chromatography, the residue was taken up in EtOAc and washed with 1 N HCl (x1), H_2O (x1), brine (x1). The organic layer was dried (Na_2SO_4) and concentrated to afford spectroscopically pure material. **^{1}H NMR** (500 MHz, DMSO-d_6) δ 10.96 (s, 1H), 7.77 (d, J = 7.9 Hz, 2H), 7.38 (app t, J = 7.7 Hz, 2H), 7.17 (t, J = 7.3 Hz, 1H), 6.44 (s, 2H). **^{13}C NMR** (126 MHz, DMSO) δ 157.0, 156.6, 141.5, 138.1, 129.2, 125.1, 121.2. **HRMS** (ESI) found $[M+H]^+$ 205.0713, $C_9H_9N_4O_2$ requires 205.0726.

(4-amino-1,2,5-oxadiazol-3-yl)(pyrrolidin-1-yl)methanone (2b)



Subjection of cyano-oxime **3b** (0.251 g, 1.50 mmol) to General Procedure C gave the title compound (0.257 g, 1.41 mmol, 94 % yield) as a white solid after column chromatography on silica gel using Hexs/EtOAc as eluent (4:1 to 1:1). **^{1}H NMR** (500 MHz, DMSO-d_6) δ 6.39 (s, 2H), 3.73 (t, J = 6.7 Hz, 2H), 3.52 (t, J = 6.8 Hz, 2H), 1.95 – 1.91 (m, 2H), 1.89 – 1.84 (m, 2H). **^{13}C NMR** (126 MHz, DMSO) δ 157.3, 157.1, 141.6, 48.7, 47.0, 26.1, 23.9. **HRMS** (ESI) found $[M+H]^+$ 183.0886, $C_7H_{11}N_4O_2$ requires 183.0882.

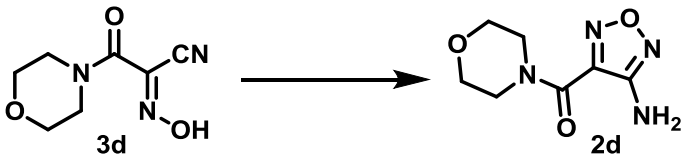
(4-amino-1,2,5-oxadiazol-3-yl)(piperidin-1-yl)methanone (2c)



Subjection of cyano-oxime **3c** (0.272 g, 1.50 mmol) to General Procedure C gave the title compound (0.204 g, 1.04 mmol, 69 % yield) as a white solid after column chromatography on silica gel using Hexs/EtOAc as eluent (4:1 to 1:1). **^{1}H NMR** (500 MHz, DMSO-d_6) δ 6.33 (s,

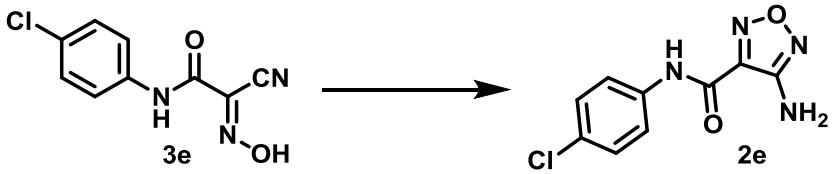
2H), 3.70 – 3.57 (m, 2H), 3.57 – 3.45 (m, 2H), 1.70 – 1.61 (m, 2H), 1.61 – 1.47 (m, 4H). **^{13}C NMR** (126 MHz, DMSO) δ 157.1, 156.3, 142.3, 47.9, 43.1, 26.6, 25.5, 24.2. **HRMS** (ESI) found $[M+H]^+$ 197.1042, $C_8H_{13}N_4O_2$ requires 197.1039.

(4-amino-1,2,5-oxadiazol-3-yl)(morpholino)methanone (2d)



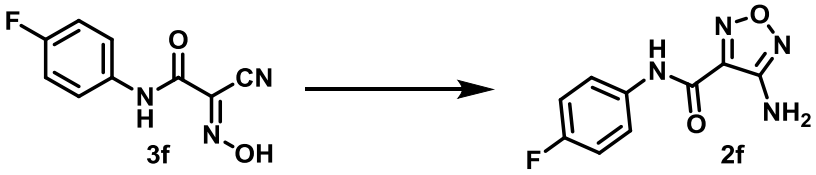
Subjection of cyano-oxime **3d** (0.275 g, 1.50 mmol) to General Procedure C gave the title compound (0.182 g, 0.92 mmol, 61 % yield) as a white solid after column chromatography on silica gel using Hexs/EtOAc as eluent (4:1 to 1:1). **^{1}H NMR** (500 MHz, DMSO-d_6) δ 6.37 (s, 2H), 3.78 – 3.56 (m, 8H). **^{13}C NMR** (126 MHz, DMSO) δ 157.6, 156.5, 141.8, 66.6, 66.2, 47.4, 42.71. **HRMS** (ESI) found $[M+H]^+$ 199.0825, $C_7H_{11}N_4O_3$ requires 199.0831.

4-amino-N-(4-chlorophenyl)-1,2,5-oxadiazole-3-carboxamide (2e)



Subjection of cyano-oxime **3e** (0.313 g, 1.40 mmol) to General Procedure C gave the title compound (0.288 g, 1.21 mmol, 86 % yield) as a white solid after column chromatography on silica gel using Hexs/EtOAc as eluent (4:1 to 1:1). **^{1}H NMR** (500 MHz, DMSO-d_6) δ 11.10 (s, 1H), 7.81 (d, J = 8.9 Hz, 2H), 7.45 (d, J = 8.9 Hz, 2H), 6.44 (s, 2H). **^{13}C NMR** (126 MHz, DMSO) δ 157.1, 156.6, 141.4, 137.1, 129.2, 128.9, 122.7. **HRMS** (ESI) found $[M-H]^-$ 237.0176, $C_9H_6ClN_4O_2$ requires 237.0180.

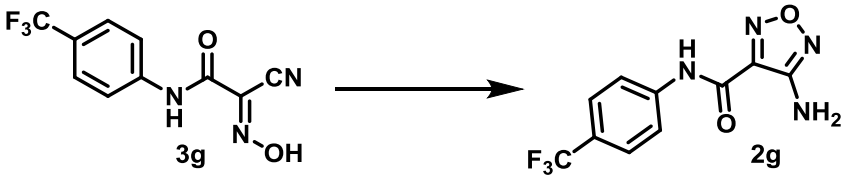
4-amino-N-(4-fluorophenyl)-1,2,5-oxadiazole-3-carboxamide (2f)



Subjection of cyano-oxime **3f** (0.200 g, 0.97 mmol) to General Procedure C gave the title compound (0.200 g, 0.90 mmol, 93 % yield) as a white solid after column chromatography on silica gel using Hexs/EtOAc as eluent (100 % Hexs to 4:1 Hexs: EtOAc). **^{1}H NMR** (500 MHz, DMSO-d_6) δ 11.03 (s, 1H), 7.81 – 7.77 (m, 2H), 7.30 – 7.06 (m, 2H), 6.43 (s, 2H). **^{13}C NMR** (126 MHz, DMSO) δ 159.3 (d, J = 241.9 Hz), 156.96, 156.62, 141.41, 134.5 (d, J = 2.6 Hz),

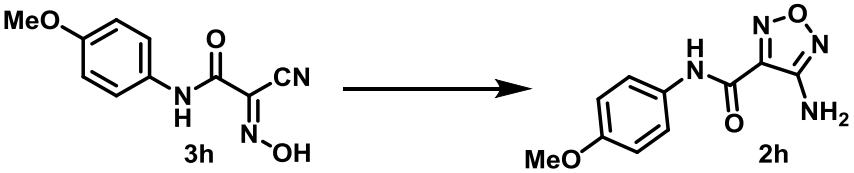
134.47, 123.17, 123.11, 115.9 (d, J = 22.4 Hz). **^{19}F NMR** (471 MHz, DMSO) δ -117.5. **HRMS** (ESI) found [M-H]$^-$ 221.0480, $C_9H_6FN_4O_2$ requires 221.0475.

4-amino-N-(4-(trifluoromethyl)phenyl)-1,2,5-oxadiazole-3-carboxamide (2g)



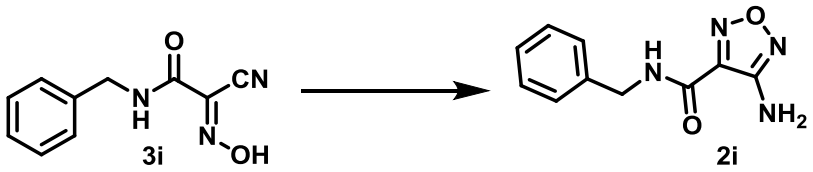
Subjection of cyano-oxime **3g** (0.386 g, 1.50 mmol) to General Procedure C gave the title compound (0.386 g, 1.42 mmol, 95 % yield) as a white solid after column chromatography on silica gel using Hexs/EtOAc as eluent (100 % Hexs to 4:1 Hexs: EtOAc). **^{1}H NMR** (500 MHz, DMSO-d_6) δ 11.31 (s, 1H), 8.01 (d, J = 8.5 Hz, 2H), 7.76 (d, J = 8.6 Hz, 2H), 6.47 (s, 2H). **^{13}C NMR** (126 MHz, DMSO) δ 157.53, 156.65, 141.82, 141.37, 126.5 (d, J = 3.8 Hz), 125.1 (q, J = 32.1 Hz), 124.70 (q, J = 271.9), 121.1. **^{19}F NMR** (471 MHz, DMSO) δ -60.5. **HRMS** (ESI) found [M-H]$^-$ 221.0447, $C_{10}H_6F_3N_4O_2$ requires 221.0443.

4-amino-N-(4-methoxyphenyl)-1,2,5-oxadiazole-3-carboxamide (2h)



Subjection of cyano-oxime **3h** (0.268 g, 1.22 mmol) to General Procedure C gave the title compound (0.237 g, 1.01 mmol, 83 % yield) as an orange solid after column chromatography on silica gel using Hexs/EtOAc as eluent (4:1 to 1:1). **^{1}H NMR** (500 MHz, DMSO-d_6) δ 10.84 (s, 1H), 7.68 (d, J = 9.1 Hz, 2H), 6.95 (d, J = 9.1 Hz, 2H), 6.41 (s, 2H), 3.76 (s, 3H). **^{13}C NMR** (126 MHz, DMSO) δ 156.7, 156.6, 156.6, 141.5, 131.1, 122.8, 114.3, 55.7. **HRMS** (ESI) found [M-H]$^-$ 233.0678, $C_{10}H_9N_4O_3$ requires 233.0675.

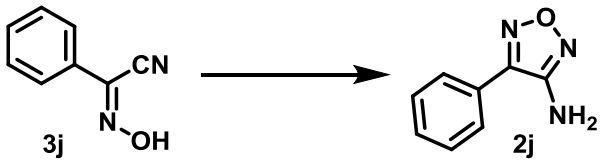
4-amino-N-benzyl-1,2,5-oxadiazole-3-carboxamide (2i)



Subjection of cyano-oxime **3i** (0.305 g, 1.50 mmol) to General Procedure C gave the title compound (0.234 g, 1.07 mmol, 72 % yield) as a white solid after column chromatography on silica gel using Hexs/EtOAc as eluent (100 % Hexs to 4:1 Hexs/EtOAc). **^{1}H NMR** (500 MHz, DMSO-d_6) δ 9.62 (t, J = 5.9 Hz, 1H), 7.38 – 7.31 (m, 4H), 7.29 – 7.23 (m, 1H), 6.36 (s, 2H),

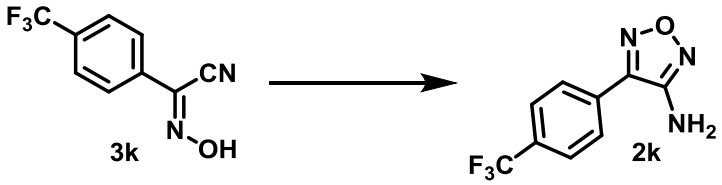
4.46 (d, *J* = 6.2 Hz, 2H). **^{13}C NMR** (126 MHz, DMSO) δ 158.5, 156.6, 140.9, 139.1, 128.8, 127.8, 127.5, 42.8. **HRMS** (ESI) found $[M+H]^+$ 219.0882, $C_{10}H_{11}N_4O_2$ requires 219.0882.

4-phenyl-1,2,5-oxadiazol-3-amine (2j)



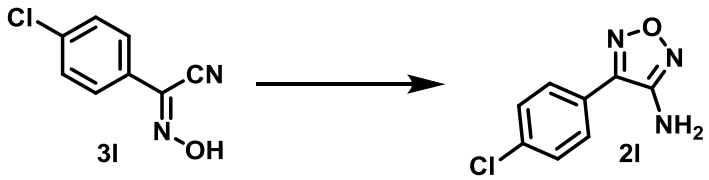
Subjection of cyano-oxime **3j** (0.224 g, 1.50 mmol) to General Procedure D gave the title compound (0.171 g, 1.06 mmol, 71 % yield) as a white solid after column chromatography on silica gel using Hexs/EtOAc as eluent (9:1 to 3:2). **^{1}H NMR** (500 MHz, DMSO-d_6) δ 7.84 – 7.71 (m, 2H), 7.64 – 7.50 (m, 3H), 6.21 (s, 2H). **^{13}C NMR** (126 MHz, DMSO) δ 155.8, 147.3, 130.8, 129.6, 128.2, 126.0. **HRMS** (ESI) found $[M-H]^-$ 160.0483, $C_8H_6N_3O$ requires 160.0511.

4-(4-(trifluoromethyl)phenyl)-1,2,5-oxadiazol-3-amine (2k)



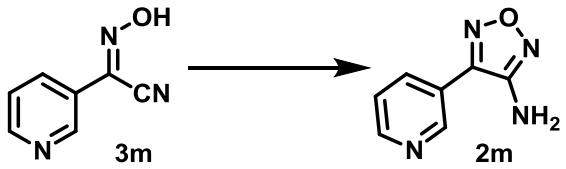
Subjection of cyano-oxime **3k** (0.329 g, 1.50 mmol) to General Procedure D gave the title compound (0.263 g, 1.15 mmol, 77 % yield) as a white solid after column chromatography on silica gel using Hexs/EtOAc as eluent (9:1 to 3:2). **^{1}H NMR** (500 MHz, DMSO-d_6) δ 8.00 (d, *J* = 8.0 Hz, 2H), 7.93 (d, *J* = 8.1 Hz, 2H), 6.32 (s, 2H). **^{13}C NMR** (126 MHz, DMSO) δ 155.8, 146.5, 130.8 (q, *J* = 32.1 Hz), 130.1, 129.2, 126.4 (q, *J* = 3.8 Hz), 124.4 (q, *J* = 272.8 Hz). **^{19}F NMR** (471 MHz, DMSO) δ -61.5. **HRMS** (ESI) found $[M-H]^-$ 228.0357, $C_9H_5F_3N_3O$ requires 228.0385.

4-(4-chlorophenyl)-1,2,5-oxadiazol-3-amine (2l)



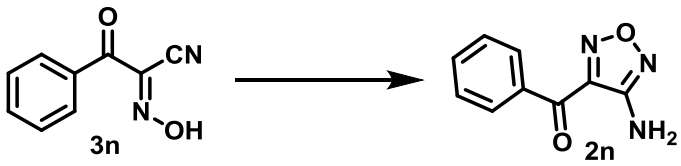
Subjection of cyano-oxime **3l** (0.271 g, 1.50 mmol) to General Procedure D gave the title compound (0.240 g, 1.23 mmol, 82 % yield) as a white solid after column chromatography on silica gel using Hexs/EtOAc as eluent (9:1 to 3:2). **^{1}H NMR** (500 MHz, DMSO-d_6) δ 7.79 (d, *J* = 8.6 Hz, 2H), 7.63 (d, *J* = 8.6 Hz, 2H), 6.24 (s, 2H). **^{13}C NMR** (126 MHz, DMSO) δ 155.7, 146.6, 135.6, 130.1, 129.7, 124.9. **HRMS** (ESI) found $[M-H]^-$ 194.0095, $C_8H_5ClN_3O$ requires 194.0121.

4-(pyridin-3-yl)-1,2,5-oxadiazol-3-amine (2m)



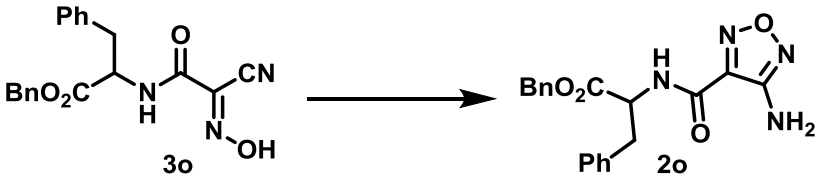
Subjection of cyano-oxime **3m** (0.221 g, 1.50 mmol) to General Procedure D gave the title compound (0.102 g, 0.63 mmol, 42 % yield) as a white solid after column chromatography on silica gel using Hexs/EtOAc as eluent (2:3 Hexs/EtOAc to 100 % EtOAc). **^{1}H NMR** (500 MHz, DMSO-d_6) δ 8.95 (s, 1H), 8.75 (d, J = 3.8 Hz, 1H), 8.17 (d, J = 7.9 Hz, 1H), 7.60 (dd, J = 7.8, 4.9 Hz, 1H), 6.34 (s, 2H). **^{13}C NMR** (126 MHz, DMSO) δ 155.9, 151.5, 148.6, 145.5, 136.0, 124.5, 122.5. **HRMS** (ESI) found $[M+H]^+$ 163.0628, $C_7H_7N_4O$ requires 163.0620.

(4-amino-1,2,5-oxadiazol-3-yl)(phenyl)methanone (2n)



Subjection of cyano-oxime **3n** (0.261 g, 1.50 mmol) to General Procedure C gave the title compound (0.157 g, 0.83 mmol, 55 % yield) as a white solid after column chromatography on silica gel using Hexs/EtOAc as eluent (100 % Hexs to 4:1 Hexs/EtOAc). **^{1}H NMR** (500 MHz, DMSO-d_6) δ 8.17 (d, J = 7.6 Hz, 2H), 7.76 (t, J = 7.4 Hz, 1H), 7.62 (app t, J = 7.7 Hz, 2H), 6.61 (s, 2H). **^{13}C NMR** (126 MHz, DMSO) δ 185.5, 157.3, 143.8, 136.1, 134.9, 130.5, 129.3. **HRMS** (ESI) found $[M+H]^+$ 190.0624, $C_9H_7N_3O_2$ requires 190.0616.

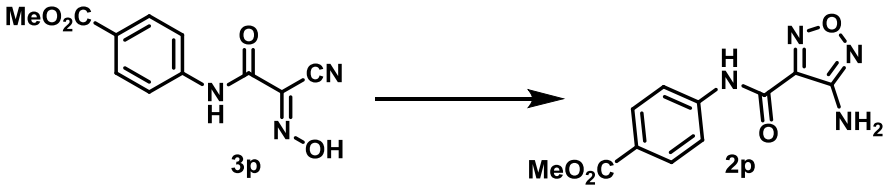
benzyl (4-amino-1,2,5-oxadiazole-3-carbonyl)phenylalaninate (2o)



Subjection of cyano-oxime **3o** (0.527 g, 1.50 mmol) to General Procedure C gave the title compound (0.463 g, 1.26 mmol, 84 % yield) as a white solid after column chromatography on silica gel using Hexs/EtOAc as eluent (100 % Hexs to 3:1 Hexs/EtOAc). **^{1}H NMR** (500 MHz, DMSO-d_6) δ 9.55 (d, J = 7.5 Hz, 1H), 7.48 – 7.08 (m, 10H), 6.32 (s, 2H), 5.18 – 5.13 (m, 2H),

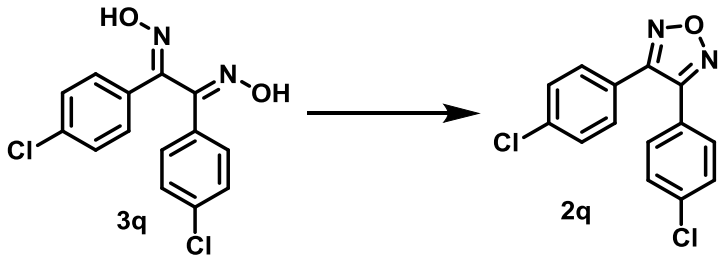
4.81 – 4.70 (m, 1H), 3.26 – 3.10 (m, 2H). **^{13}C NMR** (126 MHz, DMSO) δ 171.0, 158.6, 156.5, 140.3, 137.7, 136.2, 129.5, 128.9, 128.8, 128.5, 128.3, 127.1, 66.8, 54.4, 36.2. **HRMS** (ESI) found $[M-H]^-$ 365.1272, $C_{19}H_{17}N_4O_4$ requires 365.1250.

methyl 4-(4-amino-1,2,5-oxadiazole-3-carboxamido)benzoate (2p)



Subjection of cyano-oxime **3p** (0.062 g, 0.25 mmol) to General Procedure C gave the title compound (0.047 g, 0.221 mmol, 72 % yield) as a white solid after column chromatography on silica gel using Hexs/EtOAc as eluent (100 % Hexs to 4:1 Hexs/EtOAc). **^{1}H NMR** (500 MHz, DMSO-d_6) δ 11.28 (s, 1H), 7.98 (d, J = 8.7 Hz, 2H), 7.94 (d, J = 8.6 Hz, 2H), 6.46 (s, 2H), 3.85 (s, 3H). **^{13}C NMR** (126 MHz, DMSO) δ 166.2, 157.4, 156.6, 142.6, 141.4, 130.6, 125.8, 120.6, 52.5. **HRMS** (ESI) found $[M-H]^-$ 261.0639, $C_{11}H_9N_4O_4$ requires 261.0624.

3,4-bis(4-chlorophenyl)-1,2,5-oxadiazole (2q)



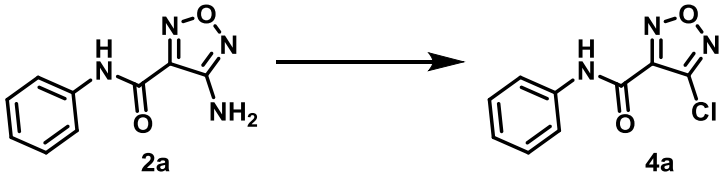
A 2-dram vial equipped with a magnetic stir bar was charged with **3q** (0.231 g, 0.75 mmol) and DMF (5.8 mL). To the homogeneous solution was added 1,1'-carbonyldiimidazole (0.242 mg, 1.5 mmol). The vial was sealed and heated at 80 C for 16 h, at which point the mixture was cooled to rt and diluted with EtOAc and H_2O. The layers were separated and the aqueous layer extracted with EtOAc (x2). The combined organics were washed with H_2O (x3), dried (Na_2SO_4) and concentrated *in vacuo*. The crude residue was purified by column chromatography on silica gel using Hexs/EtOAc as eluent (100 % Hexs to 4:1 Hexs/EtOAc) to afford the title compound (0.122 g, 0.419 mmol, 56 % yield) as a white solid. **^{1}H NMR** (500 MHz, DMSO-d_6) δ 7.62 (d, J = 8.5 Hz, 4H), 7.56 (d, J = 8.5 Hz, 4H). **^{13}C NMR** (126 MHz, DMSO) δ 153.0, 136.2, 131.2, 129.8, 124.3. **HRMS** (ESI) found $[M+H]^+$ 291.0147, $C_{14}H_8Cl_2N_2O$ requires 261.0624.

Furazan Derivatization

General Procedure E: A 40-mL vial equipped with a magnetic stir bar was charged with the appropriate amino-furazan (1.0 mmol, 1.0 eq.), MeCN (4.5 mL), AcOH (4.5 mL), concentrated HCl (2.46 mL, 30 eq.) and lithium chloride (0.127 g, 3.0 mmol, 3.0 eq.) resulting in a nearly

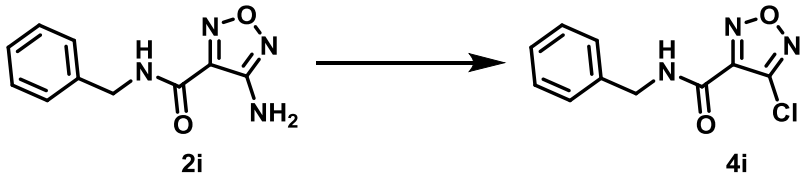
homogeneous solution. The mixture was cooled to 0 ^{o}C using an ice water bath. In a separate 1-dram vial, sodium nitrite (0.103 g, 1.5 mmol, 1.5 eq.) was dissolved in minimal H_2O (0.2 mL). The solution was added dropwise to the reaction mixture at 0 ^{o}C, resulting in a color change from colorless to yellow. After 10 min of vigorous stirring at 0 ^{o}C, the reaction mixture was allowed to warm to room temperature. Upon complete consumption of the starting material, as judged by UPLC analysis (typically 30 min), the reaction mixture was diluted with sat. aq. NH_4Cl, resulting in a white precipitate. The contents of the vial were transferred to a separatory funnel and partitioned between EtOAc and H_2O. The aqueous layer was extracted with EtOAc (x3). The combined organics were dried (Na_2SO_4) and concentrated *in vacuo*. The resulting crude residue was purified by column chromatography on silica gel using Hexs/EtOAc as eluent.

4-chloro-N-phenyl-1,2,5-oxadiazole-3-carboxamide (4a)



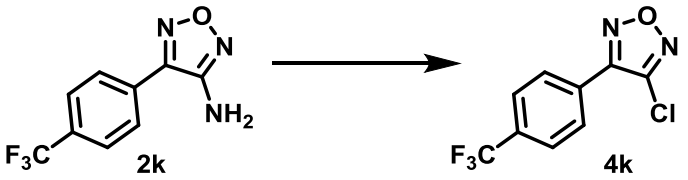
Subjection of **2a** (0.500 g, 2.32 mmol) to General Procedure E afforded the title compound (0.465 g, 2.08 mmol, 90 % yield) as an off-white solid after column chromatography on silica gel using Hexs/EtOAc as eluent (100 % Hexs to 4:1 Hexs/EtOAc). **^{1}H NMR** (500 MHz, DMSO-d_6) δ 11.19 (s, 1H), 7.75 (d, J = 8.1 Hz, 2H), 7.41 (app t, J = 7.8 Hz, 2H), 7.20 (t, J = 7.3 Hz, 1H). **^{13}C NMR** (126 MHz, DMSO) δ 153.7, 148.7, 146.6, 137.9, 129.4, 125.5, 121.0. **HRMS** (ESI) found $[M-H]^-$ 222.0050, $C_9H_5ClN_3O_2$ requires 222.0071.

N-benzyl-4-chloro-1,2,5-oxadiazole-3-carboxamide (4i)



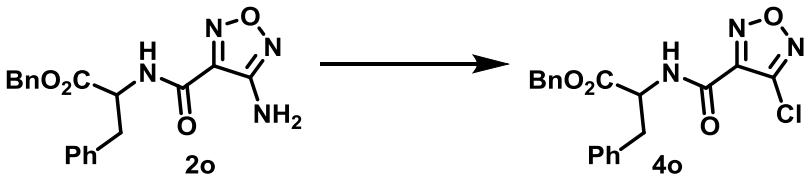
Subjection of **2i** (0.218 g, 1.00 mmol) to General Procedure E afforded the title compound (0.177 g, 0.75 mmol, 75 % yield) as a colorless oil after column chromatography on silica gel using Hexs/EtOAc as eluent (100 % Hexs to 4:1 Hexs/EtOAc). **^{1}H NMR** (500 MHz, DMSO-d_6) δ 9.77 (s, 1H), 7.38 – 7.33 (m, 4H), 7.32 – 7.25 (m, 1H), 4.50 (d, J = 6.1 Hz, 2H). **^{13}C NMR** (126 MHz, DMSO) δ 155.3, 148.5, 146.4, 138.5, 128.9, 127.9, 127.6, 43.1. **HRMS** (ESI) found $[M-H]^-$ 236.0227, $C_{10}H_7ClN_3O_2$ requires 236.0227.

3-chloro-4-(p-trifluoromethyl)-1,2,5-oxadiazole (4k)



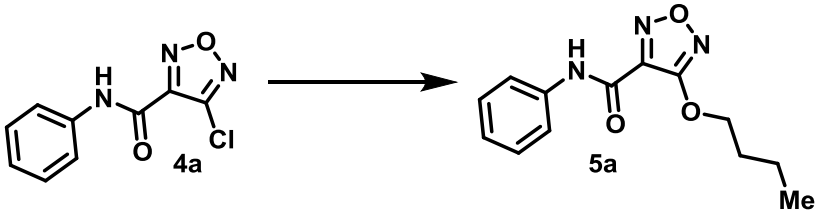
Subjection of **2k** (0.229 g, 1.00 mmol) to General Procedure E afforded the title compound (0.185 g, 0.74 mmol, 74 % yield) as a pale yellow oil after column chromatography on silica gel using Hexs/EtOAc as eluent (100 % Hexs to 4:1 Hexs/EtOAc). **^{1}H NMR** (500 MHz, DMSO-d_6) δ 8.13 (d, *J* = 8.2 Hz, 2H), 8.01 (d, *J* = 8.3 Hz, 2H). **^{13}C NMR** (126 MHz, DMSO) δ 152.2, 146.2, 131.9 (q, *J* = 32.3 Hz), 129.8, 127.8, 126.6 (q, *J* = 3.8 Hz), 124.2 (q, *J* = 273.0 Hz). **^{19}F NMR** (471 MHz, DMSO) δ -61.7. **HRMS** (ESI) found $[M\text{-}Cl]^-$ 213.0275, $C_9H_4F_3N_2O$ requires 222.0071.

benzyl (4-chloro-1,2,5-oxadiazole-3-carbonyl)phenylalaninate (4o)



Subjection of **2o** (0.366 g, 1.00 mmol) to General Procedure E afforded the title compound (0.312 g, 0.81 mmol, 81 % yield) as a pale yellow oil after column chromatography on silica gel using Hexs/EtOAc as eluent (100 % Hexs to 4:1 Hexs/EtOAc). **^{1}H NMR** (500 MHz, DMSO-d_6) δ 9.78 (d, *J* = 7.7 Hz, 1H), 7.43 – 7.16 (m, 10H), 5.18 (d, *J* = 12.6 Hz, 1H), 5.15 (d, *J* = 12.6 Hz, 1H), 4.86 – 4.74 (m, 1H), 3.23 (dd, *J* = 13.9, 5.4 Hz, 1H), 3.11 (dd, *J* = 13.8, 9.7 Hz, 1H). **^{13}C NMR** (126 MHz, DMSO) δ 170.6, 155.4, 148.2, 146.1, 137.2, 136.1, 129.6, 128.9, 128.8, 128.6, 128.3, 127.1, 66.9, 54.7, 36.4. **HRMS** (ESI) found $[M+H]^+$ 386.0913, $C_{19}H_{17}ClN_3O_4$ requires 386.0908.

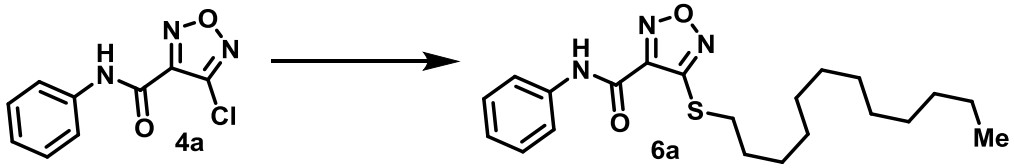
4-butoxy-N-phenyl-1,2,5-oxadiazole-3-carboxamide (5a)



A 2-dram vial equipped with a magnetic stir bar was charged with sodium hydride (60 wt % suspension in mineral oil, 0.240 g, 6.0 mmol, 6.0 eq.) and THF (1 mL). In a separate vial, *n*-butanol (0.111 g, 1.5 mmol, 1.5 eq.) was dissolved in THF (2.5 mL) and the resulting solution was added to the NaH suspension at room temperature. The mixture was stirred for 5 min at room temperature at which point **4a** (0.224 g, 1.0 mmol, 1.0 eq) was added as a solid. The mixture was heated at 50 ^{o}C for 75 min, at which point UPLC analysis indicated complete

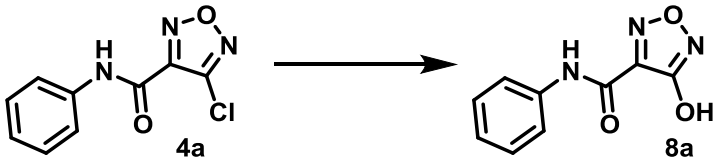
consumption of **4a**. The reaction mixture was cooled to room temperature and quenched with 1 N HCl. The aqueous layer was extracted with EtOAc (x3). The combined organics were washed with brine (x1), dried (Na_2SO_4) and concentrated *in vacuo*. The crude residue was purified by column chromatography on silica gel using Hexs/EtOAc as eluent (100 % Hexs to 4:1 Hexs/EtOAc) to afford the title compound (0.231 g, 0.884 mmol, 88 % yield) as a colorless oil. **^{1}H NMR** (500 MHz, DMSO-d_6) δ 10.93 (s, 1H), 7.71 (d, *J* = 7.7 Hz, 2H), 7.40 (app t, *J* = 7.9 Hz, 2H), 7.18 (t, *J* = 7.4 Hz, 1H), 4.41 (t, *J* = 6.5 Hz, 2H), 1.82 – 1.74 (m, 2H), 1.48 – 1.39 (m, 2H), 0.93 (t, *J* = 7.4 Hz, 3H). **^{13}C NMR** (126 MHz, DMSO) δ 163.8, 154.5, 143.0, 138.1, 129.4, 125.3, 120.7, 73.3, 30.6, 18.8, 14.0. **HRMS** (ESI) found $[M+H]^+$ 262.1197, $C_{13}H_{16}N_3O_3$ requires 262.1192.

4-(dodecylthio)-N-phenyl-1,2,5-oxadiazole-3-carboxamide (6a)



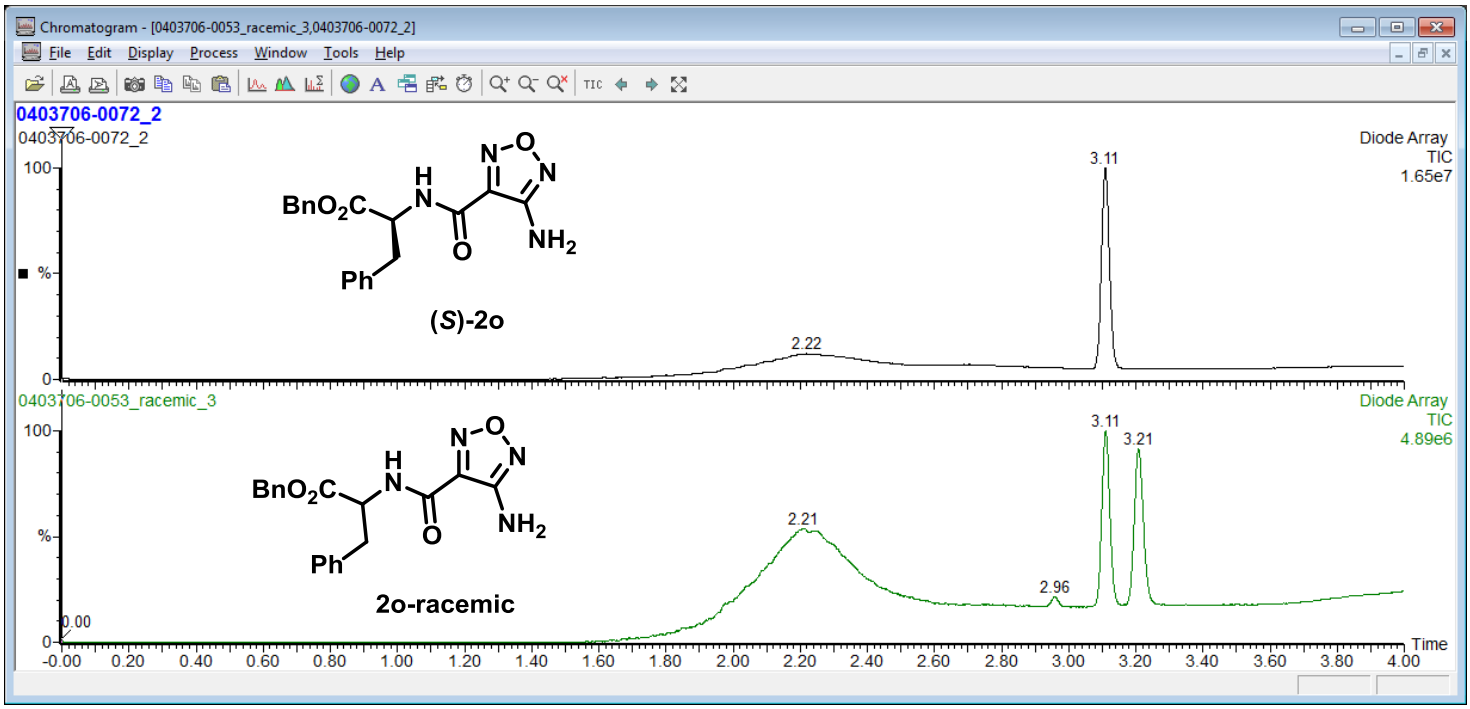
A 2-dram vial equipped with a magnetic stir bar was charged with sodium hydride (60 wt % suspension in mineral oil, 0.240 g, 6.0 mmol, 6.0 eq.) and THF (3 mL). In a separate vial, *n*-dodecanethiol (0.304 g, 1.5 mmol, 1.5 eq.) was dissolved in THF (1.5 mL) and the resulting solution was added to the NaH suspension at room temperature. The mixture was stirred for 5 min at room temperature at which point **4a** (0.224 g, 1.0 mmol, 1.0 eq) was added as a solid. The mixture was heated at 50 ^{o}C for 75 min, at which point UPLC analysis indicated complete consumption of **4a**. The reaction mixture was cooled to room temperature and quenched with 1 N HCl. The aqueous layer was extracted with EtOAc (x3). The combined organics were washed with brine (x1), dried (Na_2SO_4) and concentrated *in vacuo*. The crude residue was purified by column chromatography on silica gel using Hexs/EtOAc as eluent (100 % Hexs to 4:1 Hexs/EtOAc) to afford the title compound (0.333 g, 0.855 mmol, 85 % yield) as a white solid. **^{1}H NMR** (400 MHz, DMSO-d_6) δ 11.09 (s, 1H), 7.75 (d, *J* = 7.6 Hz, 2H), 7.42 – 7.35 (m, 2H), 7.18 (t, *J* = 7.4 Hz, 1H), 3.18 (t, *J* = 7.3 Hz, 2H), 1.78 – 1.69 (m, 2H), 1.45 – 1.35 (m, 2H), 1.34 – 1.18 (m, 16H), 0.91 – 0.77 (m, 3H). **^{13}C NMR** (126 MHz, DMSO) δ 155.1, 154.5, 148.7, 138.0, 129.3, 125.3, 121.1, 32.0, 31.8, 29.5, 29.5, 29.4, 29.3, 29.2, 28.9, 28.6, 28.5, 22.6, 14.4. **HRMS** (ESI) found $[M-H]^-$ 388.2038, $C_{21}H_{30}N_3O_2S$ requires 388.2059.

4-hydroxy-N-phenyl-1,2,5-oxadiazole-3-carboxamide (8a)



A 1-dram vial equipped with a magnetic stir bar was charged with **4a** (0.155 g, 0.69 mmol) and DMSO (2.3 mL). To the resulting homogeneous mixture were added N-hydroxyacetamide (0.156 g, 2.08 mmol) and potassium carbonate (0.479 g, 3.47 mmol) and the mixture was heated at 80 ^{o}C. Upon complete consumption of the starting material, as judged by UPLC analysis (60 min), the reaction mixture was cooled to room temperature and slowly quenched with 2 N HCl (3.11 mL, 6.24 mmol) until pH = ca. 3. The aqueous layer was extracted with EtOAc (x2). The combined organics were concentrated *in vacuo* and the crude residue was purified via column chromatography on silica gel using Hexs/EtOAc as eluent (1:1) to afford the title compound (0.104 g, 0.51 mmol, 73 % yield) as a white solid. **^{1}H NMR** (500 MHz, DMSO-d_6) δ 10.85 (s, 1H), 7.72 (d, J = 7.8 Hz, 2H), 7.39 (app t, J = 7.9 Hz, 2H), 7.17 (t, J = 7.4 Hz, 1H). **^{13}C NMR** (126 MHz, DMSO) δ 162.5, 155.4, 143.8, 138.2, 129.4, 125.2, 120.6. **HRMS** (ESI) found [M-OH]$^{-}$ 145.0402, $C_8H_5N_2O$ requires 145.0402.

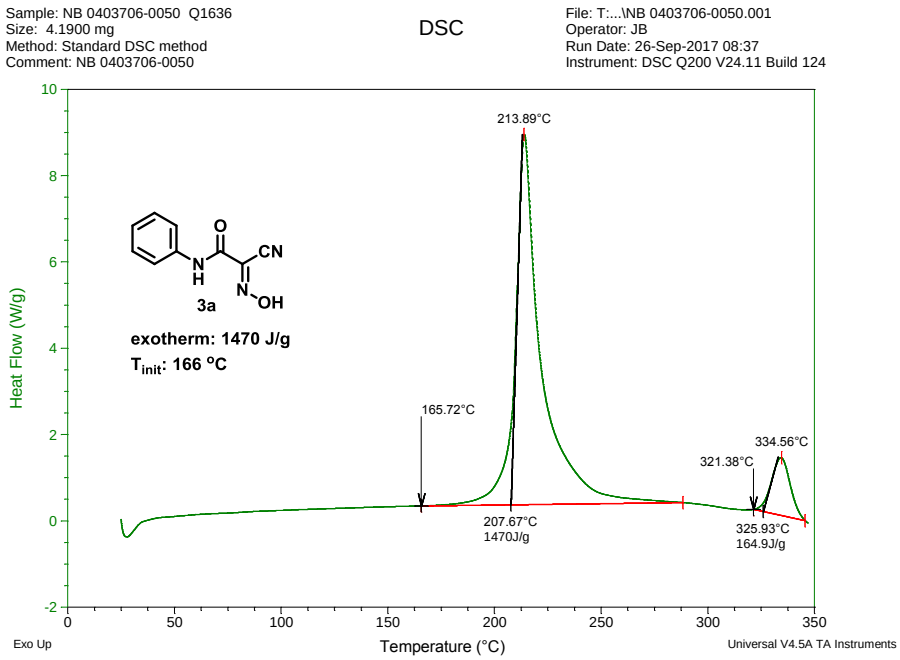
Chiral SFC Trace of 2o

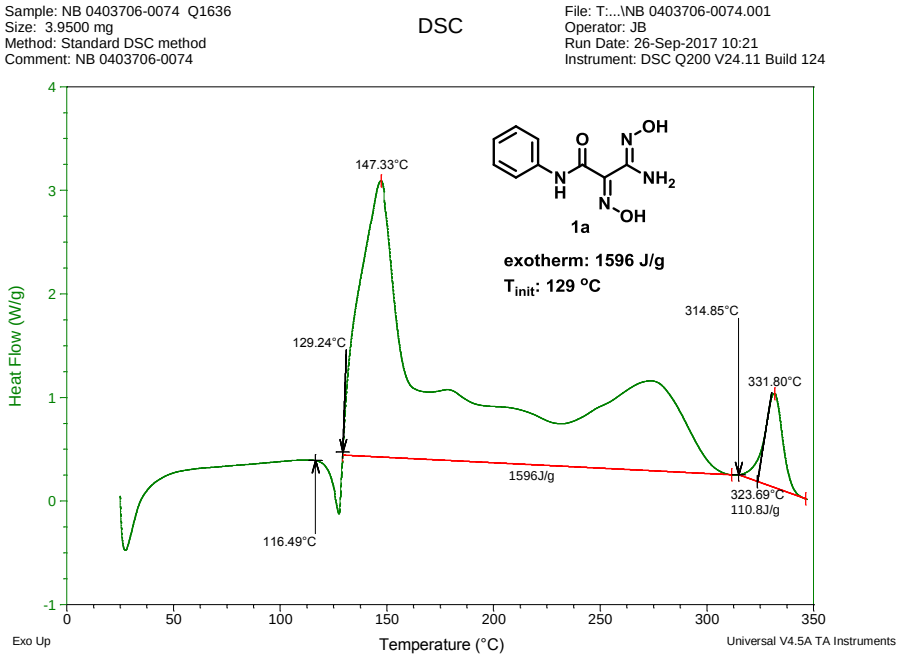


Chiral SFC analysis was performed to demonstrate the lack of racemization during the preparation of furazan **2o**. This analysis was conducted using an OD-3 column (150 x 4.6 mm, 3μm) at 40 ^{o}C. Mobile phase A: CO_2, mobile phase B: 25 mM IBA in IPA (1-40 % MPB 0-5 min, 40 % MPB 5-6 min, 3 mL/min, 200 bar).

Differential Scanning Calorimetry Data

Differential scanning calorimetry measurements for compounds **3a**, **3j**, **1a**, **1q**, **2a**, **2j**, and **2q** were obtained using 5 ^{o}C/min scan rate up to 350 ^{o}C in a Tantalum coated cell.





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Size: 4.1300 mg
Method: Standard DSC method
Comment: NB 03403706-0058

DSC

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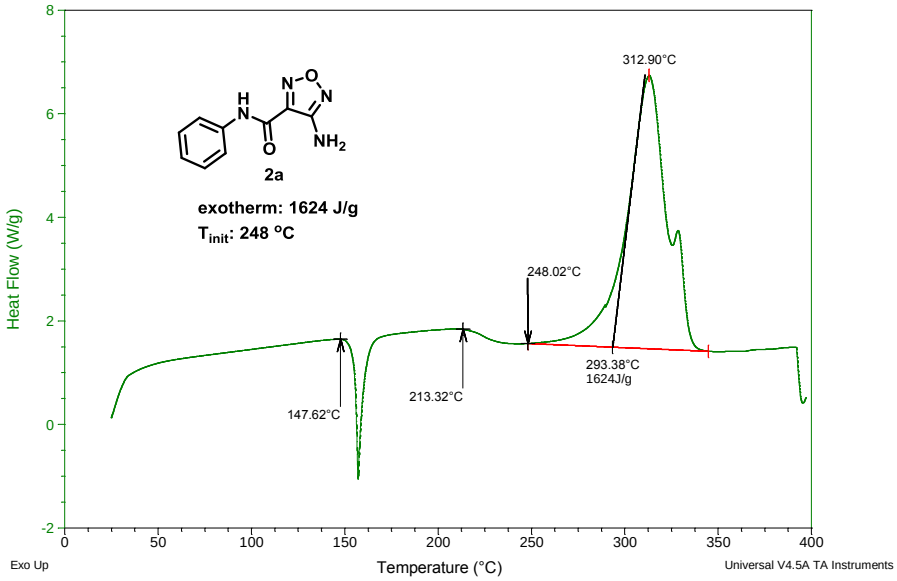
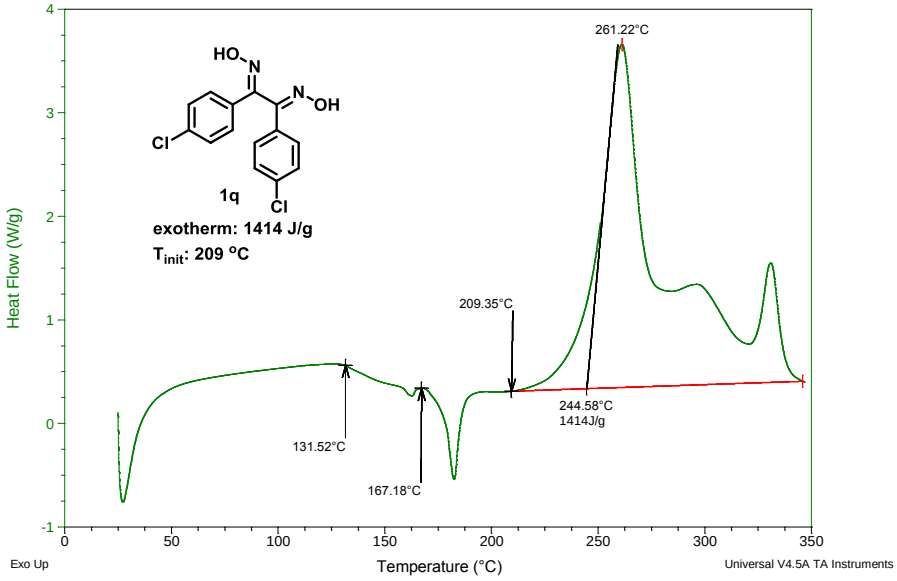
Operator: SS
Run Date: 02-Oct-2017 08:23
Instrument: DSC Q200 V24.11 Build 124



Sample: NB 0403706-0064 Q1636
Size: 3.8400 mg
Method: Standard DSC method
Comment: NB 0403706-0064

DSC

File: T:...\NB 0403706-0064.001
Operator: JB
Run Date: 26-Sep-2017 13:50
Instrument: DSC Q200 V24.11 Build 124



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Comment: NB 03403706-0077

DSC

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Operator: SS
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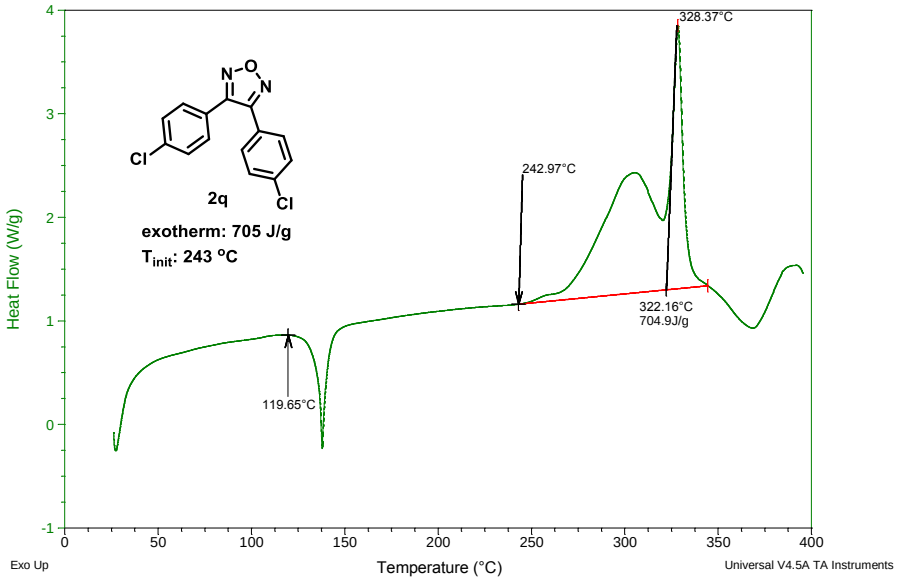
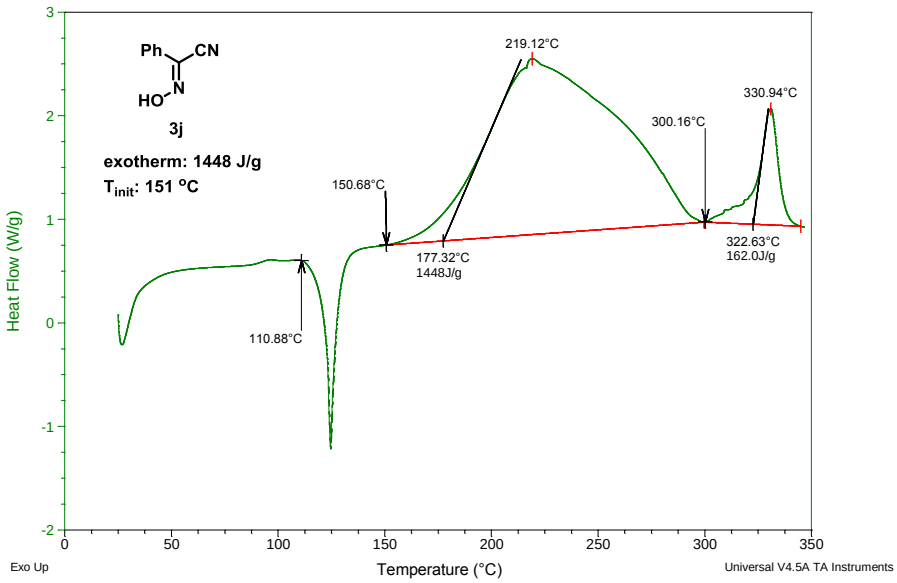
Instrument: DSC Q200 V24.11 Build 124

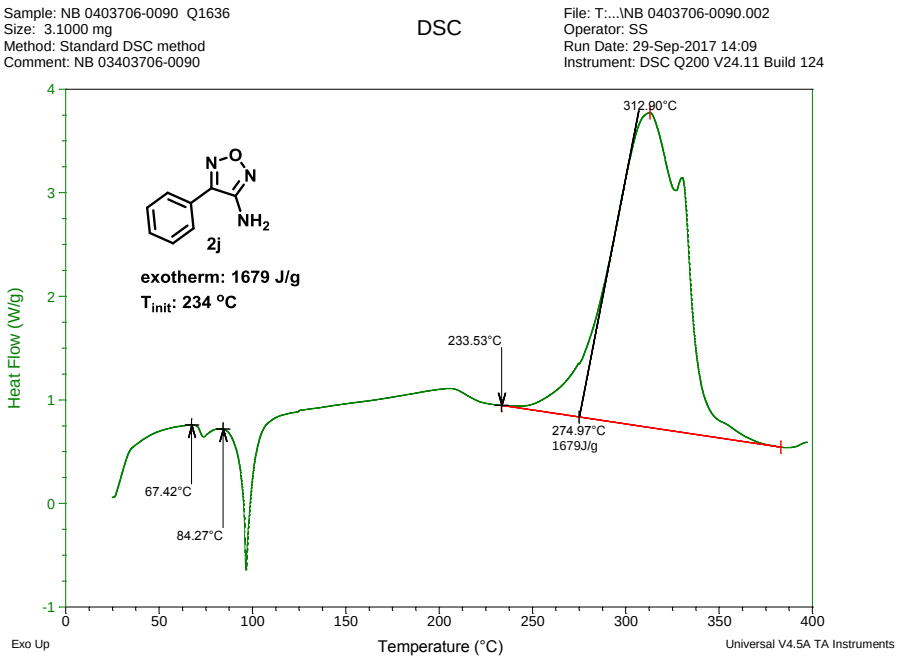


Sample: NB 0403706-0019 Q1636
Size: 3.9700 mg
Method: Standard DSC method
Comment: NB 0403706-0019

DSC

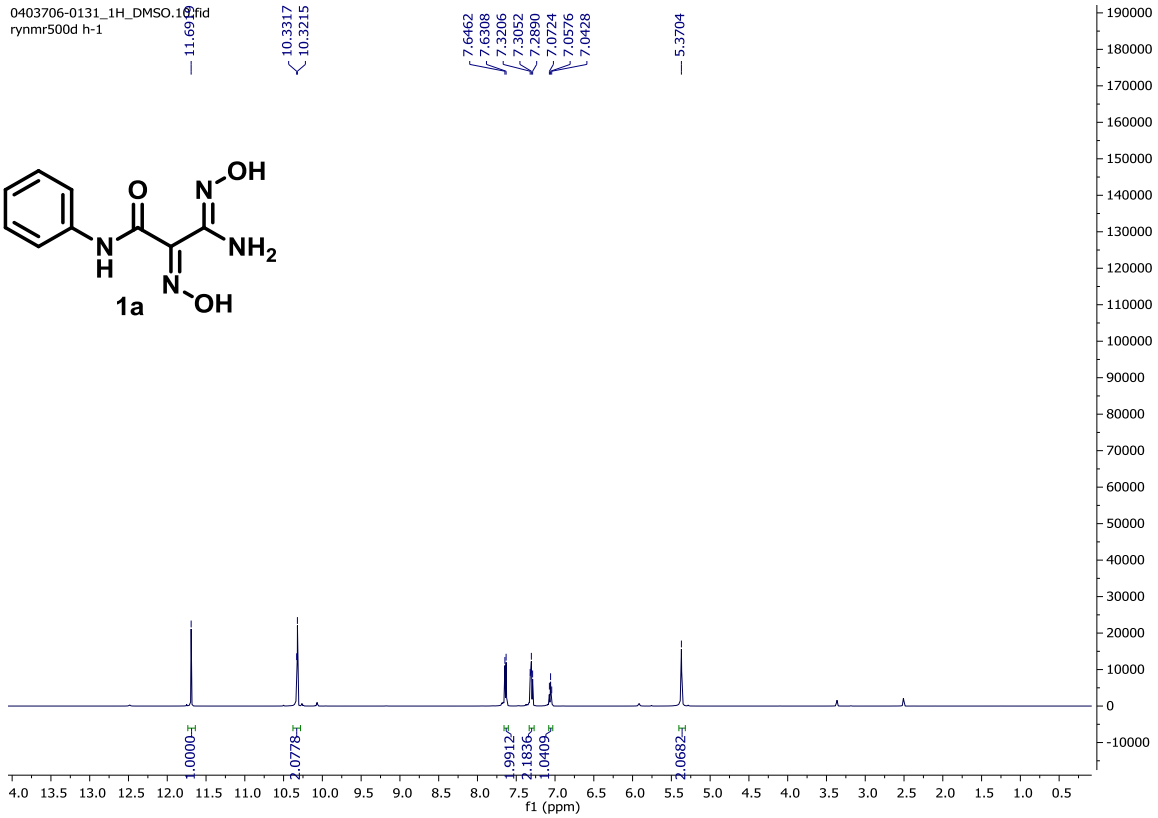
File: T:...\NB 0403706-0019.001
Operator: JB
Run Date: 27-Sep-2017 08:39
Instrument: DSC Q200 V24.11 Build 124





References

[1]Sauerberg, P.; Olesen, P. H.; Neilsen, S.; Treppendahl, S.; Sheardown, M. J.; Honore, T.; Mitch, C. H.; Ward, J. S.; Pike, A. J.; Bymaster, F. P.; Sawyer, B. D.; Shannon, H. E. *J. Med. Chem.* **1992**, *35* (12), 2274.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7.3052
7.2890
7.0724
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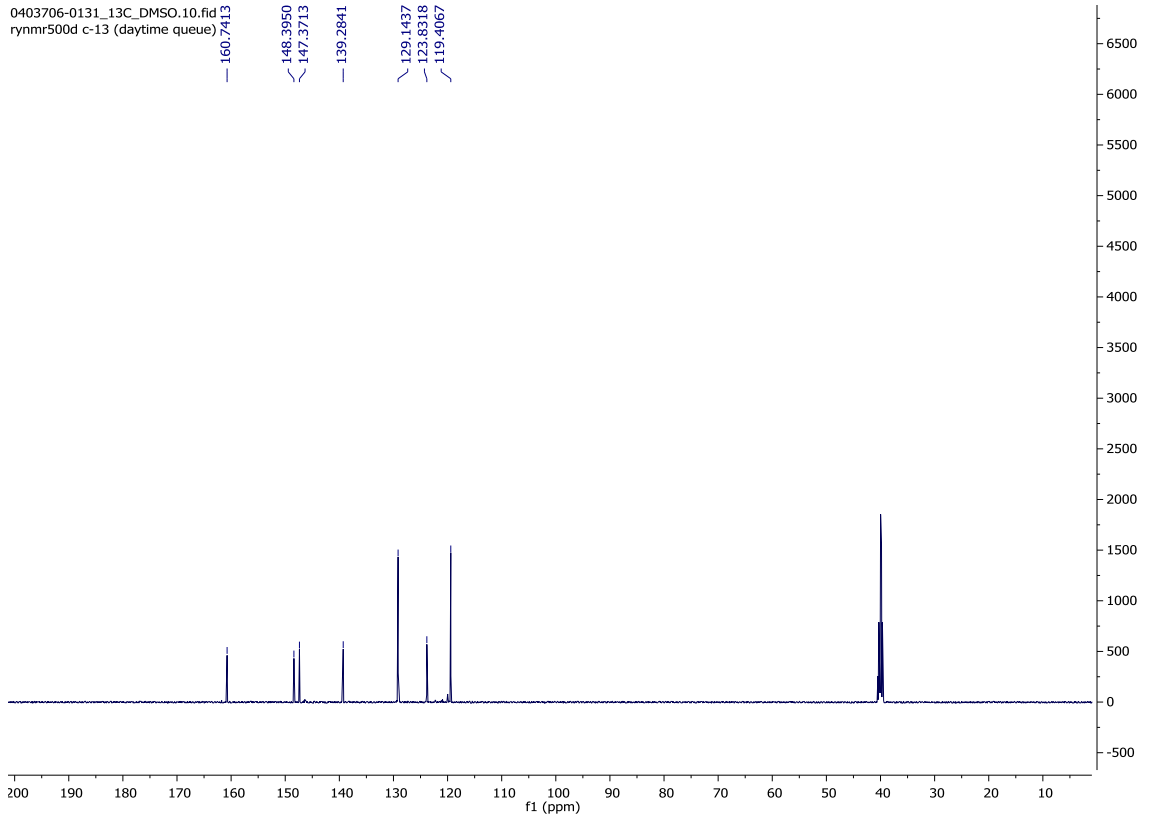
7.0428
5.3704
1.0000
2.0778
1.9912
2.1836
1.0409
2.0682
f1 (ppm)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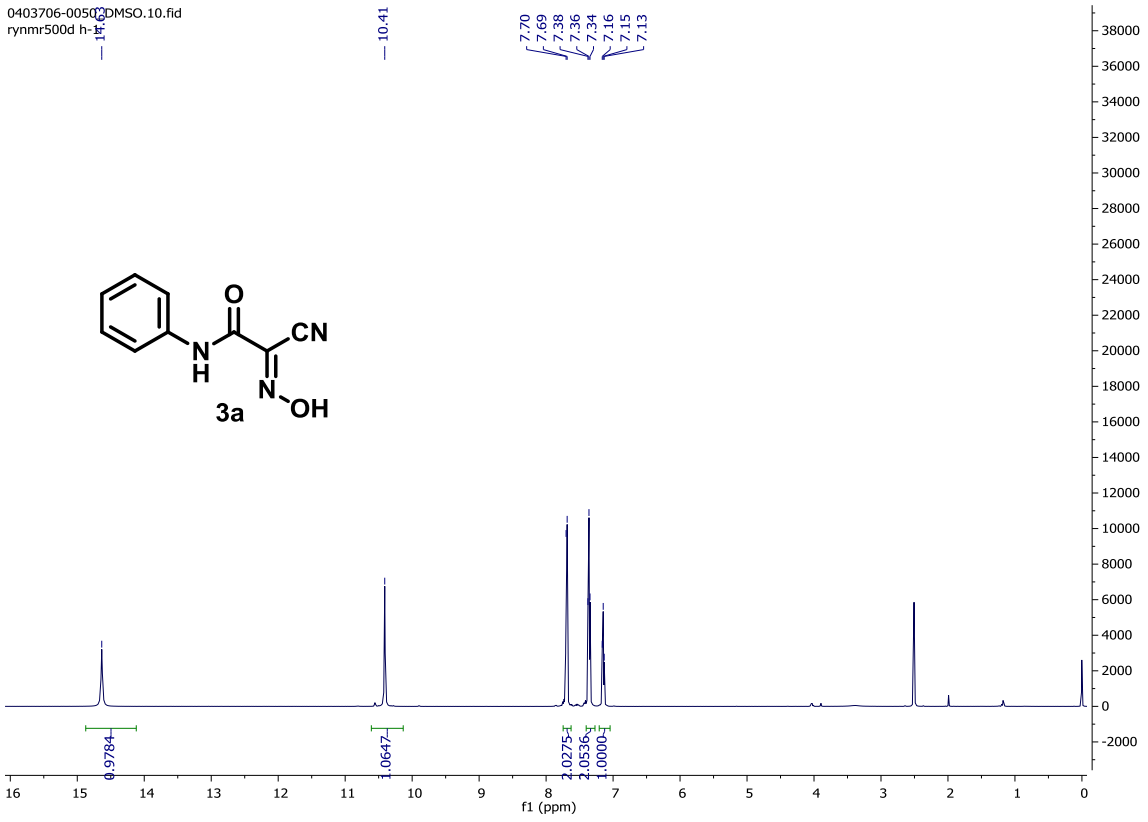
f1 (ppm)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7.36
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7.15
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N
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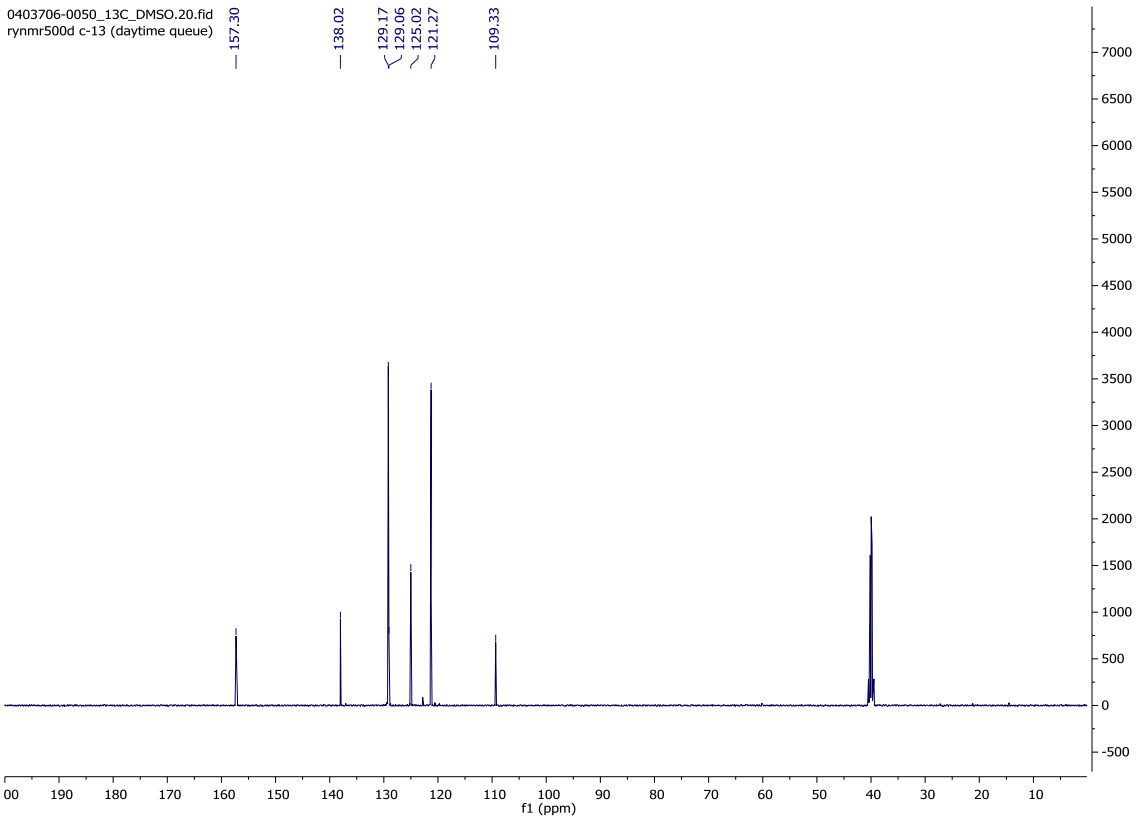
f1 (ppm)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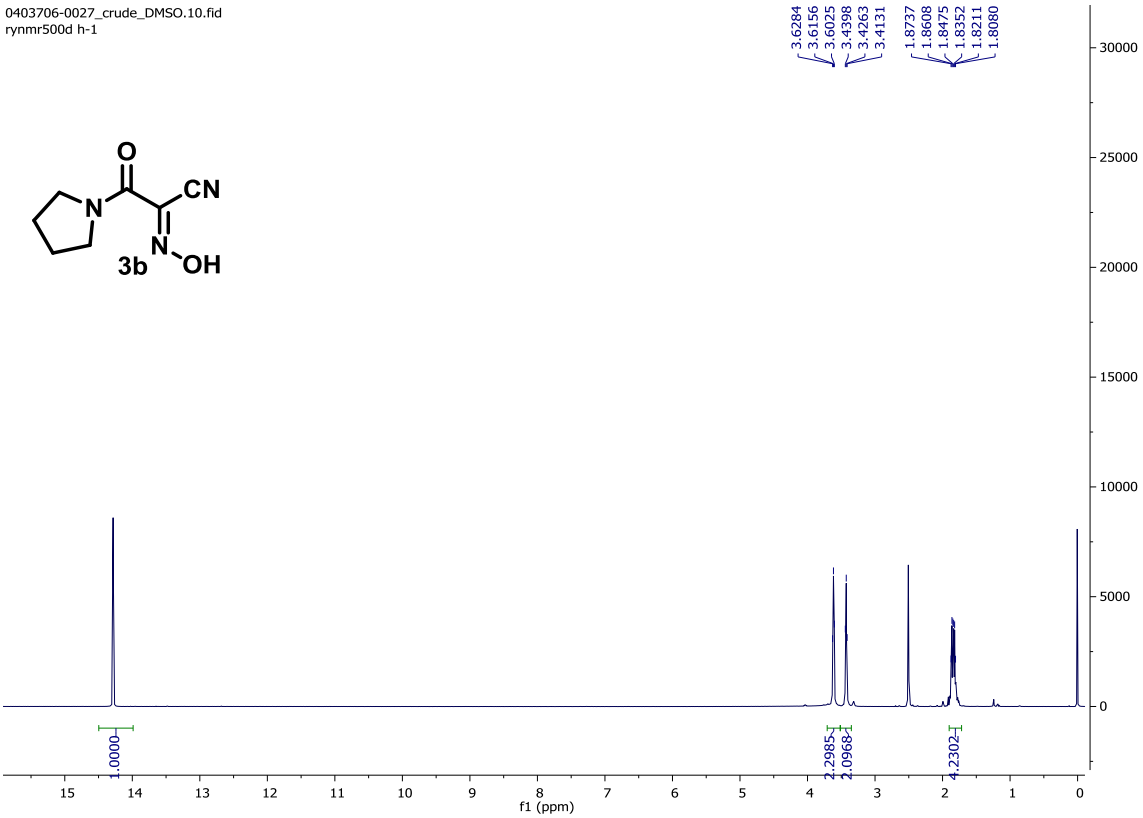
f1 (ppm)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CN
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3.4263
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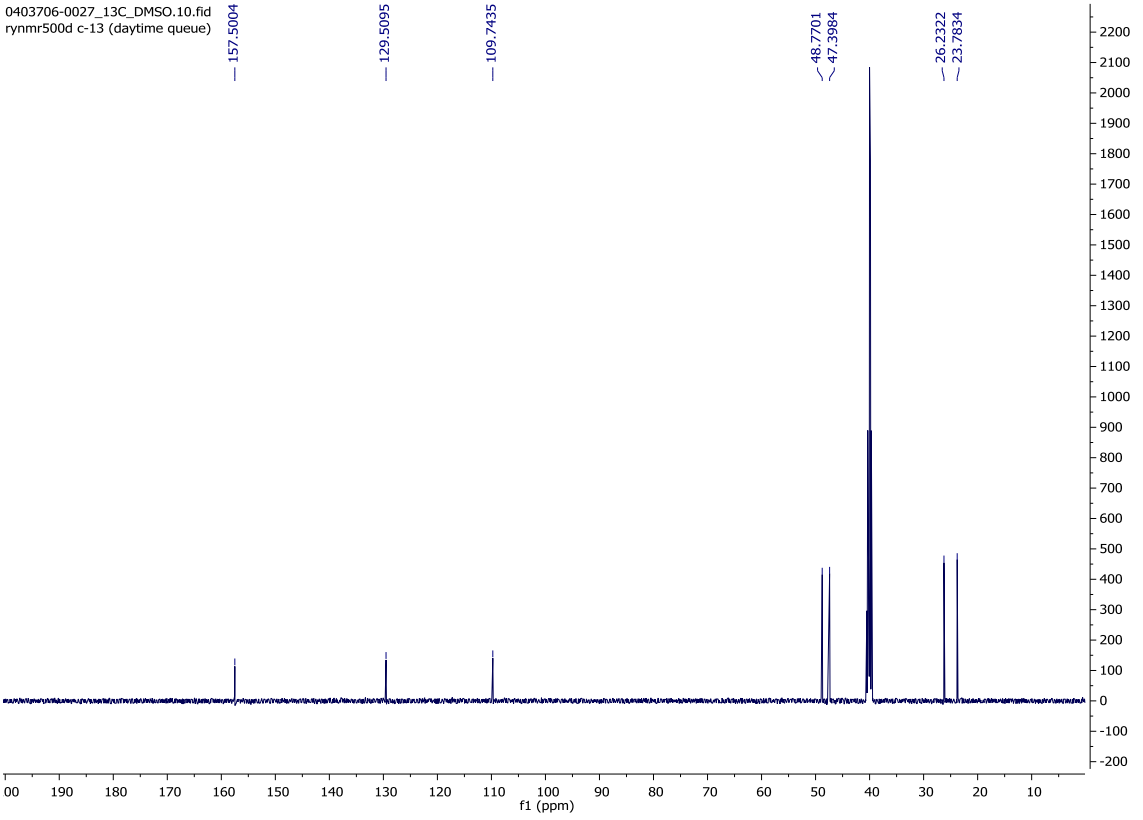
f1 (ppm)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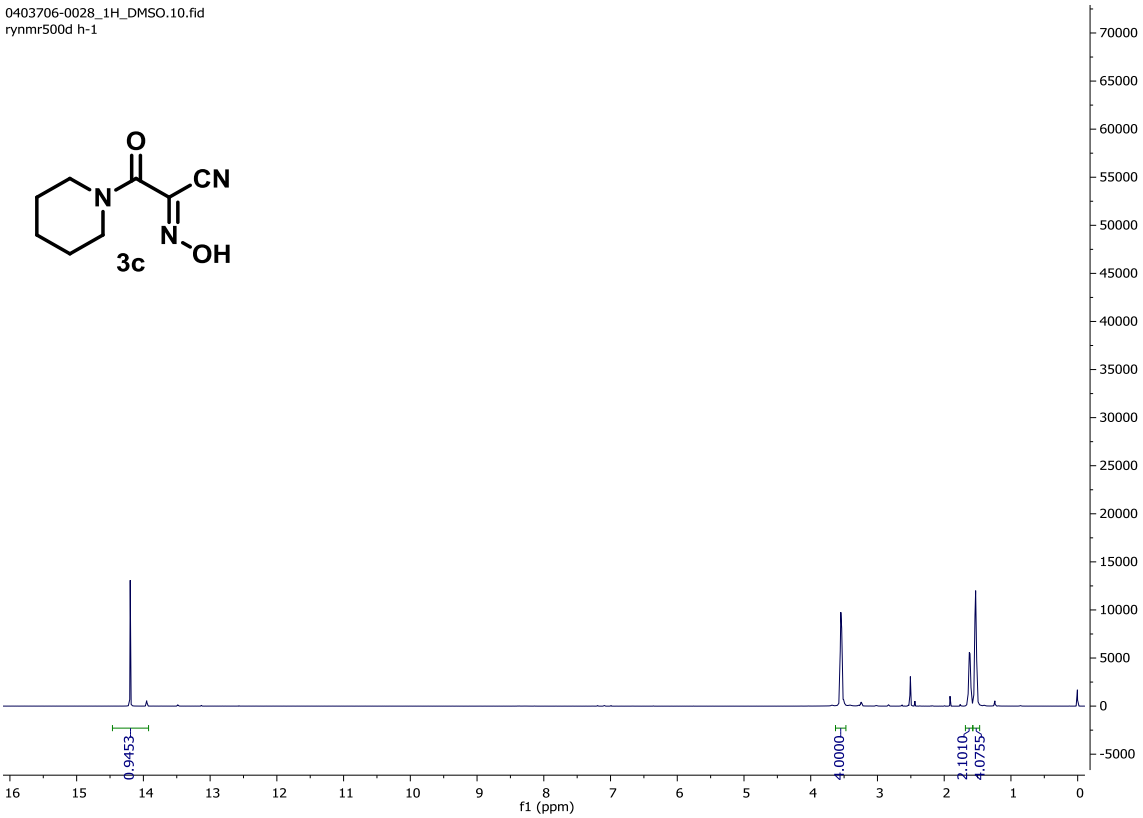
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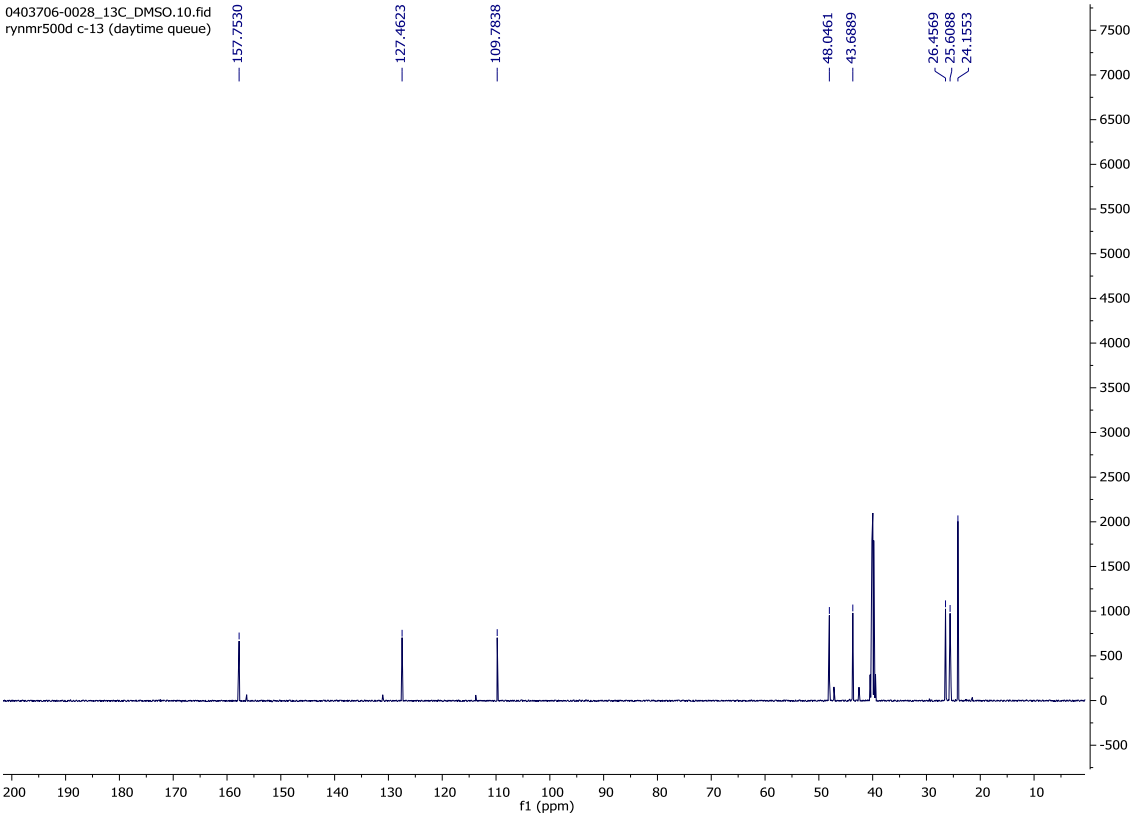
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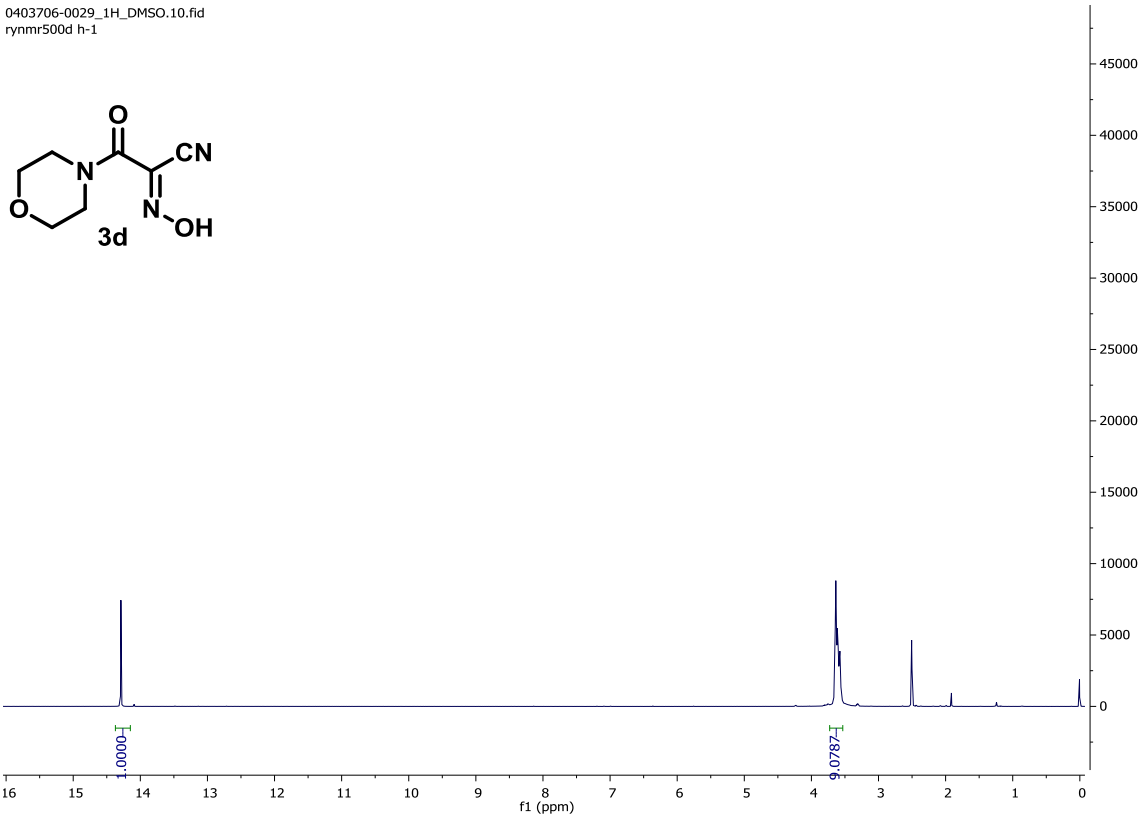
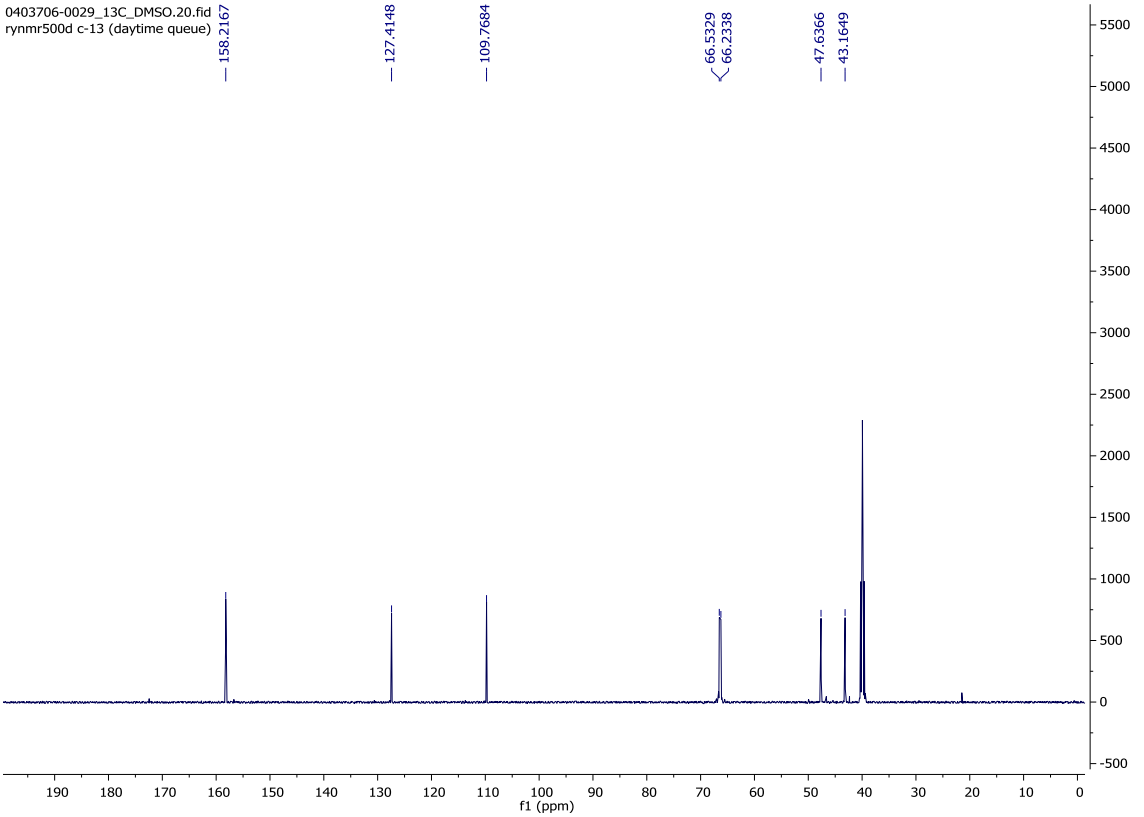
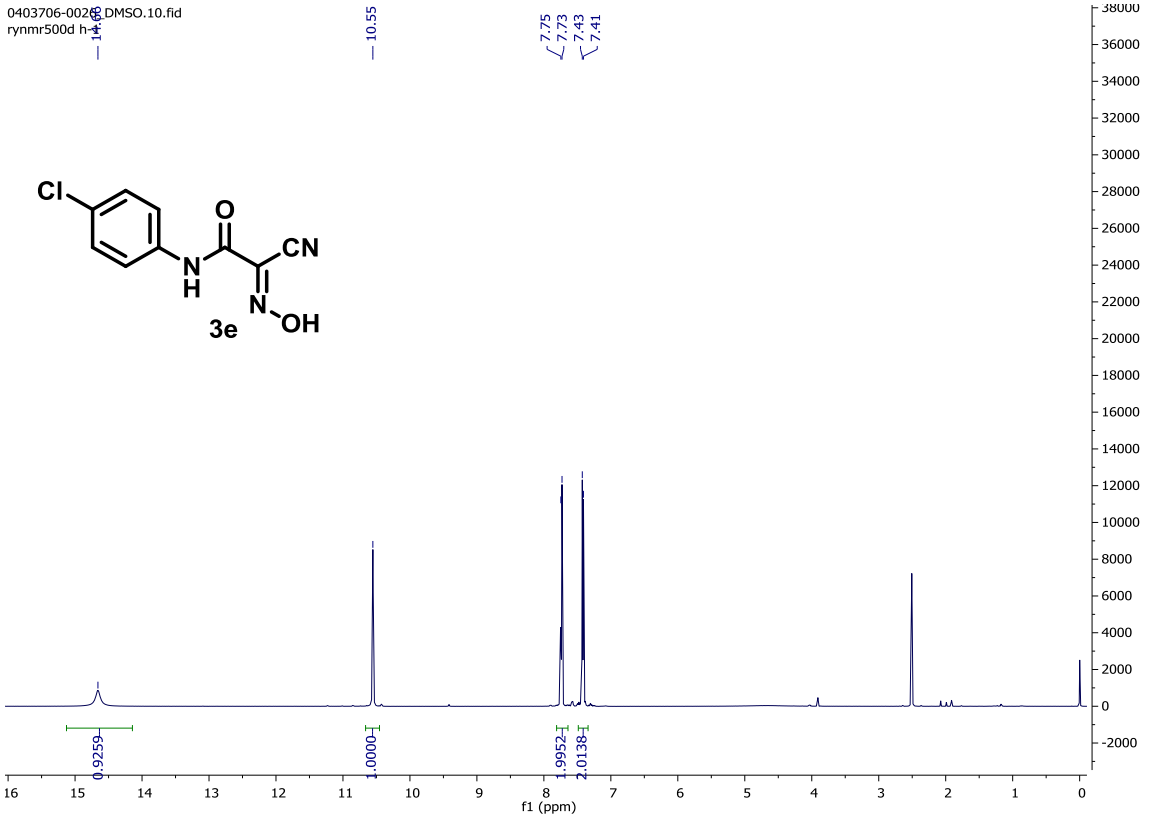
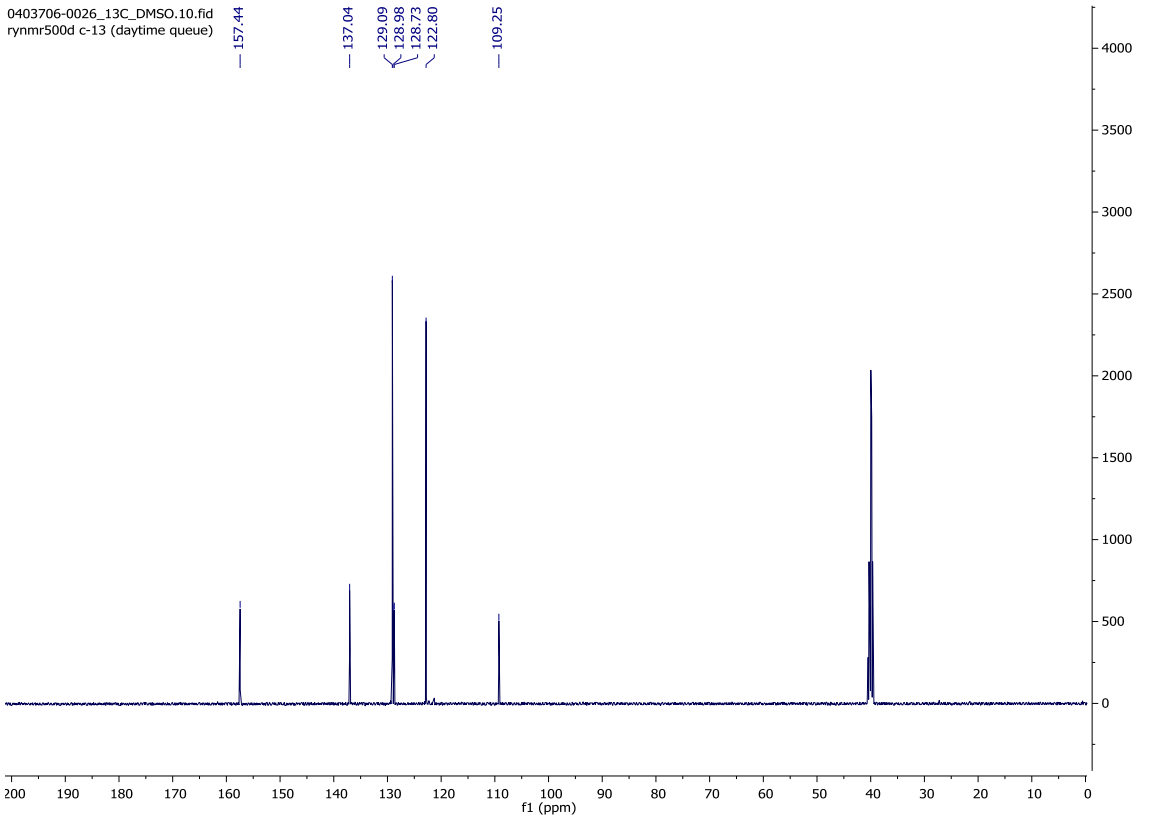
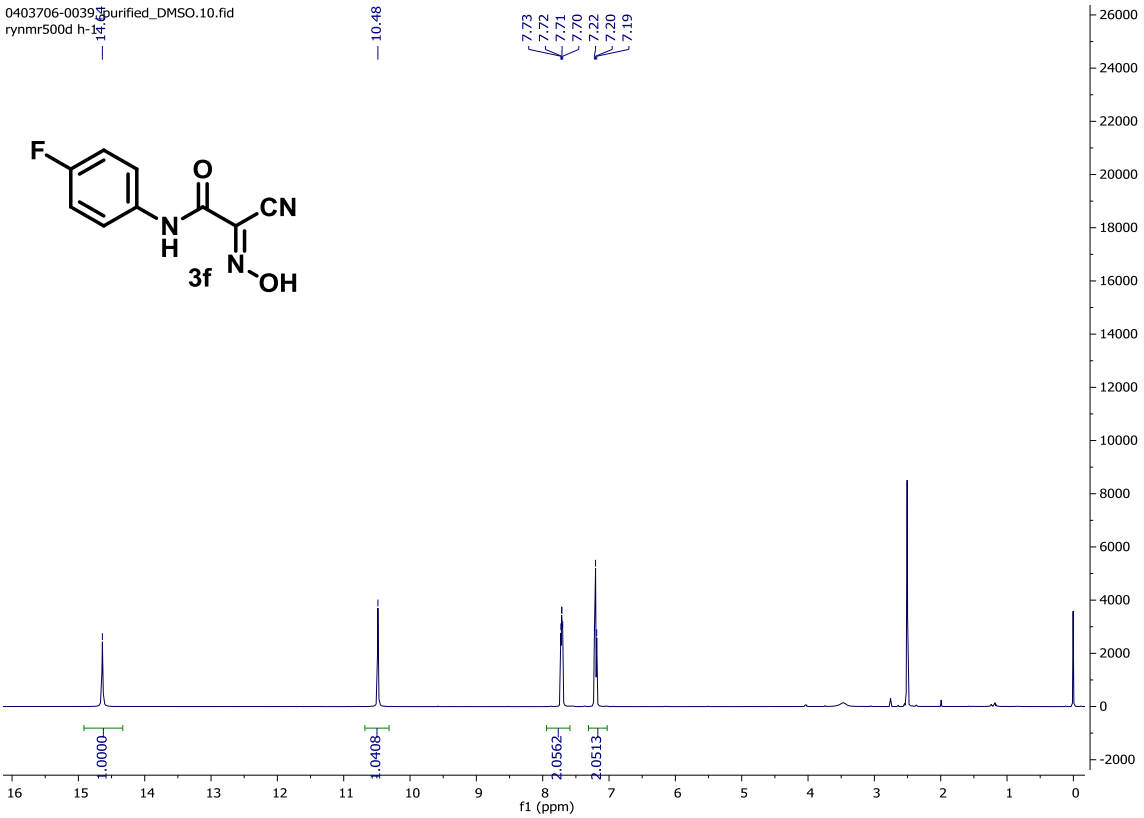
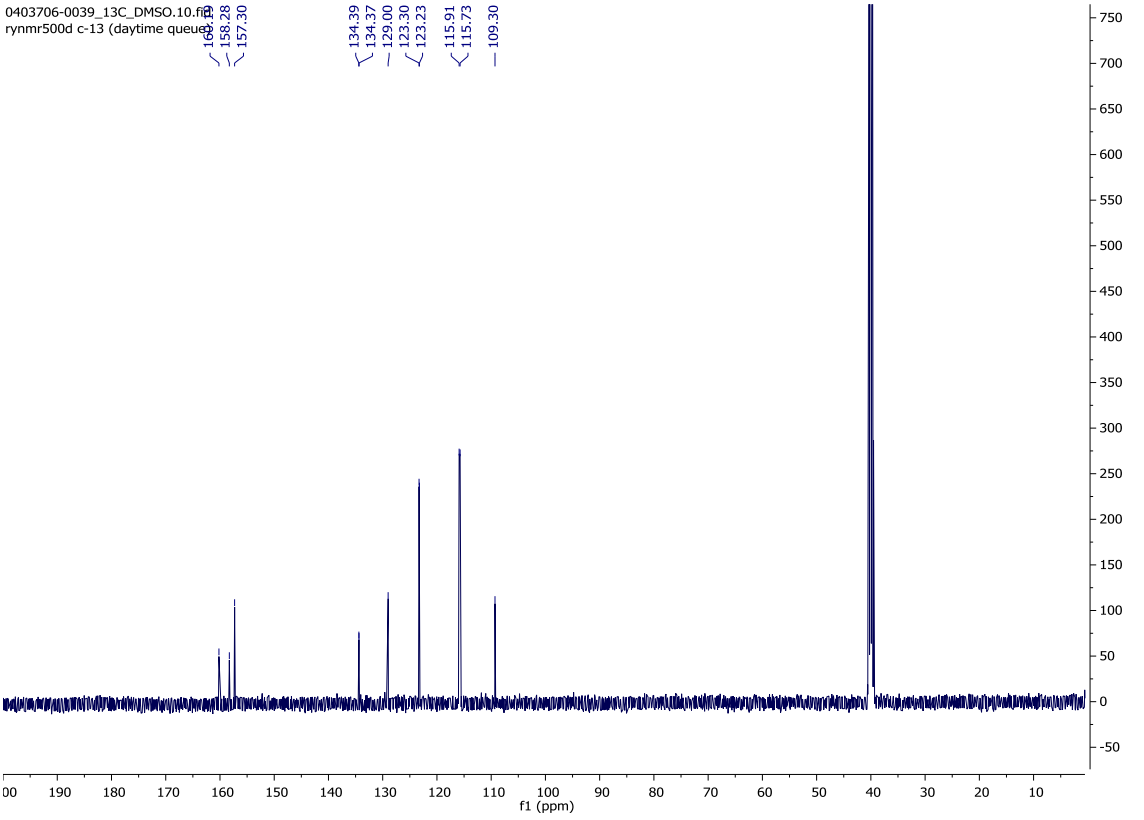

0403706-0029_1H_DMSO.10.fid
rynmr500d h-1
O
N
CN
O
N
OH
3d
1.0000
9.0787
f1 (ppm)

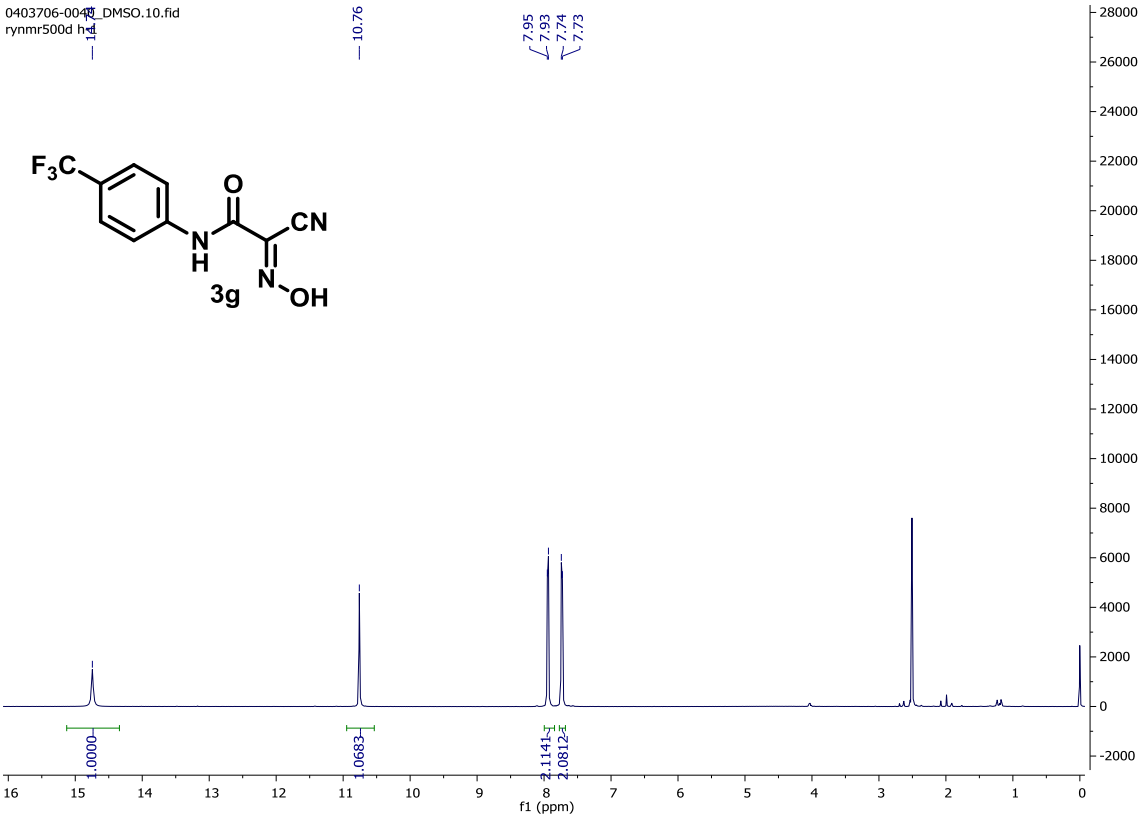

0403706-0029_13C_DMSO.20.fid
rynmr500d c-13 (daytime queue)
158.2167
127.4148
109.7684
66.5329
66.2338
47.6366
43.1649
f1 (ppm)

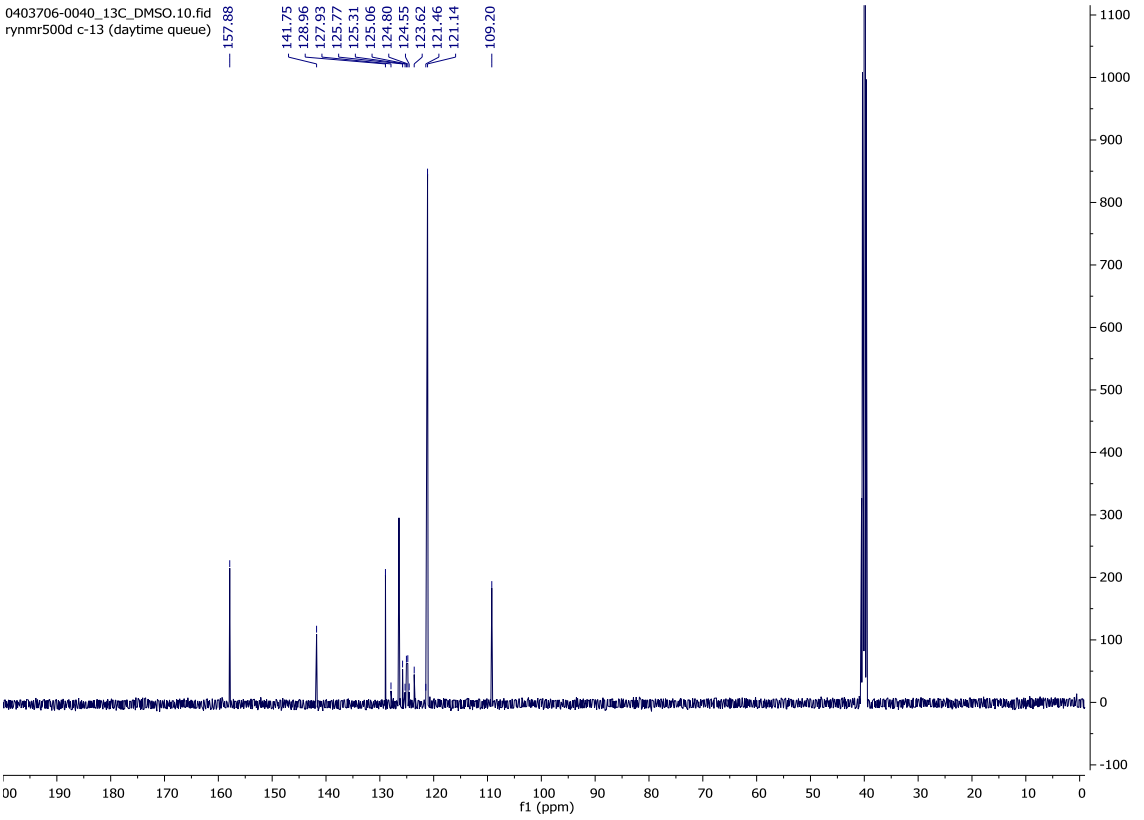

0403706-0026_DMSO.10.fid
rynmr500d h-1
14.66
10.55
7.75
7.73
7.43
7.41
Cl
O
N
H
CN
N
OH
3e
0.9259
1.0000
1.9952
2.0138
f1 (ppm)

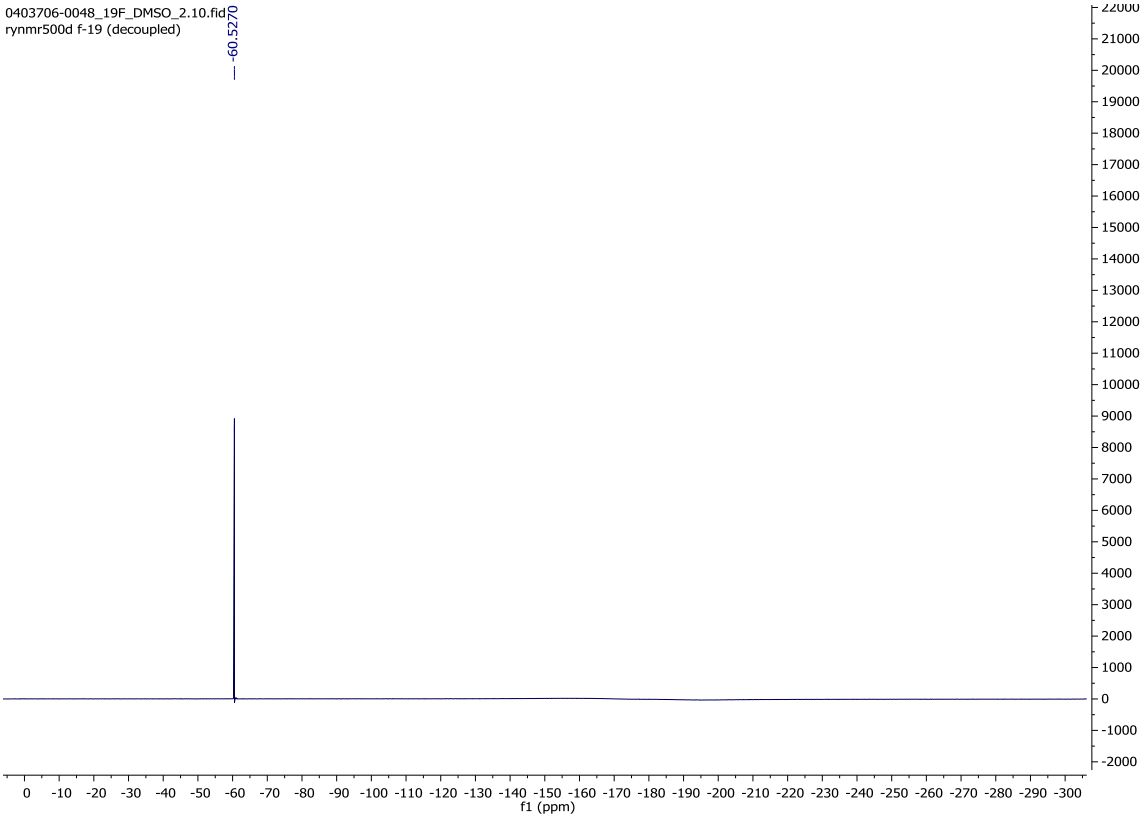

0403706-0026_13C_DMSO.10.fid
rynmr500d c-13 (daytime queue)
157.44
137.04
129.09
128.98
128.73
122.80
109.25
f1 (ppm)

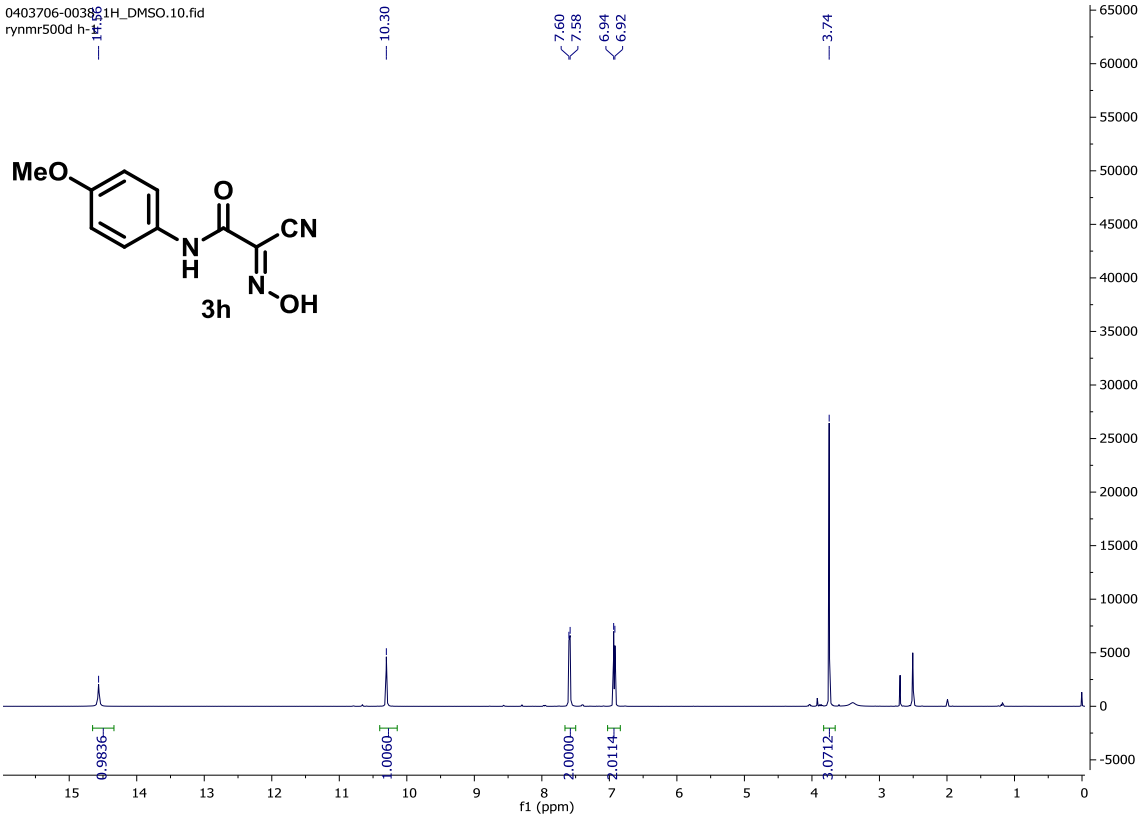

0403706-0039_purified_DMSO.10.fid
rynmr500d h-1
14.44
10.48
7.73
7.72
7.71
7.70
7.22
7.20
7.19
F
O
N
H
CN
N
OH
3f
1.0000
1.0408
2.0562
2.0513
f1 (ppm)

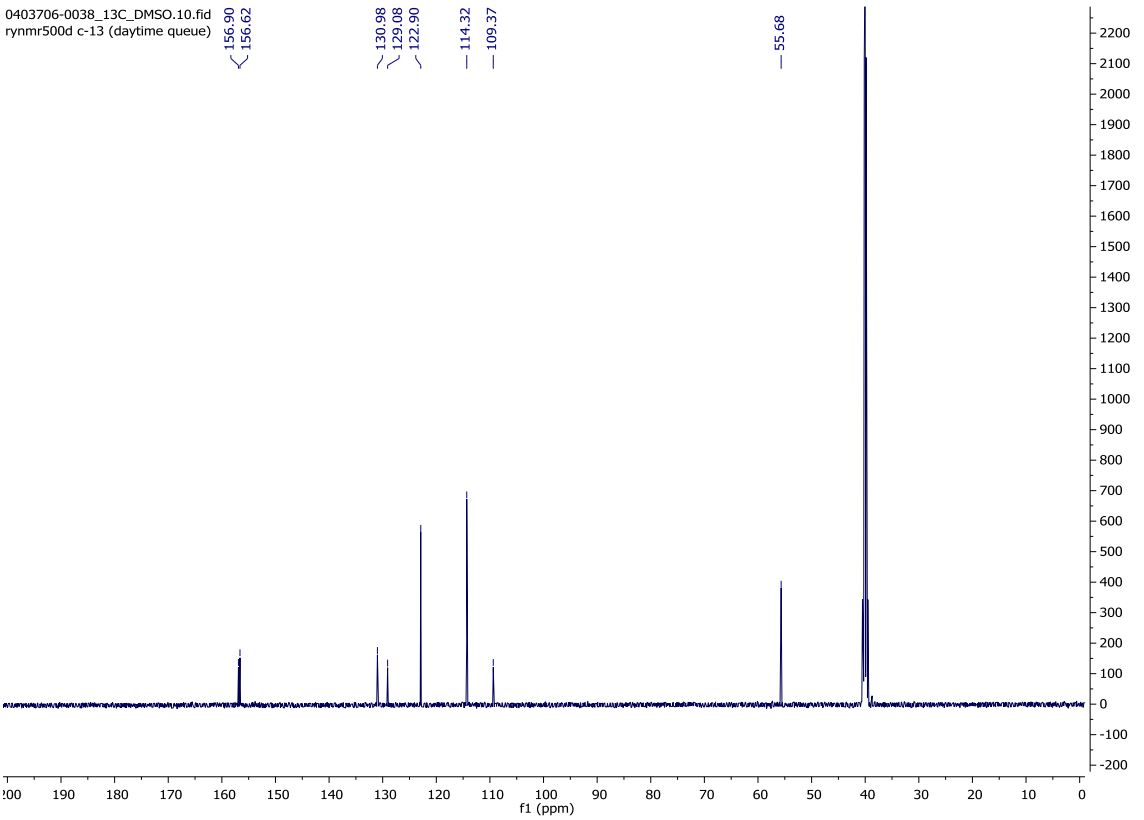

0403706-0039_13C_DMSO.10.fid
rynmr500d c-13 (daytime queued)
160.11
158.28
157.30
134.39
134.37
129.00
123.30
123.23
115.91
115.73
109.30
f1 (ppm)

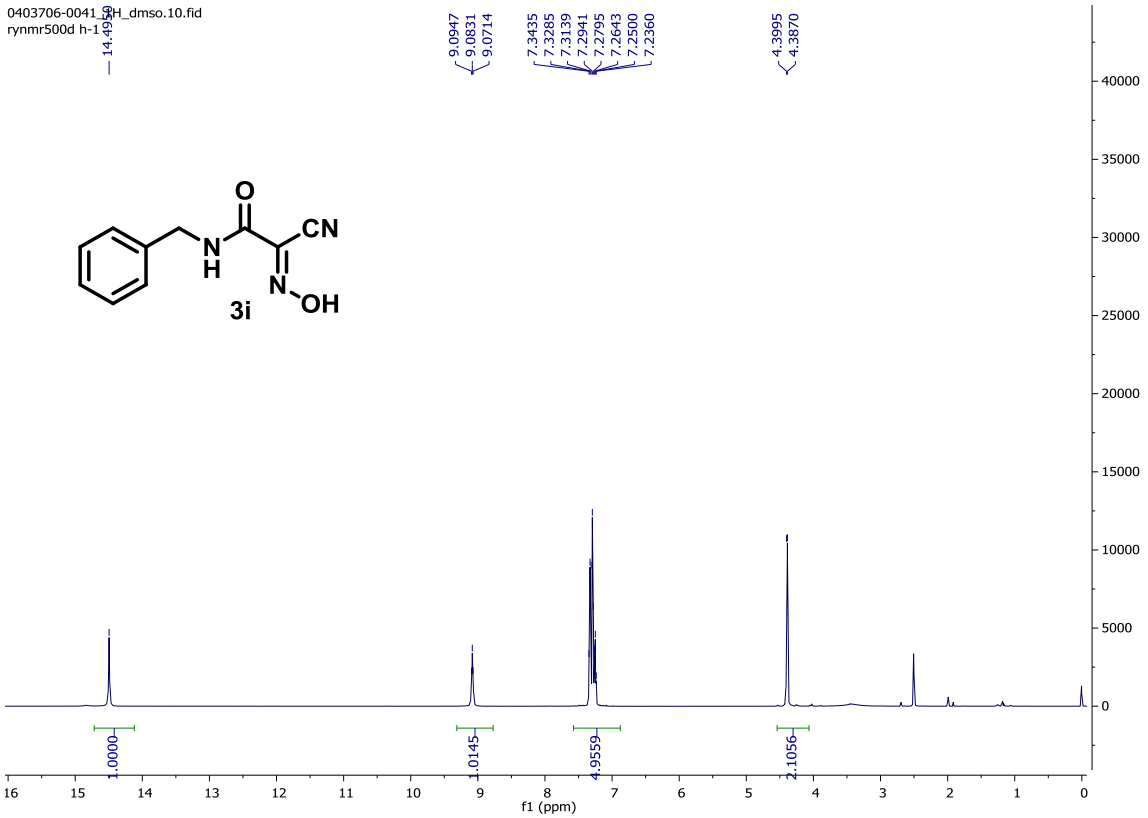

0403706-0040_DMSO.10.fid
rynmr500d h-1
14.76
10.76
7.95
7.93
7.74
7.73
F3C
O
CN
N
H
N
OH
3g
1.0000
1.0683
2.1141
2.0812
f1 (ppm)

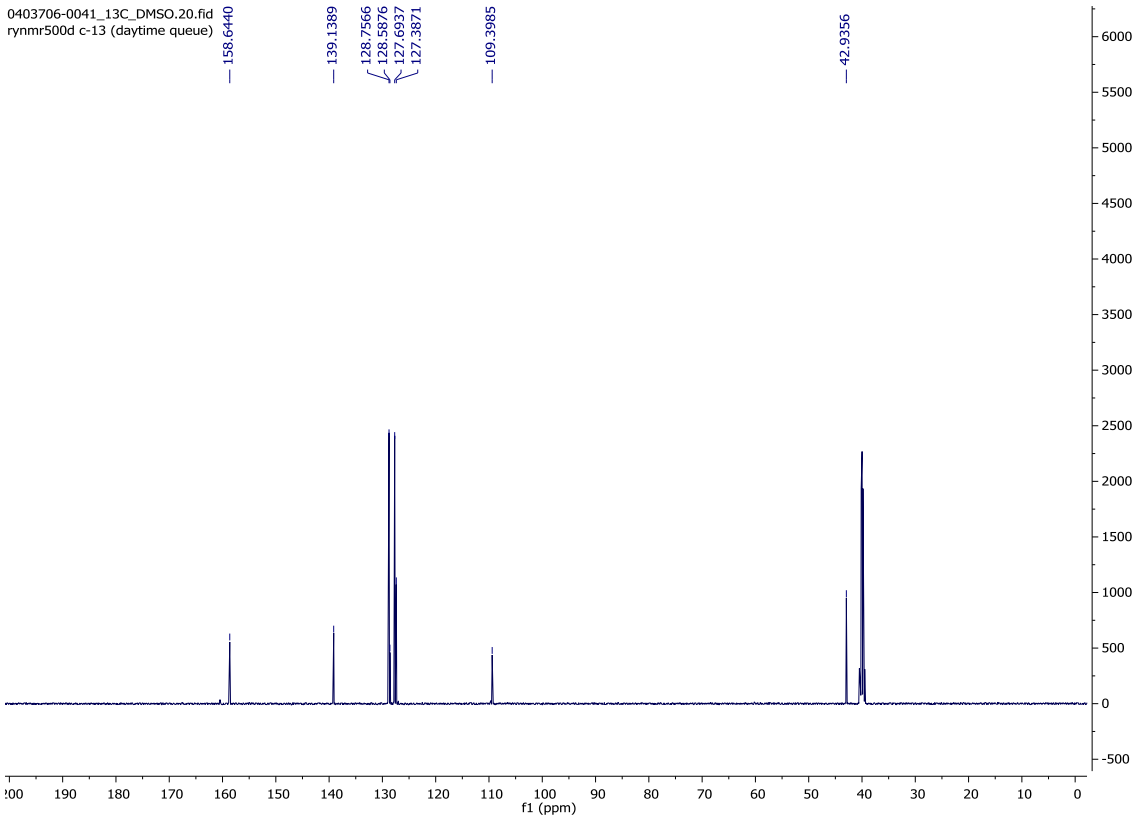

0403706-0040_13C_DMSO.10.fid
rynmr500d c-13 (daytime queue)
157.88
141.75
128.96
127.93
125.77
125.31
125.06
124.80
124.55
123.62
121.46
121.14
109.20
f1 (ppm)

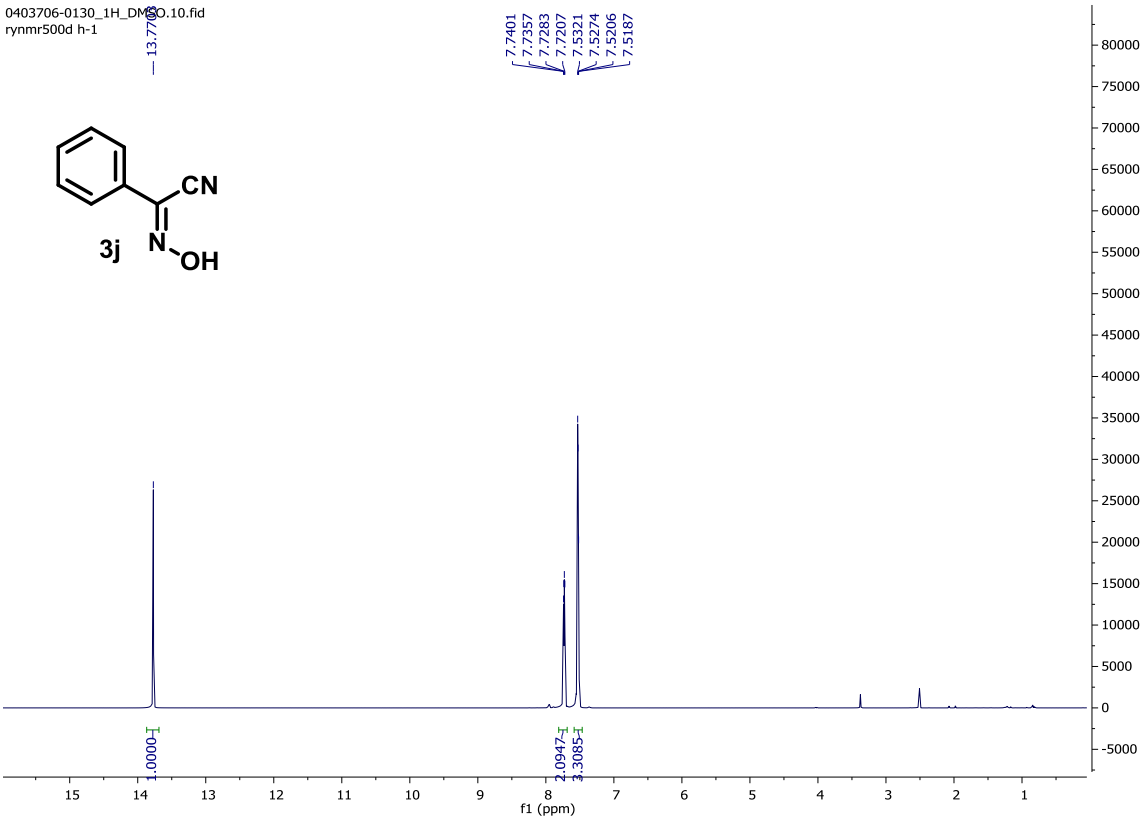

0403706-0048_19F_DMSO_2.10.fid
rynmr500d f-19 (decoupled)
-60.5270
22000
21000
20000
19000
18000
17000
16000
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
-2000
0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -220 -230 -240 -250 -260 -270 -280 -290 -300
f1 (ppm)

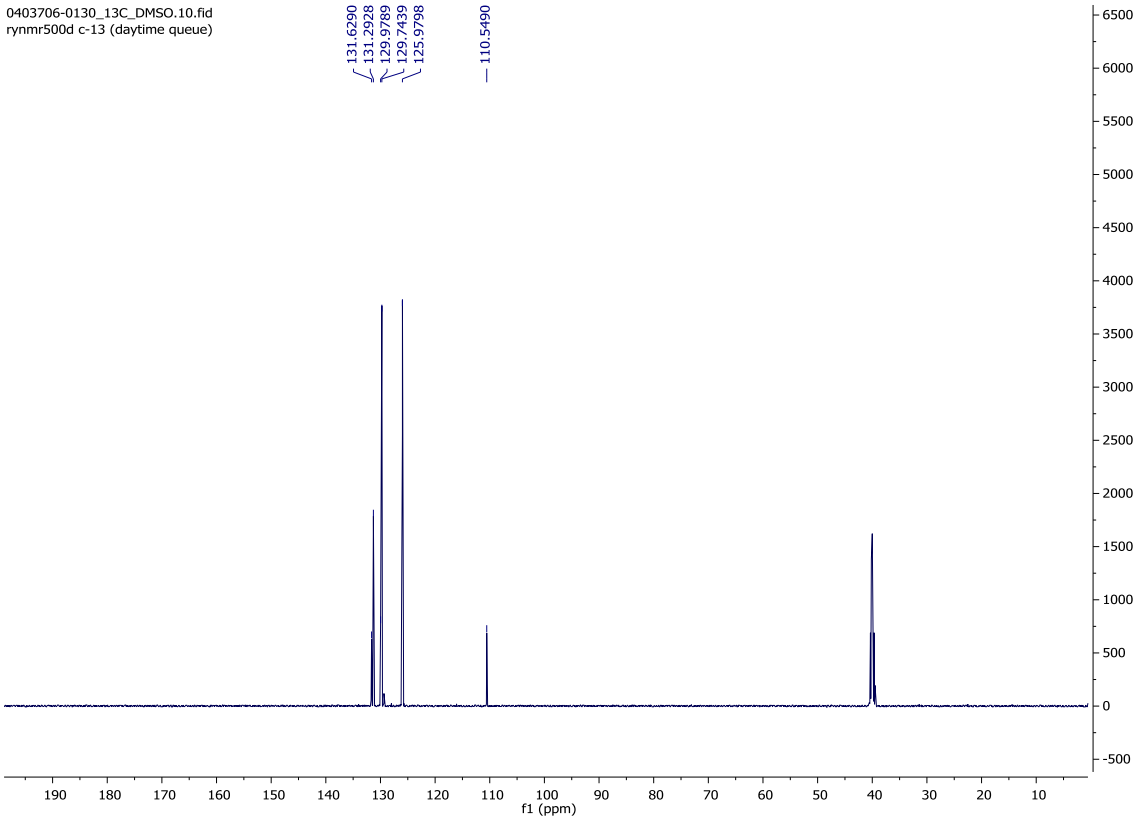

0403706-0038_1H_DMSO.10.fid
rynmr500d h-1
14.56
10.30
7.60
7.58
6.94
6.92
3.74
MeO
O
CN
N
H
N
OH
3h
0.9836
1.0060
2.0000
2.0114
3.0712
f1 (ppm)

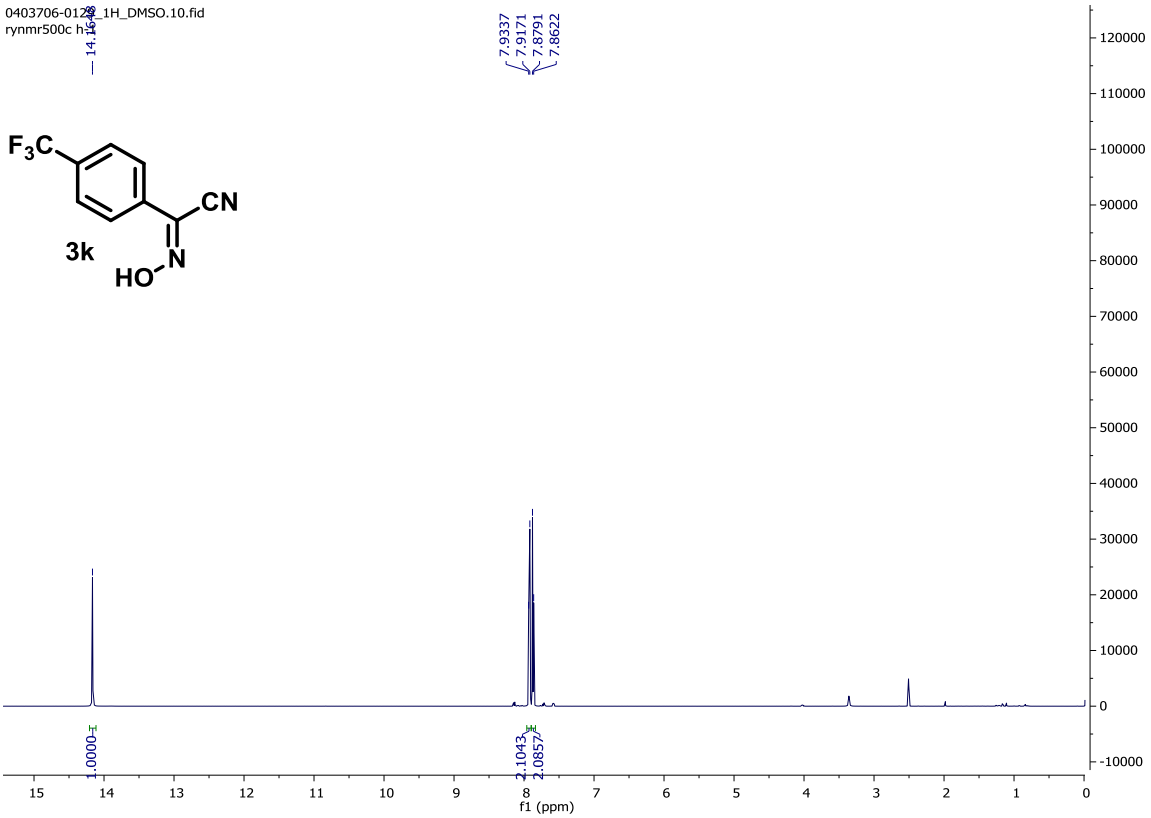

0403706-0038_13C_DMSO.10.fid
rynmr500d c-13 (daytime queue)
156.90
156.62
130.98
129.08
122.90
114.32
109.37
55.68
f1 (ppm)

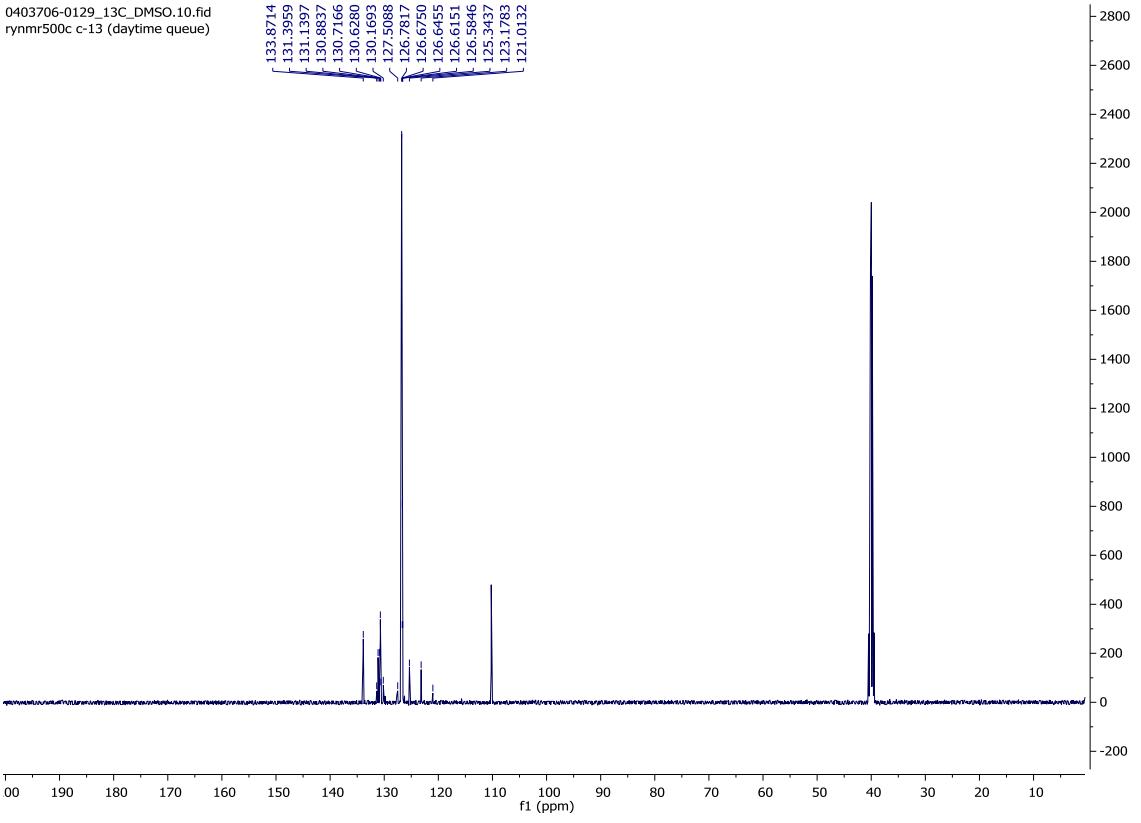

0403706-0041_1H_dmso.10.fid
rynmr500d h-1 (daytime queue)
14.4958
9.0947
9.0831
9.0714
7.3435
7.3285
7.3139
7.2941
7.2795
7.2643
7.2500
7.2360
4.3995
4.3870
O
CN
N
H
N
OH
3i
1.0000
1.0145
4.9559
2.1056
f1 (ppm)

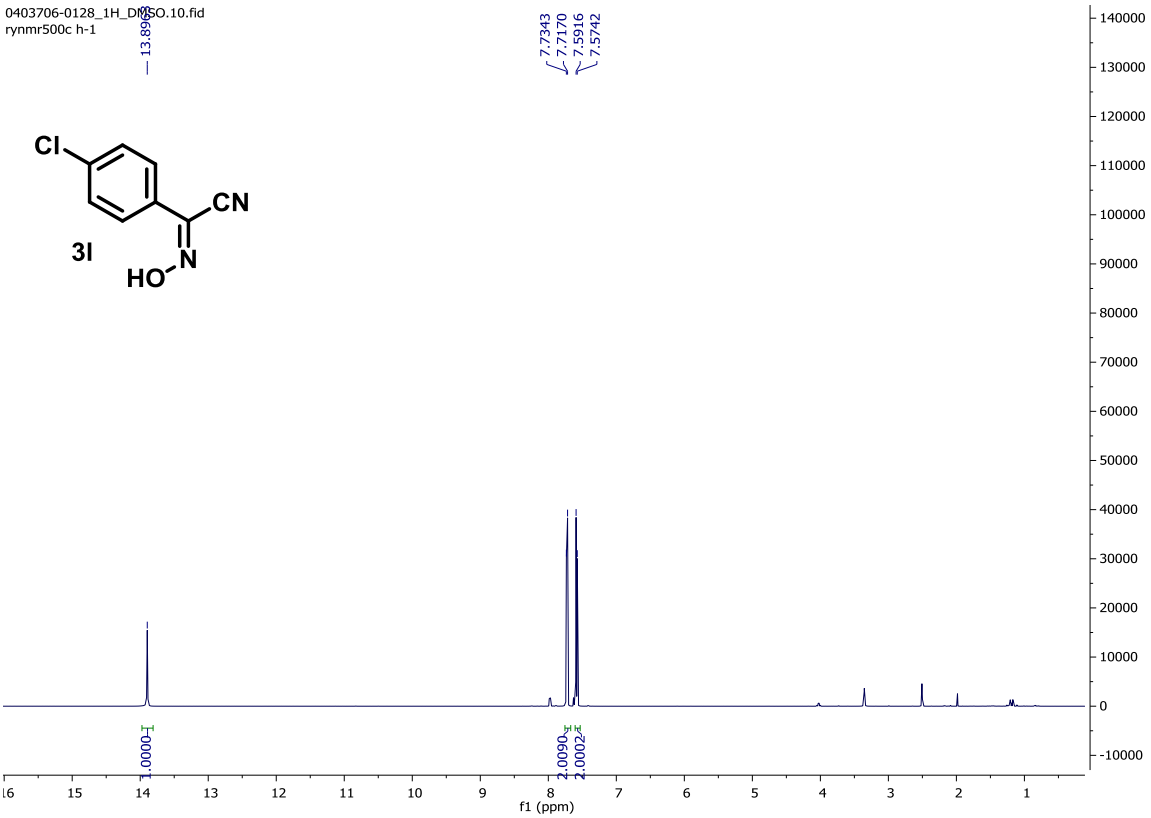

0403706-0041_13C_DMSO.20.fid
rynmr500d c-13 (daytime queue)
158.6440
139.1389
128.7566
128.5876
127.6937
127.3871
109.3985
42.9356
f1 (ppm)

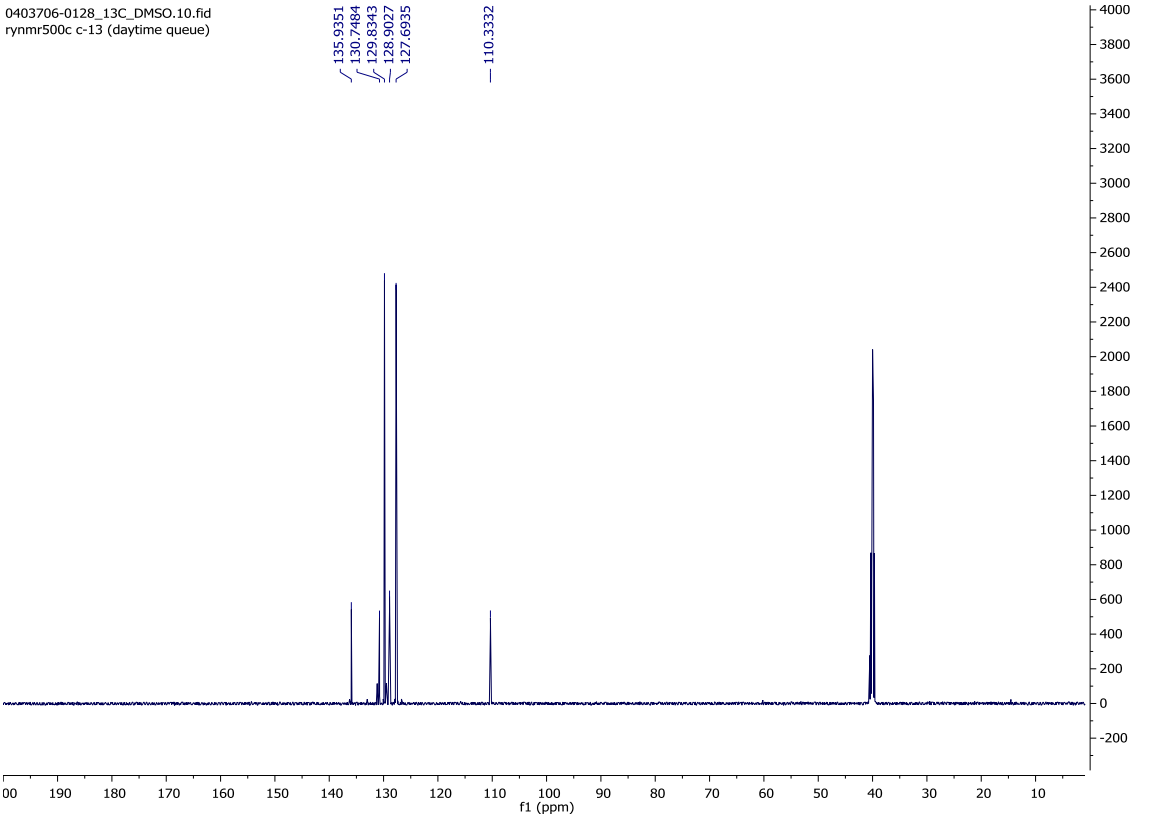

0403706-0130_1H_DMSO.10.fid
rynmr500d h-1
13.7703
7.7401
7.7357
7.7283
7.7207
7.5321
7.5274
7.5206
7.5187
CN
N
OH
3j
1.0000
2.0947
3.3085
f1 (ppm)

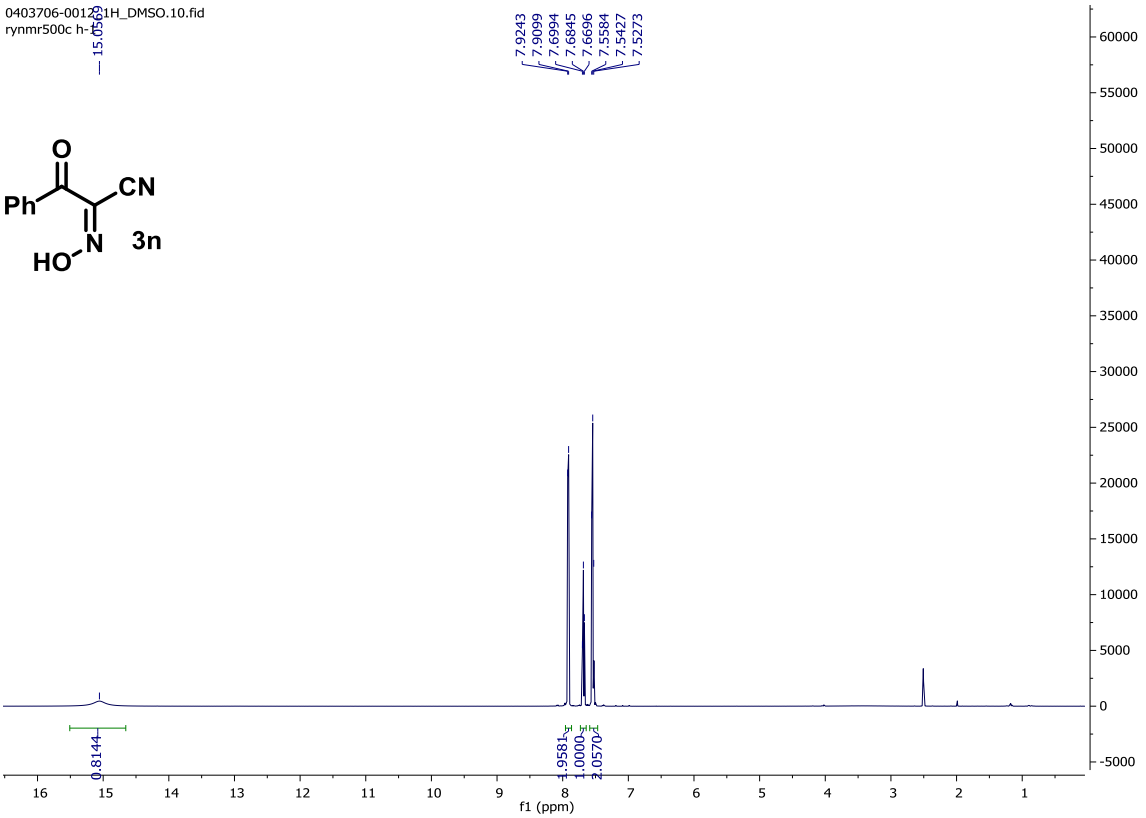

0403706-0130_13C_DMSO.10.fid
rynmr500d c-13 (daytime queue)
131.6290
131.2928
129.9789
129.7439
125.9798
110.5490
f1 (ppm)

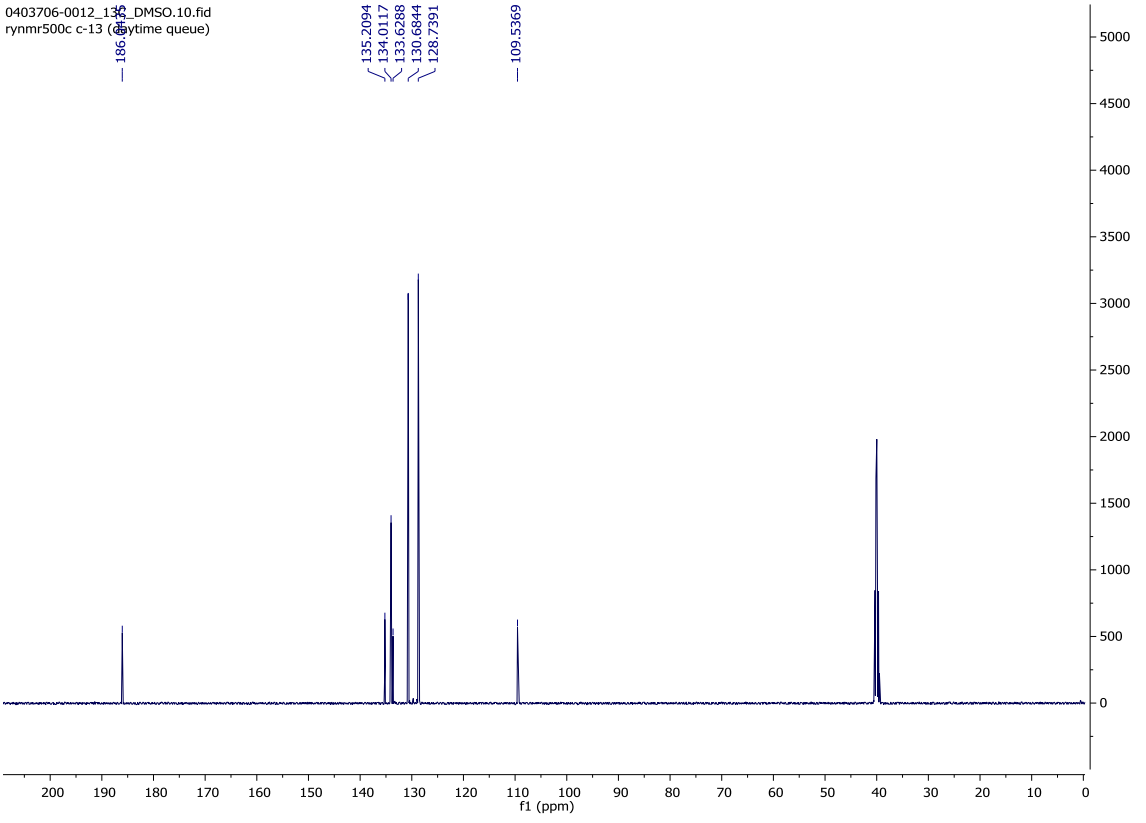

0403706-0129_1H_DMSO.10.fid
rynmr500c H-1
14.1548
7.9337
7.9171
7.8791
7.8622
F3C
CN
N
HO
3k
1.0000
2.1043
2.0857
f1 (ppm)

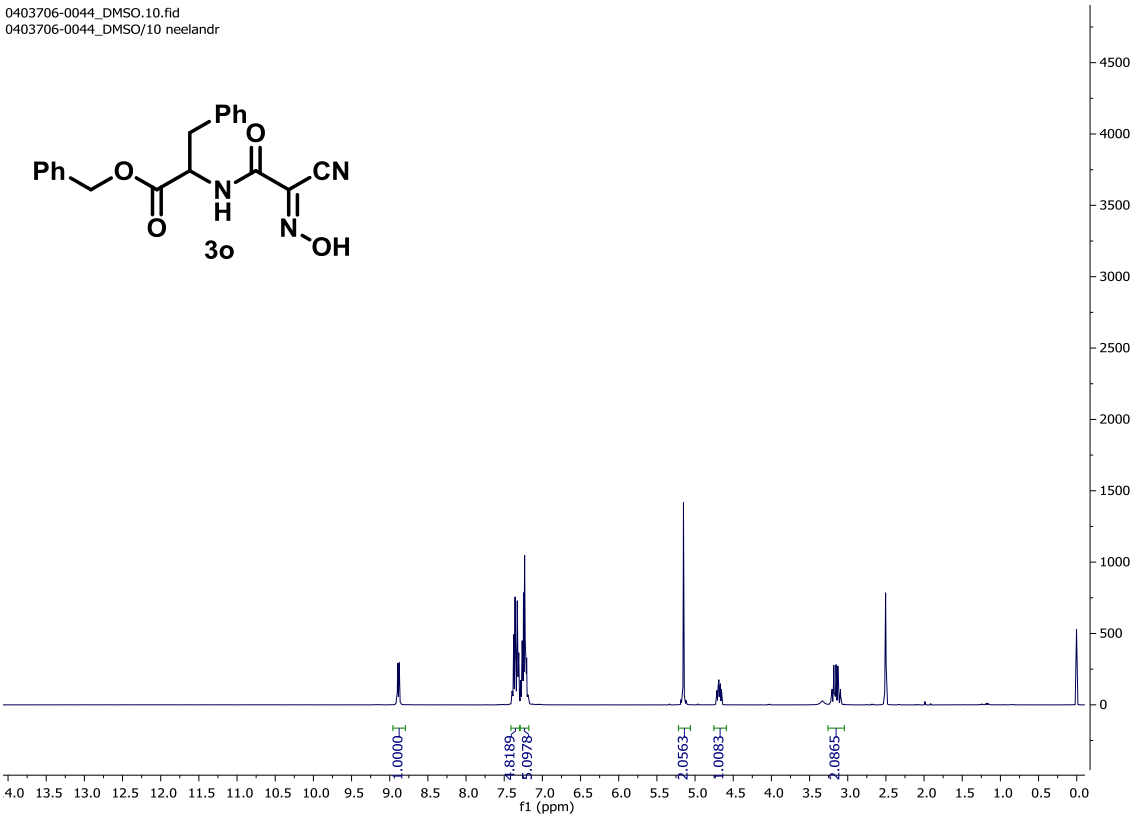

0403706-0129_13C_DMSO.10.fid
rynmr500c c-13 (daytime queue)
133.8714
131.3959
131.1397
130.8837
130.7166
130.6280
130.1693
127.5088
126.7817
126.6750
126.6455
126.6151
126.5846
125.3437
123.1783
121.0132
f1 (ppm)

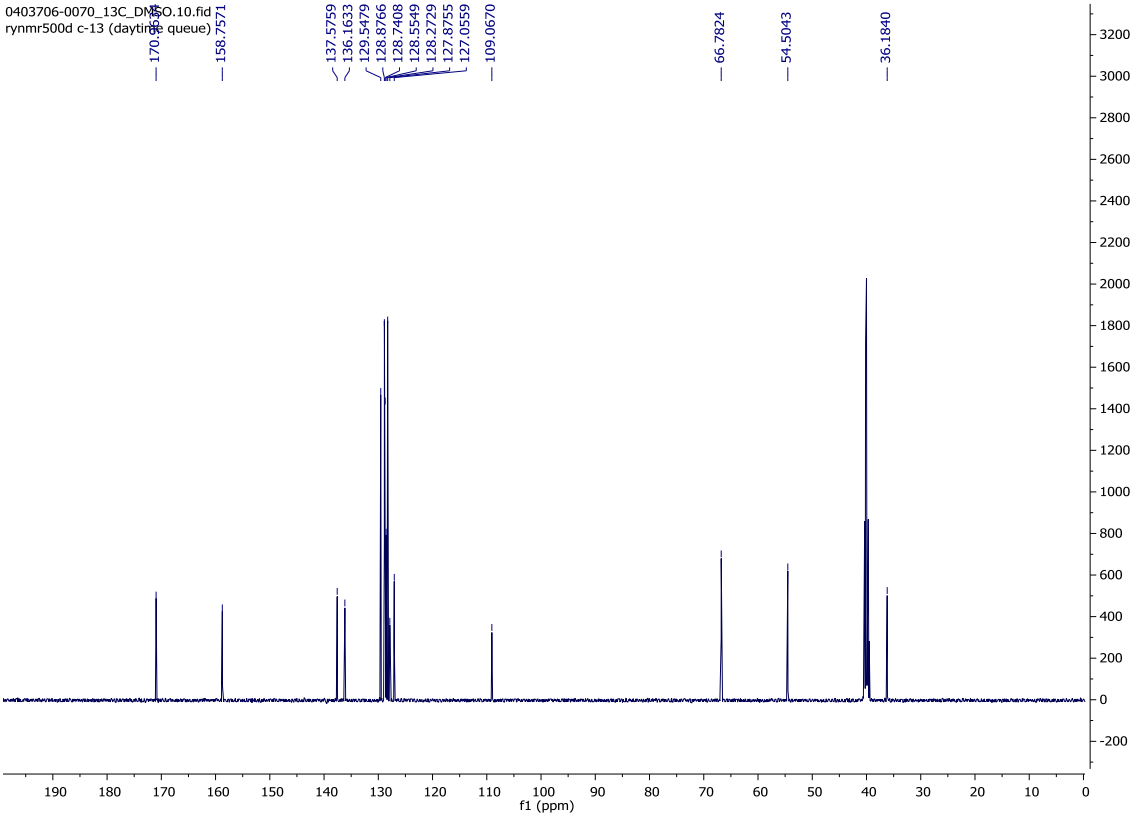

0403706-0128_1H_DMSO.10.fid
rynmr500c h-1
13.8998
7.7343
7.7170
7.5916
7.5742
Cl
CN
N
HO
3l
1.0000
2.0090
2.0002
f1 (ppm)

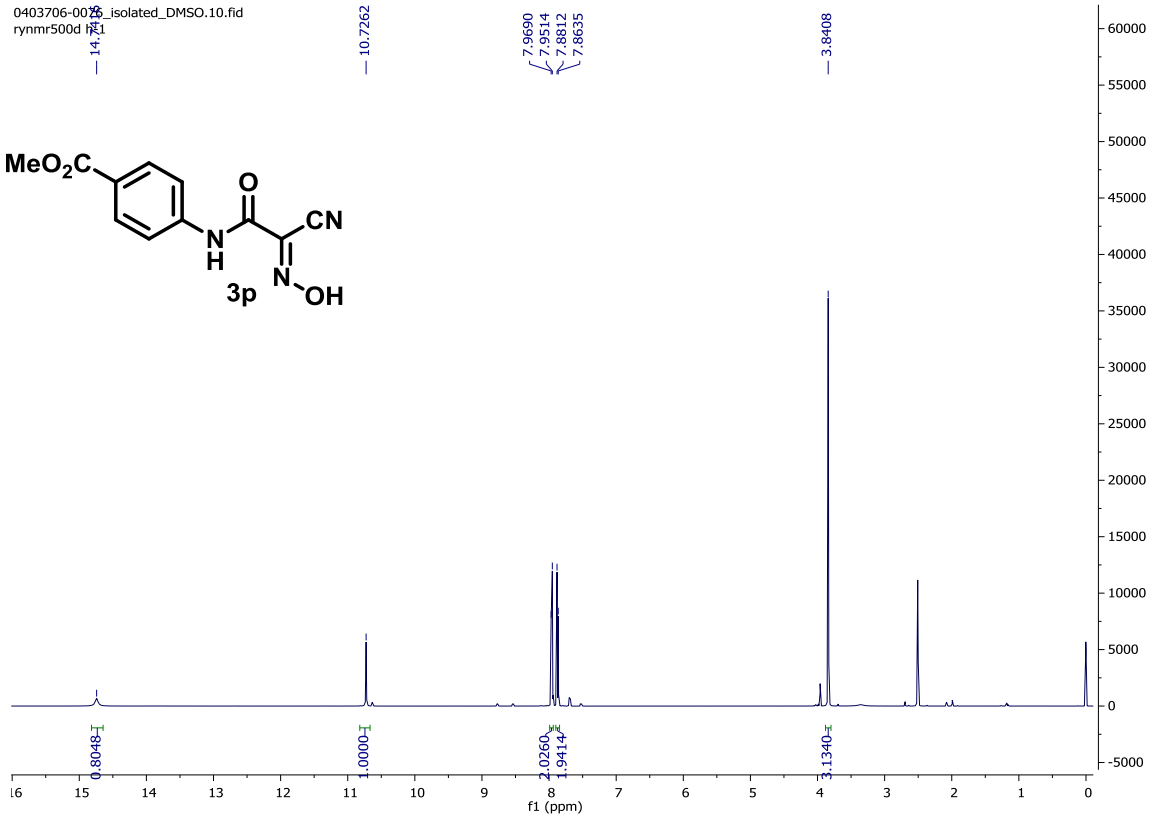

0403706-0128_13C_DMSO.10.fid
rynmr500c c-13 (daytime queue)
135.9351
130.7484
129.8343
128.9027
127.6935
110.3332
f1 (ppm)

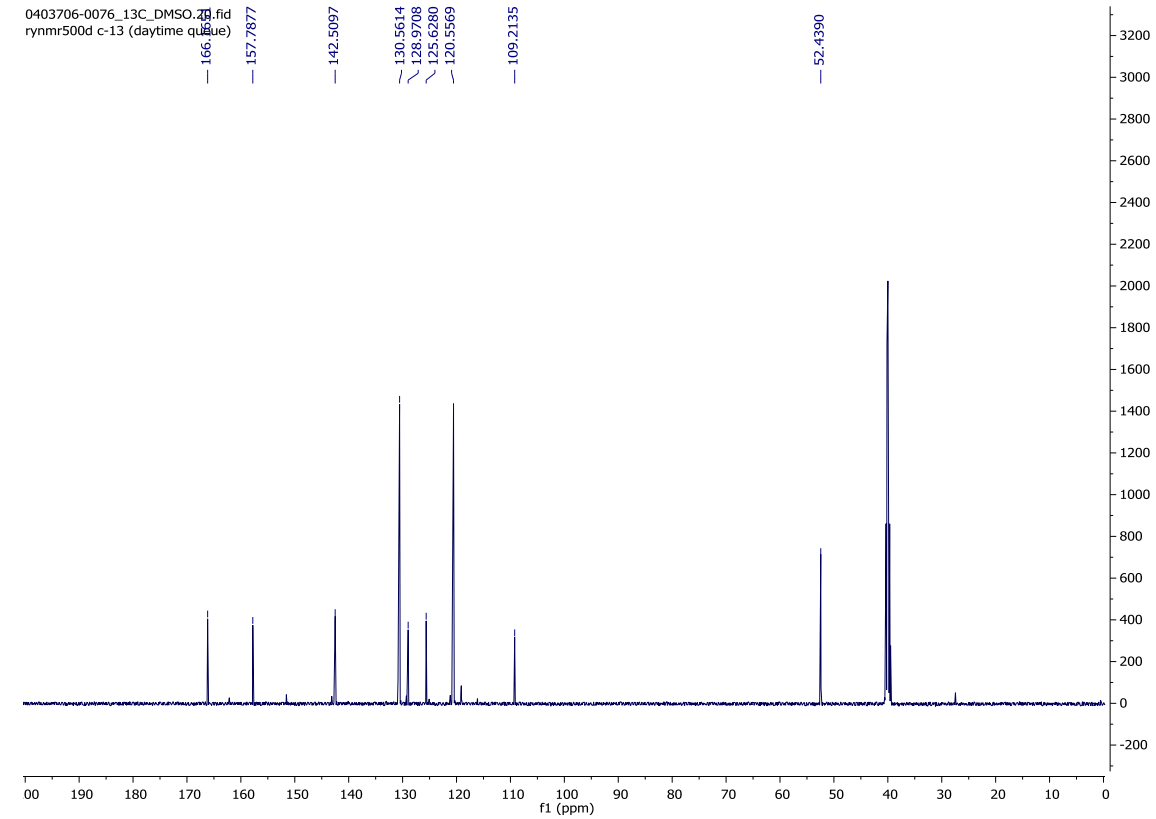

0403706-0012_1H_DMSO.10.fid
rynmr500c h-1
15.0569
7.9243
7.9099
7.6994
7.6845
7.6696
7.5584
7.5427
7.5273
O
Ph
CN
N
HO
3n
0.8144
1.9581
1.0000
2.0570
f1 (ppm)

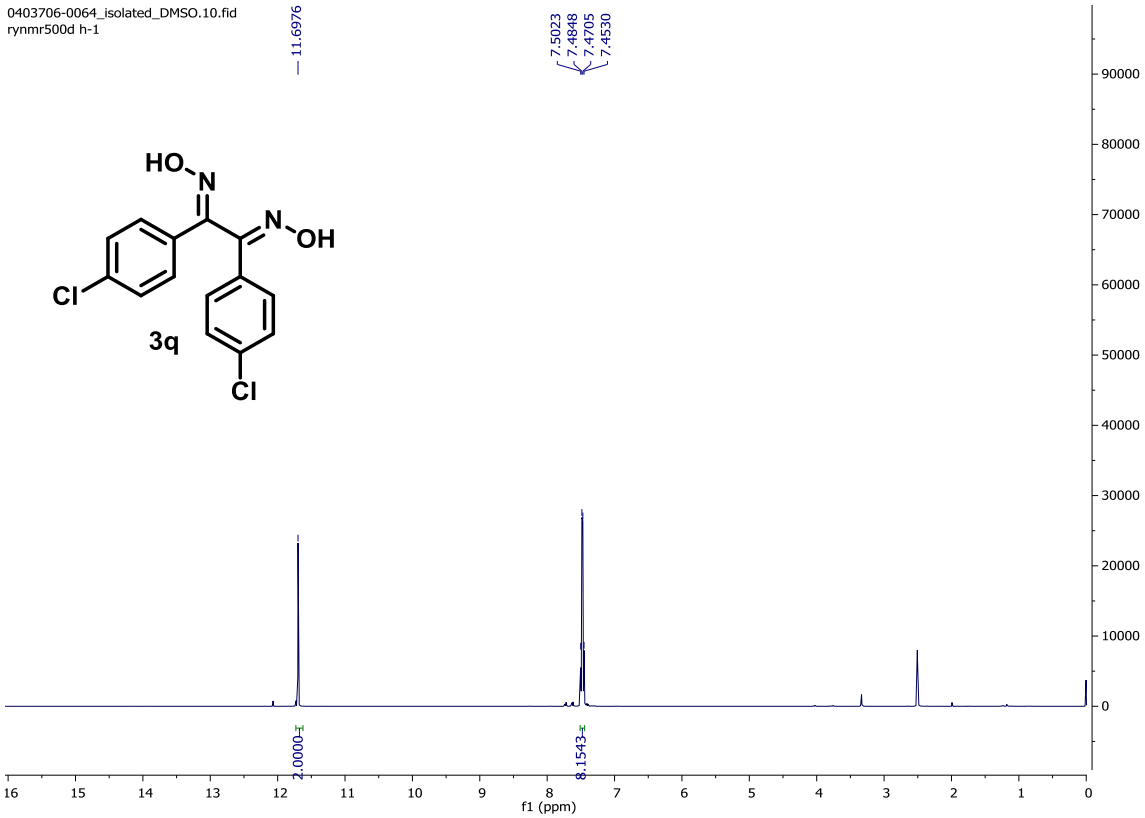

0403706-0012_13C_DMSO.10.fid
rynmr500c c-13 (daytime queue)
186.4
135.2094
134.0117
133.6288
130.6844
128.7391
109.5369
f1 (ppm)

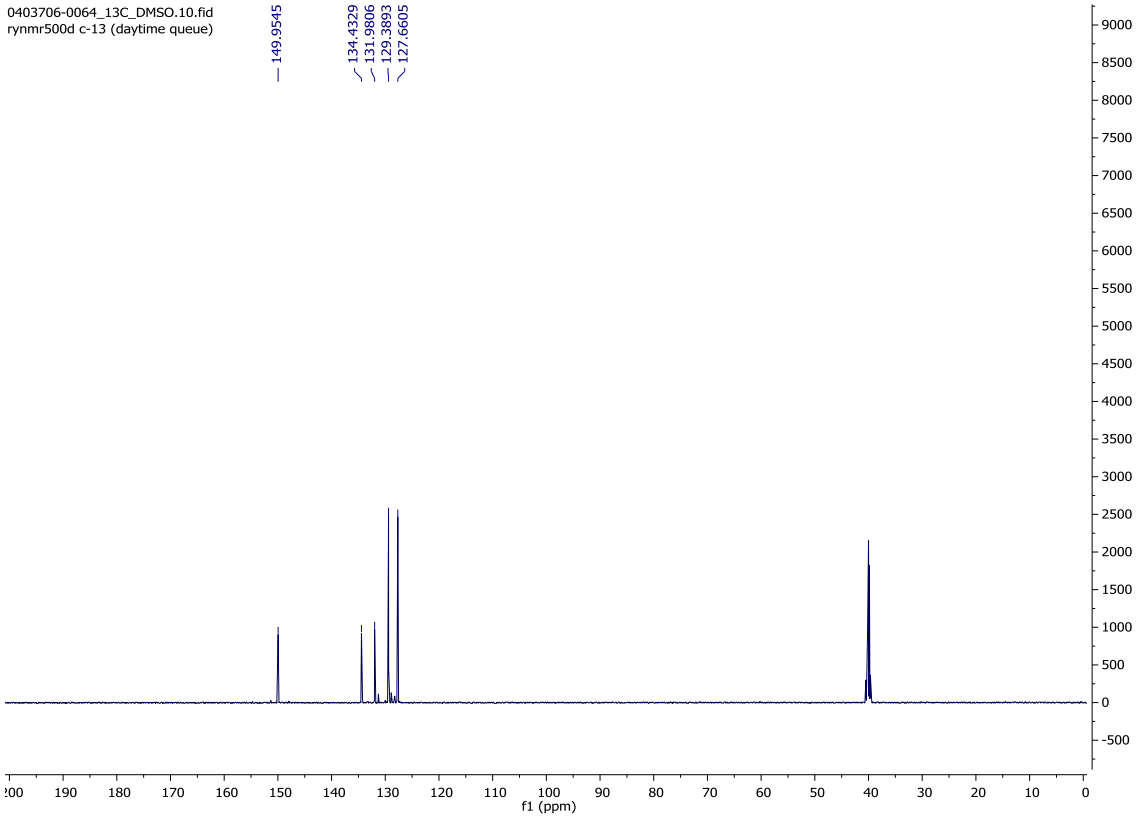

0403706-0044_DMSO.10.fid
0403706-0044_DMSO/10 neelandr
Ph
O
Ph
O
N
H
CN
N
OH
O
3o
1.0000
4.8189
5.0978
2.0563
1.0083
2.0865
f1 (ppm)

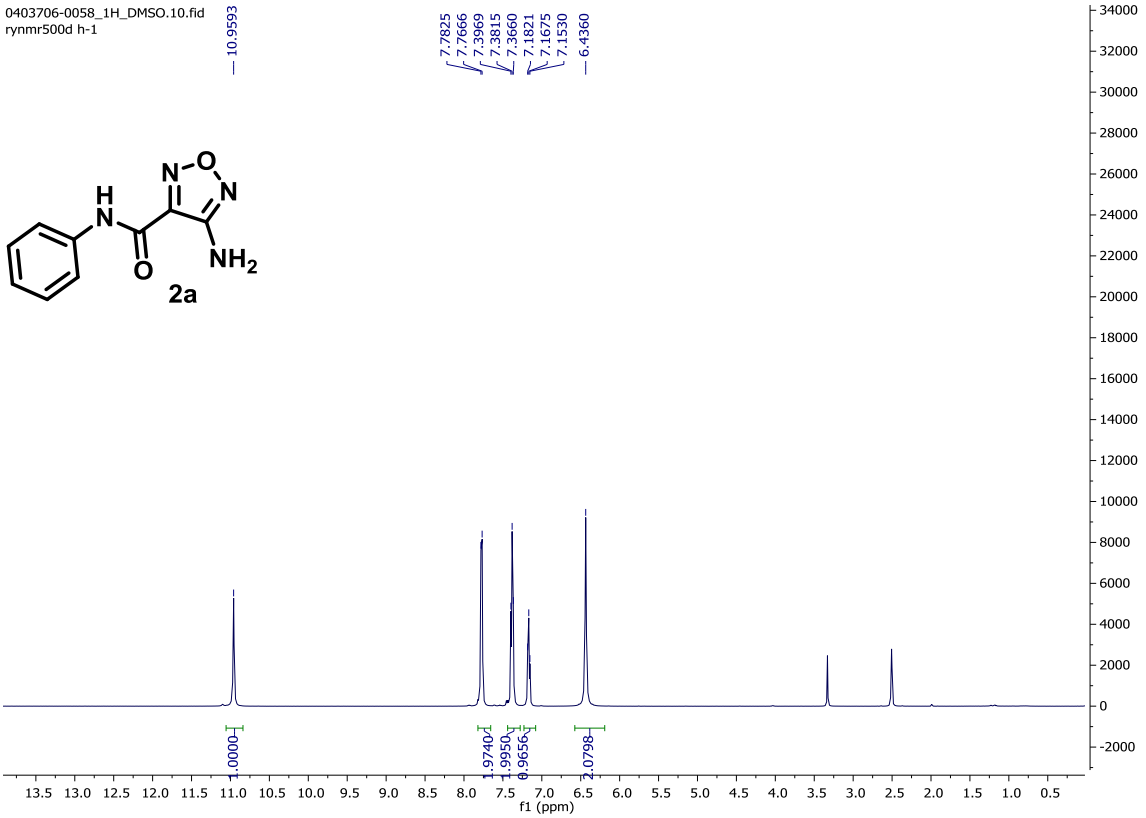

0403706-0070_13C_DMSO.10.fid
rynmr500d c-13 (daytime queue)
170.3454
158.7571
137.5759
136.1633
129.5479
128.8766
128.7408
128.5549
128.2729
127.8755
127.0559
109.0670
66.7824
54.5043
36.1840
f1 (ppm)

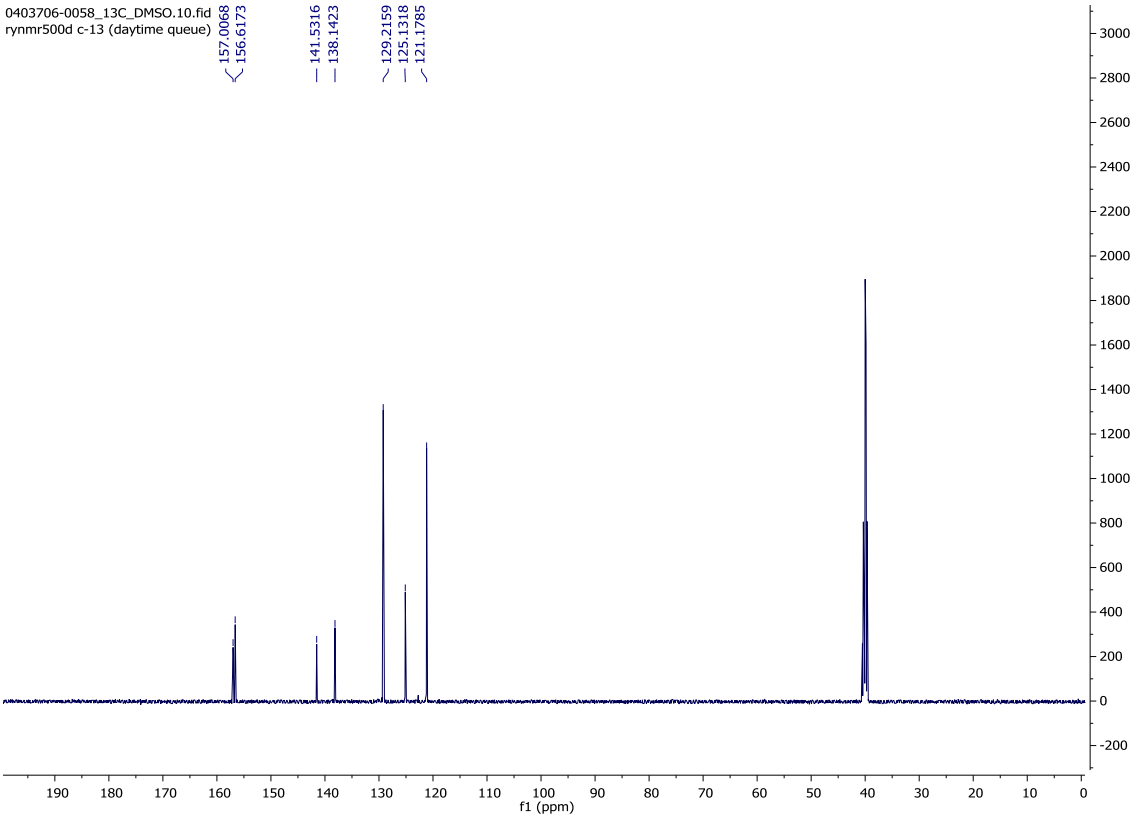

0403706-0076_isolated_DMSO.10.fid
rynmr500d h-1
14.7715
10.7262
7.9690
7.9514
7.8812
7.8635
3.8408
MeO2C
O
CN
N
H
N
OH
3p
0.8048
1.0000
2.0260
1.9414
3.1340
f1 (ppm)

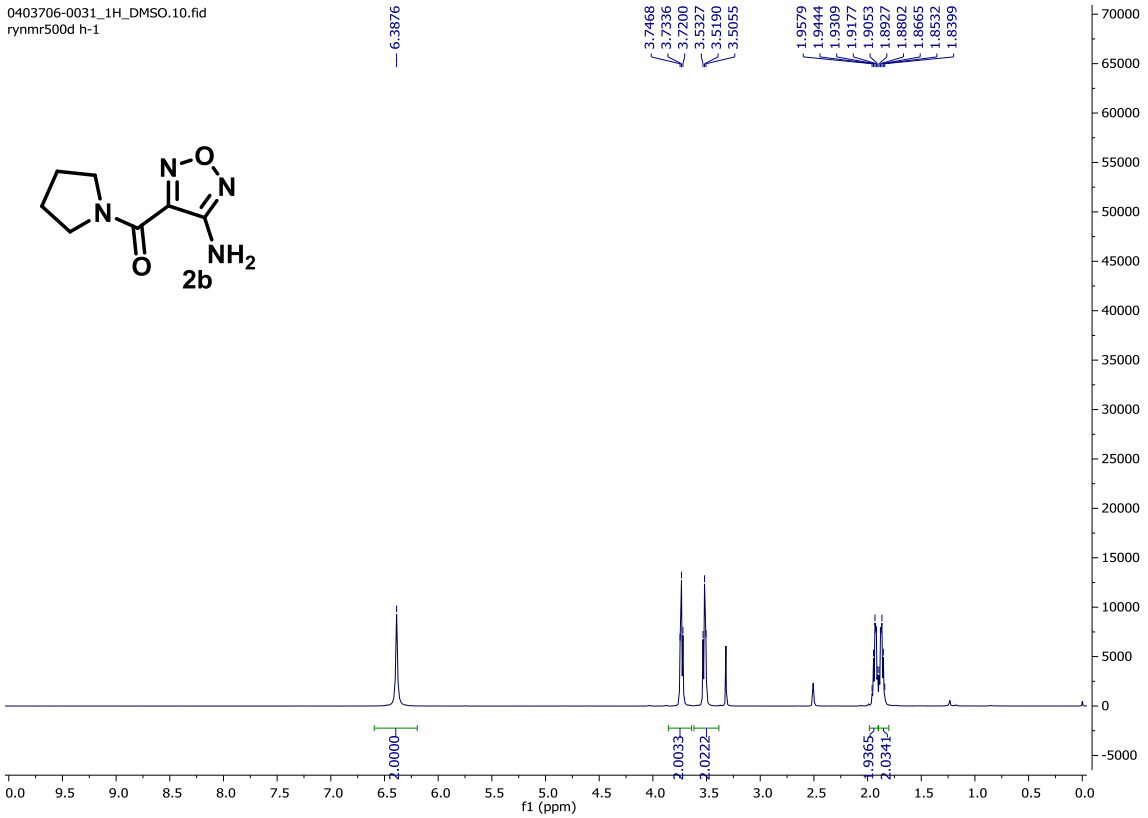

0403706-0076_13C_DMSO.20.fid
rynmr500d c-13 (daytime queue)
166.1682
157.7877
142.5097
130.5614
128.9708
125.6280
120.5569
109.2135
52.4390
f1 (ppm)

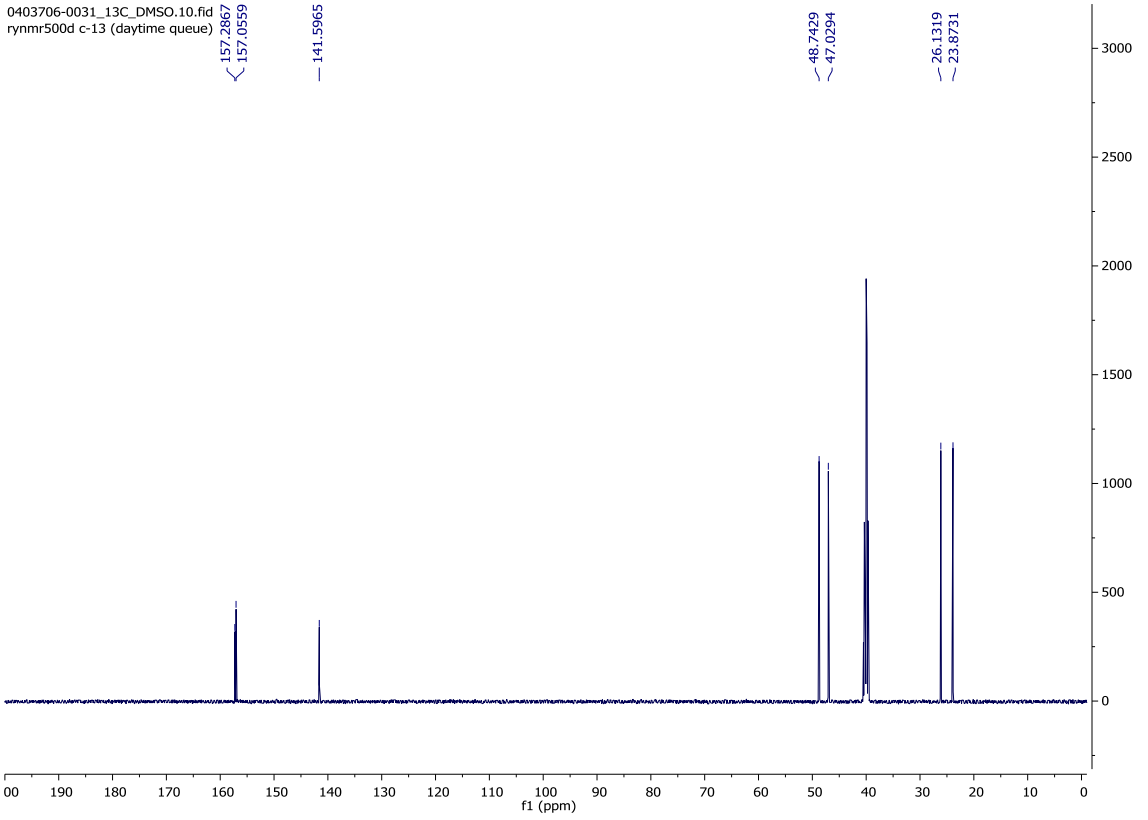

0403706-0064_isolated_DMSO.10.fid
rynmr500d h-1
11.6976
7.5023
7.4848
7.4705
7.4530
HO
N
N
OH
Cl
Cl
3q
2.0000
8.1543
f1 (ppm)

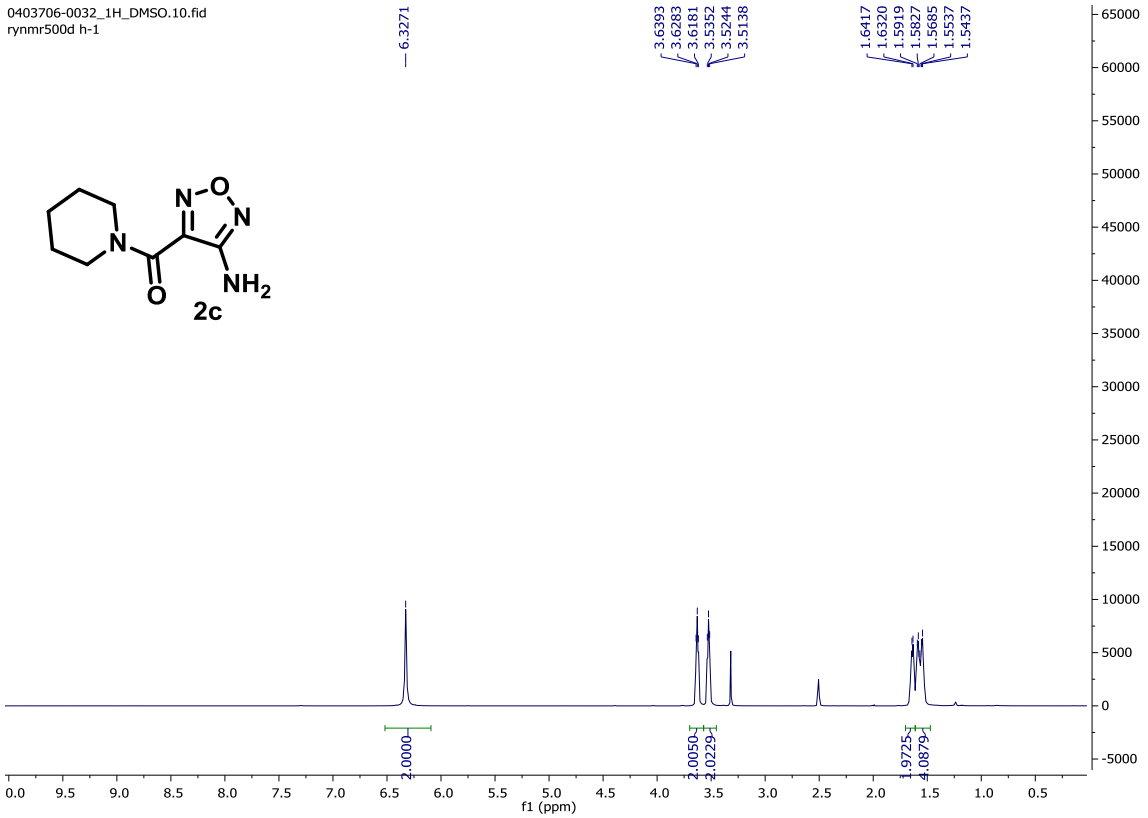

0403706-0064_13C_DMSO.10.fid
rynmr500d c-13 (daytime queue)
149.9545
134.4329
131.9806
129.3893
127.6605
f1 (ppm)


0403706-0058_1H_DMSO.10.fid
rynmr500d h-1
10.9593
7.7825
7.7666
7.3969
7.3815
7.3660
7.1821
7.1675
7.1530
6.4360
1.0000
1.9740
1.9950
0.9656
2.0798
f1 (ppm)


0403706-0058_13C_DMSO.10.fid
rynmr500d c-13 (daytime queue)
157.0068
156.6173
141.5316
138.1423
129.2159
125.1318
121.1785
f1 (ppm)

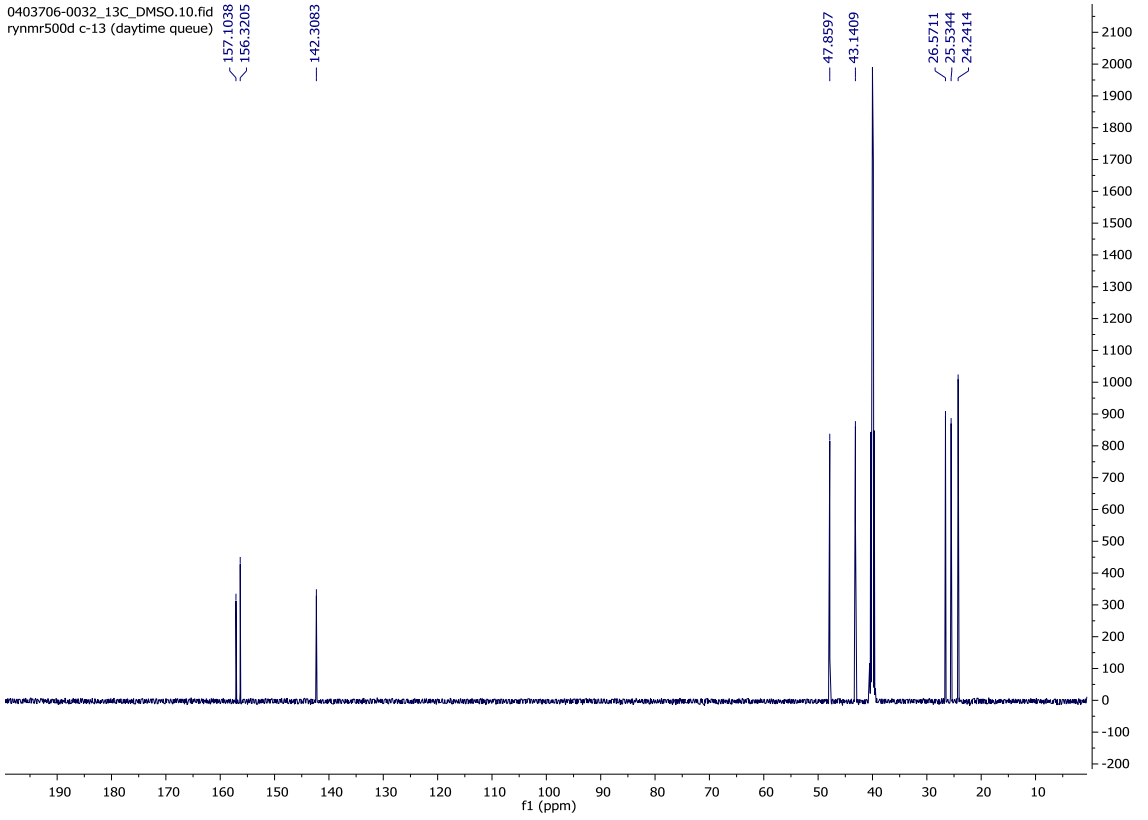

0403706-0031_1H_DMSO.10.fid
rynmr500d h-1
6.3876
3.7468
3.7336
3.7200
3.5327
3.5190
3.5055
1.9579
1.9444
1.9309
1.9177
1.9053
1.8927
1.8802
1.8665
1.8532
1.8399
2.0000
2.0033
2.0222
1.9365
2.0341
f1 (ppm)

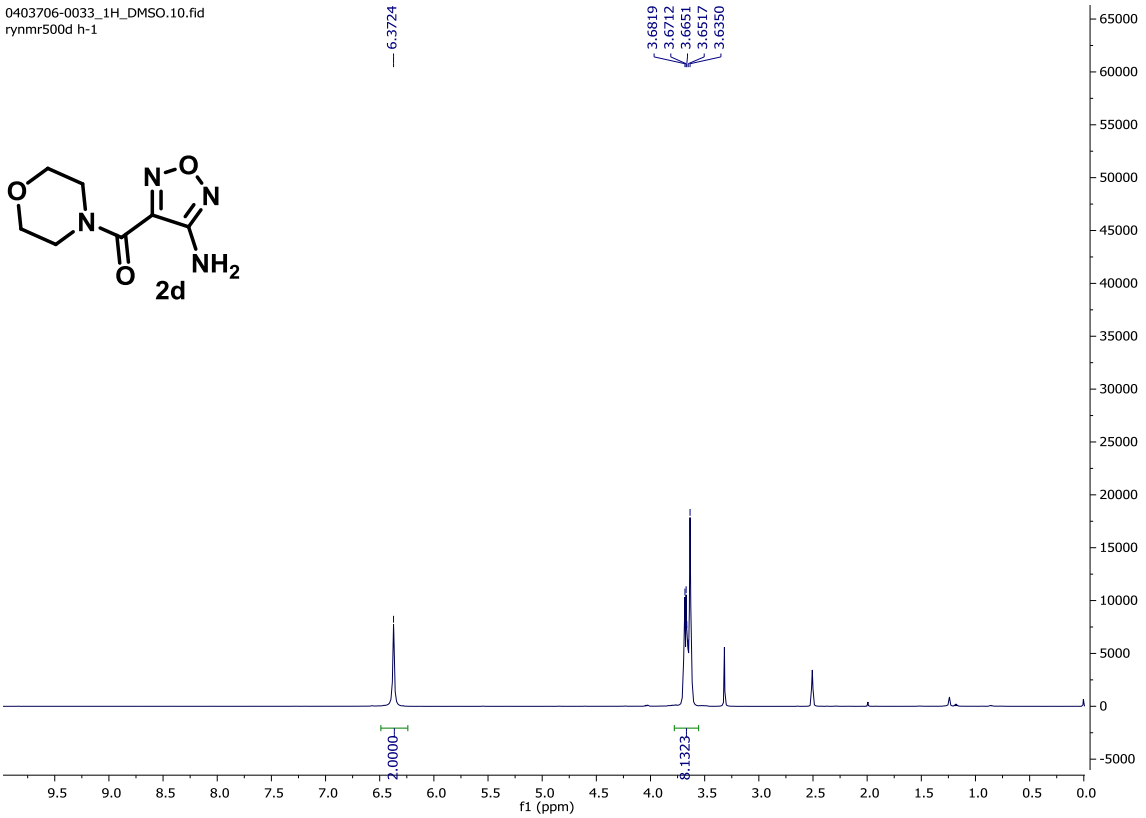

0403706-0031_13C_DMSO.10.fid
rynmr500d c-13 (daytime queue)
157.2867
157.0559
141.5965
48.7429
47.0294
26.1319
23.8731
f1 (ppm)

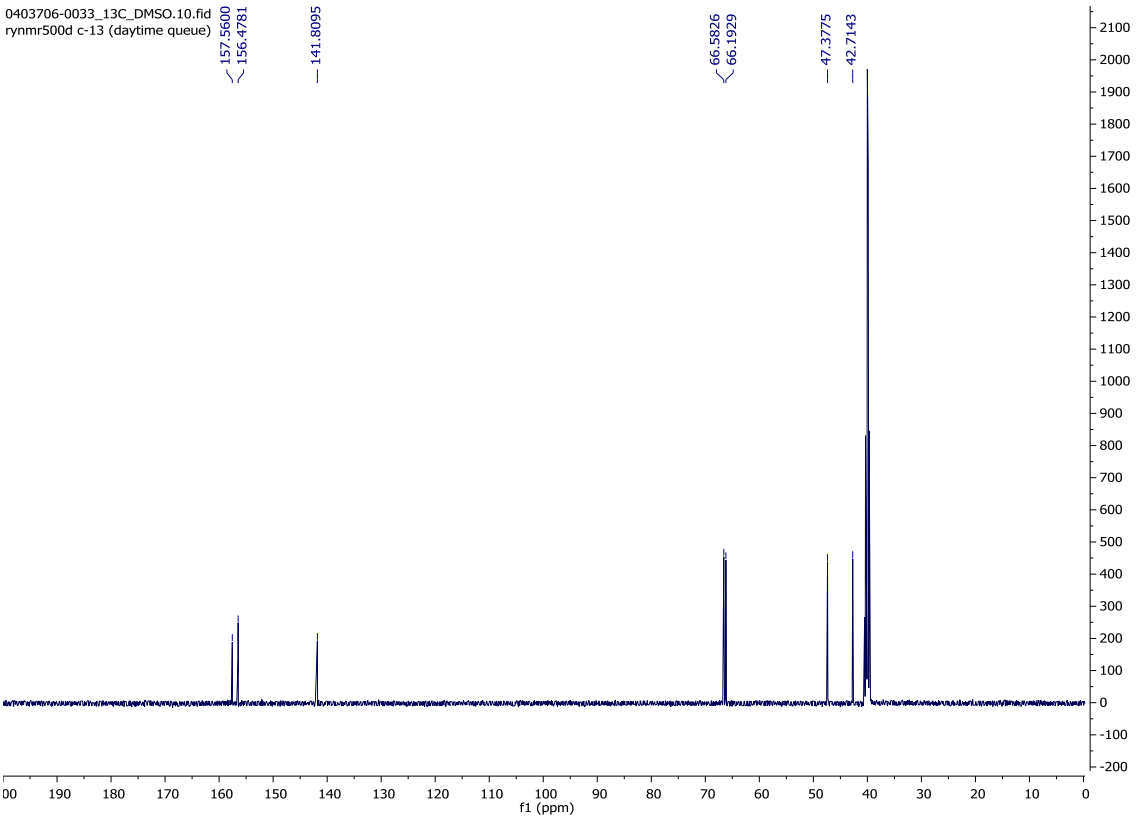

0403706-0032_1H_DMSO.10.fid
rynmr500d h-1
6.3271
3.6393
3.6283
3.6181
3.5352
3.5244
3.5138
1.6417
1.6320
1.5919
1.5827
1.5685
1.5537
1.5437
2.0000
2.0050
2.0229
1.9725
4.0879
f1 (ppm)

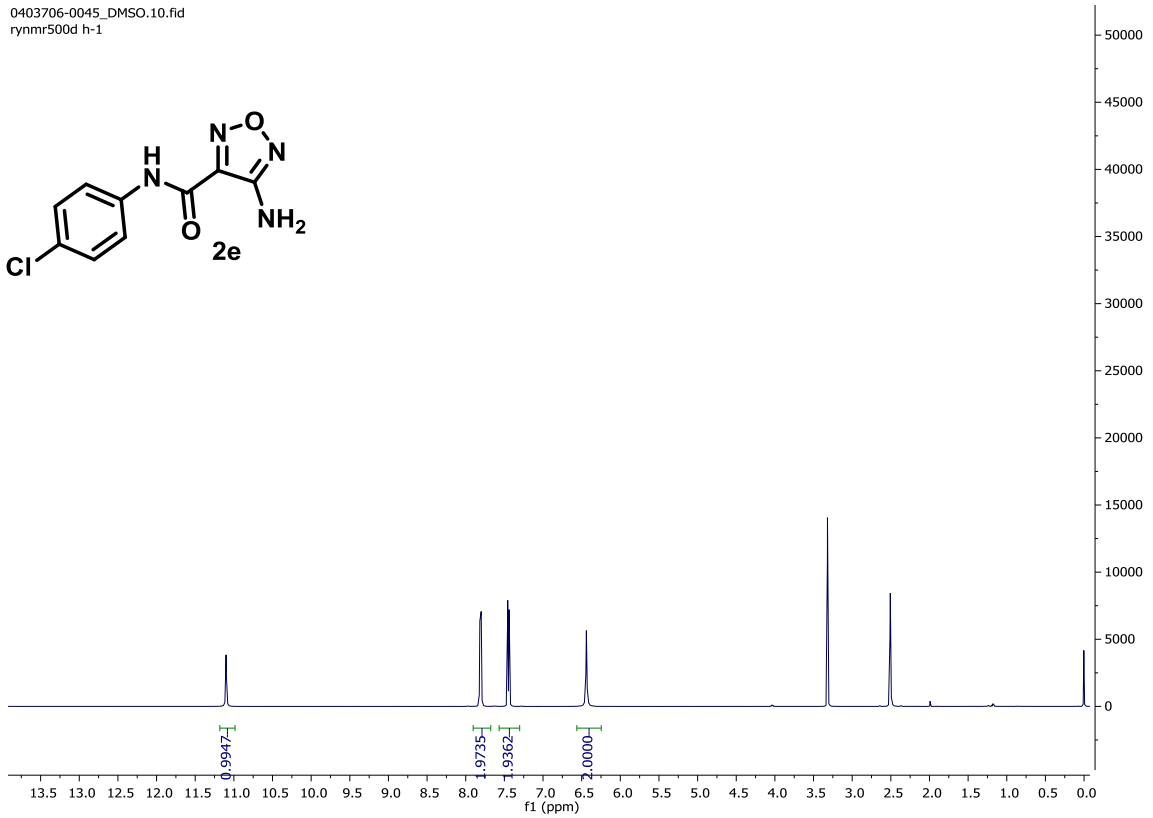
N
O
N
O
NH2

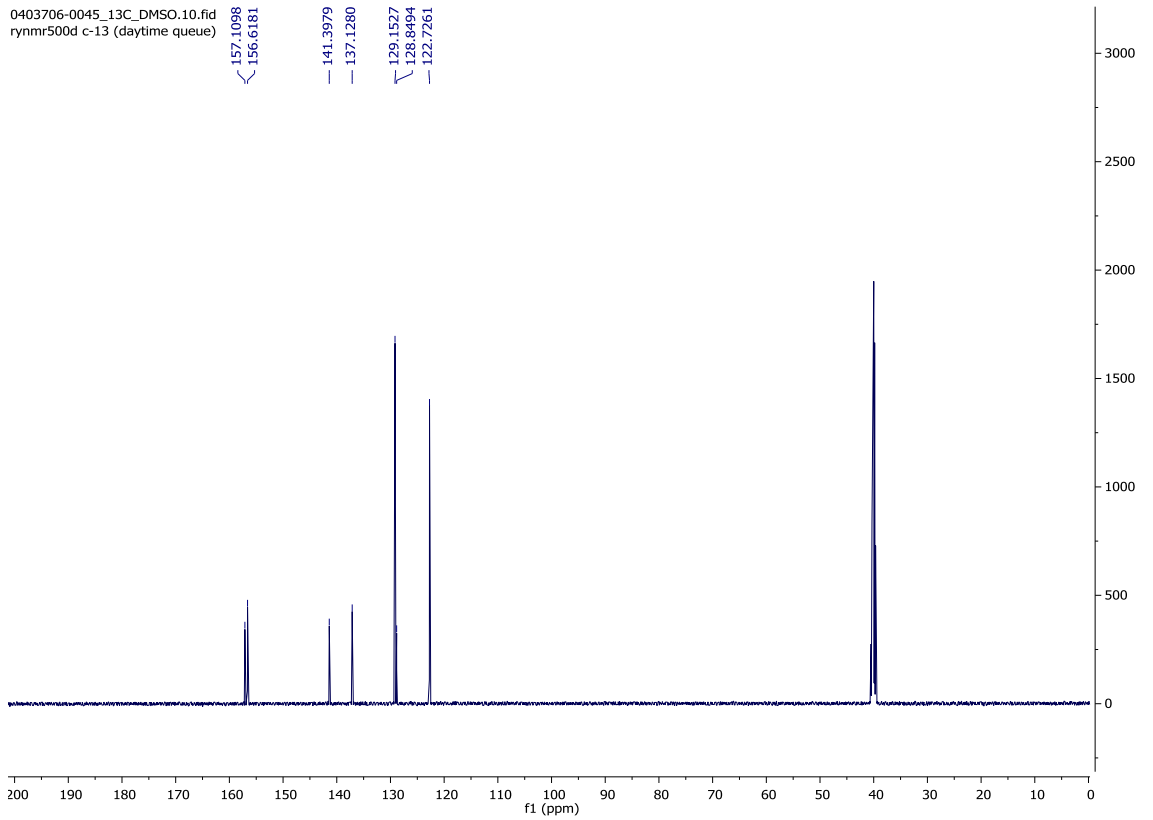
2c

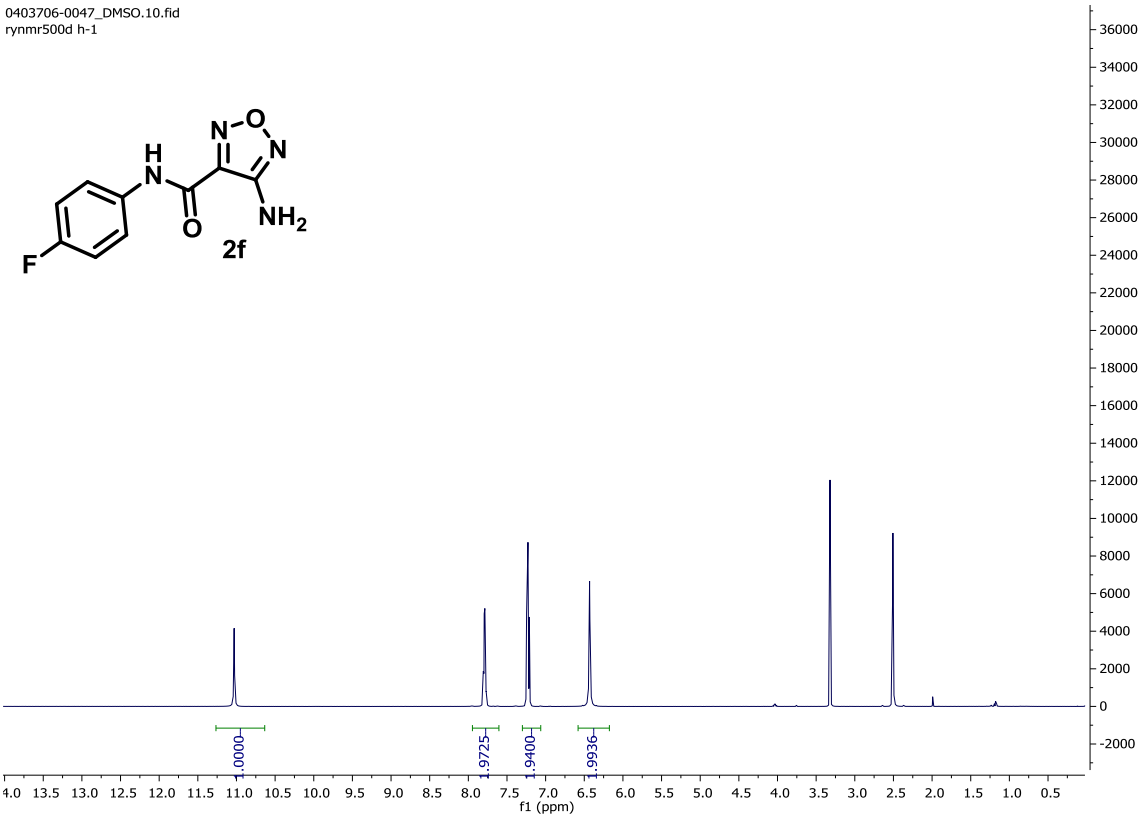

0403706-0032_13C_DMSO.10.fid
rynmr500d c-13 (daytime queue)
157.1038
156.3205
142.3083
47.8597
43.1409
26.5711
25.5344
24.2414
f1 (ppm)

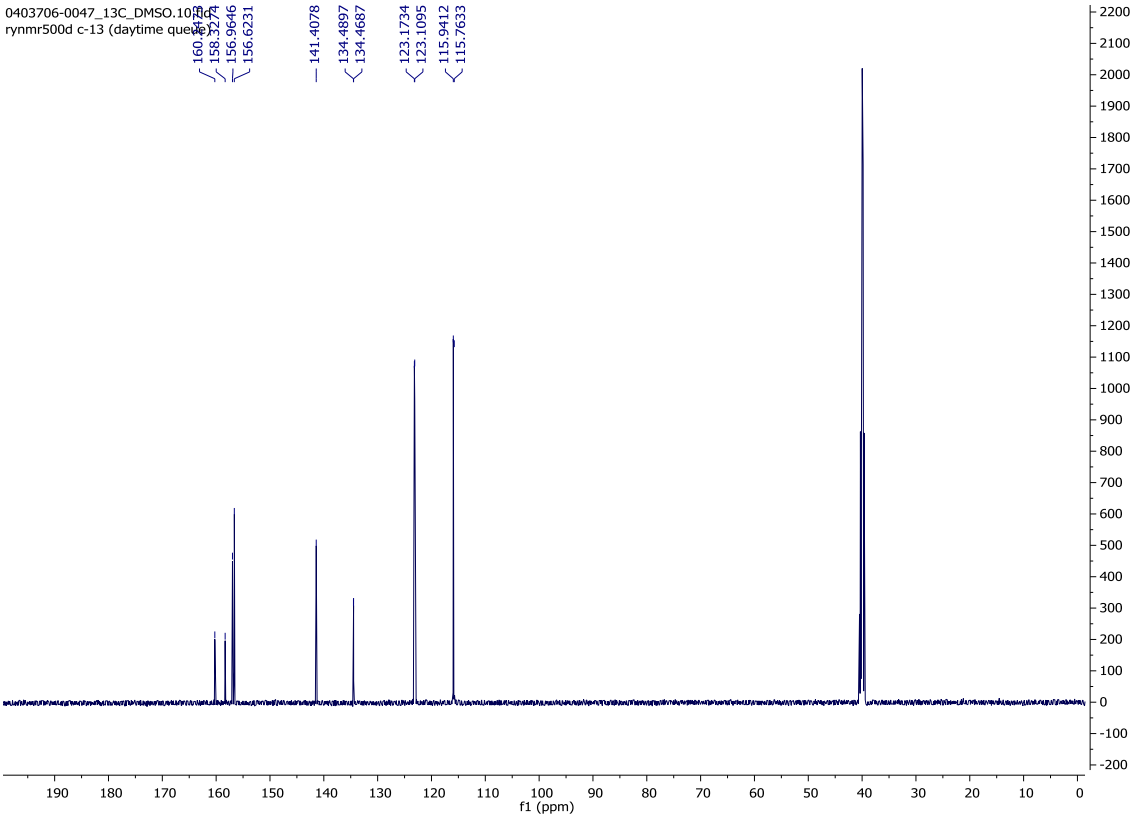

0403706-0033_1H_DMSO.10.fid
rynmr500d h-1
6.3724
3.6819
3.6712
3.6651
3.6517
3.6350
2.0000
8.1323
f1 (ppm)

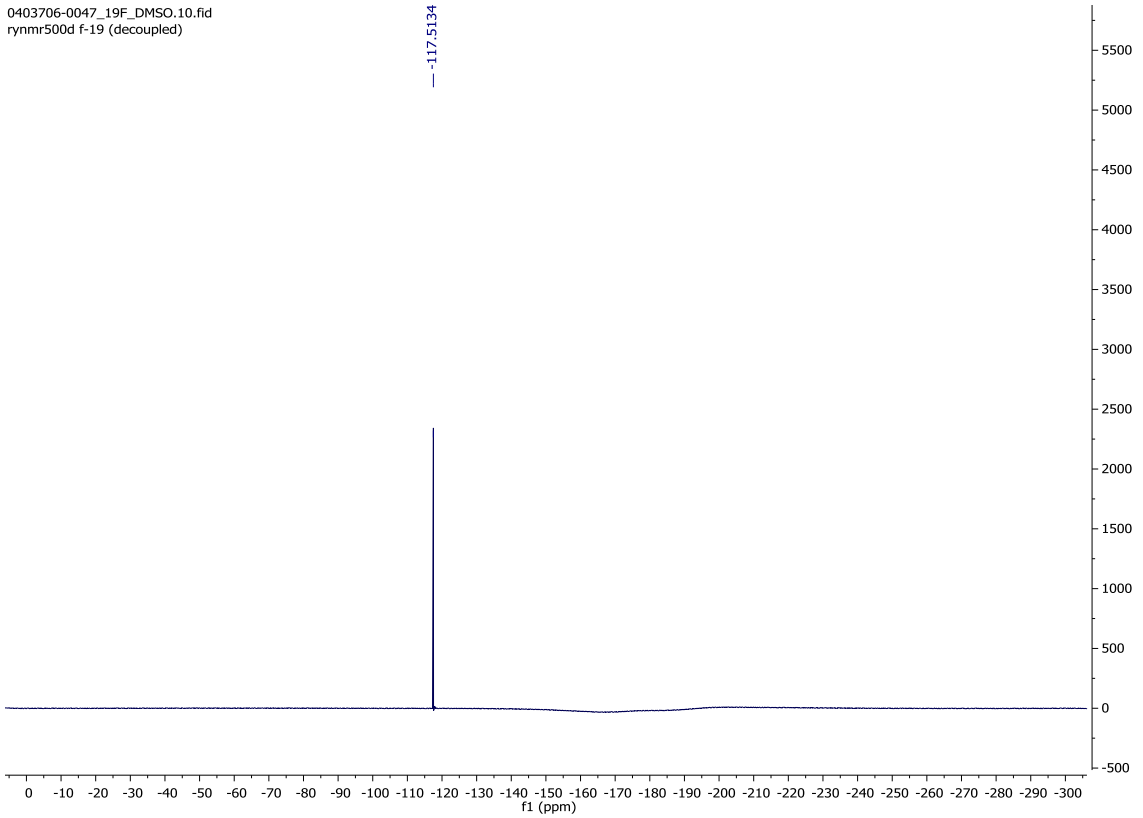

0403706-0033_13C_DMSO.10.fid
rynmr500d c-13 (daytime queue)
157.5600
156.4781
141.8095
66.5826
66.1929
47.3775
42.7143
f1 (ppm)

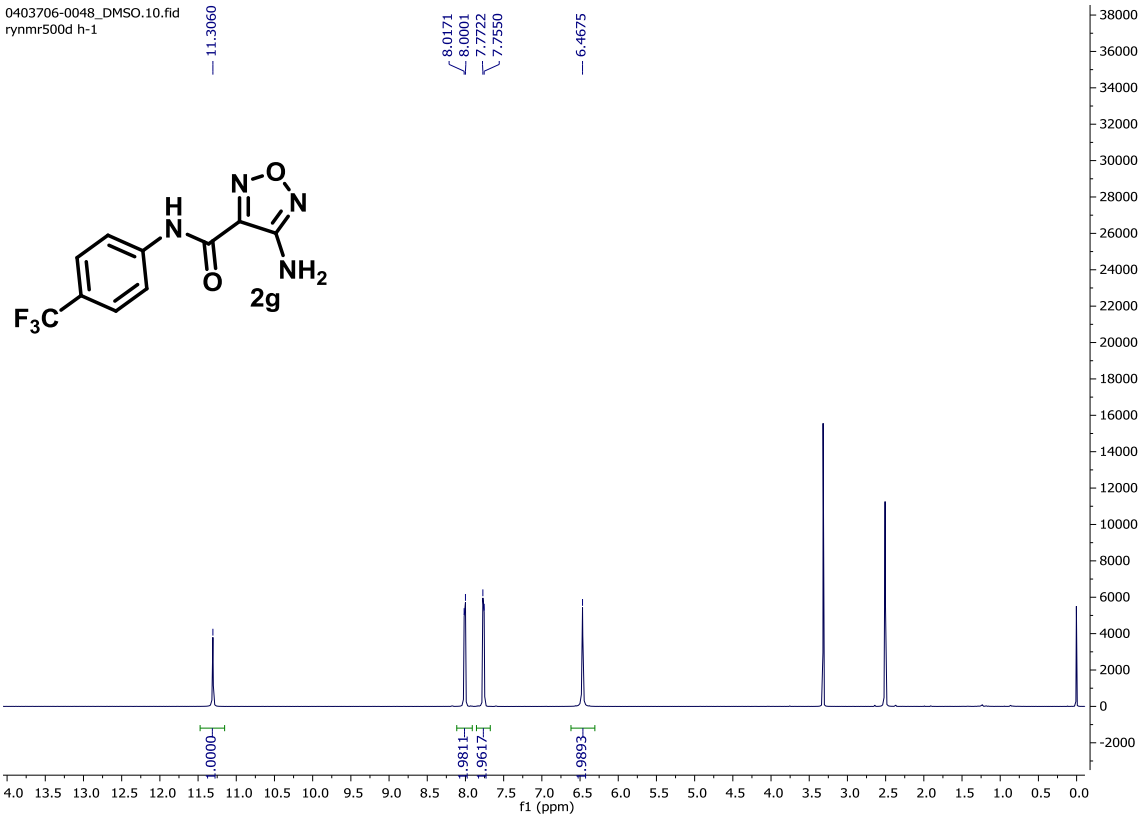

0403706-0045_DMSO.10.fid
rynmr500d h-1
2e
0.9947
1.9735
1.9362
2.0000
f1 (ppm)

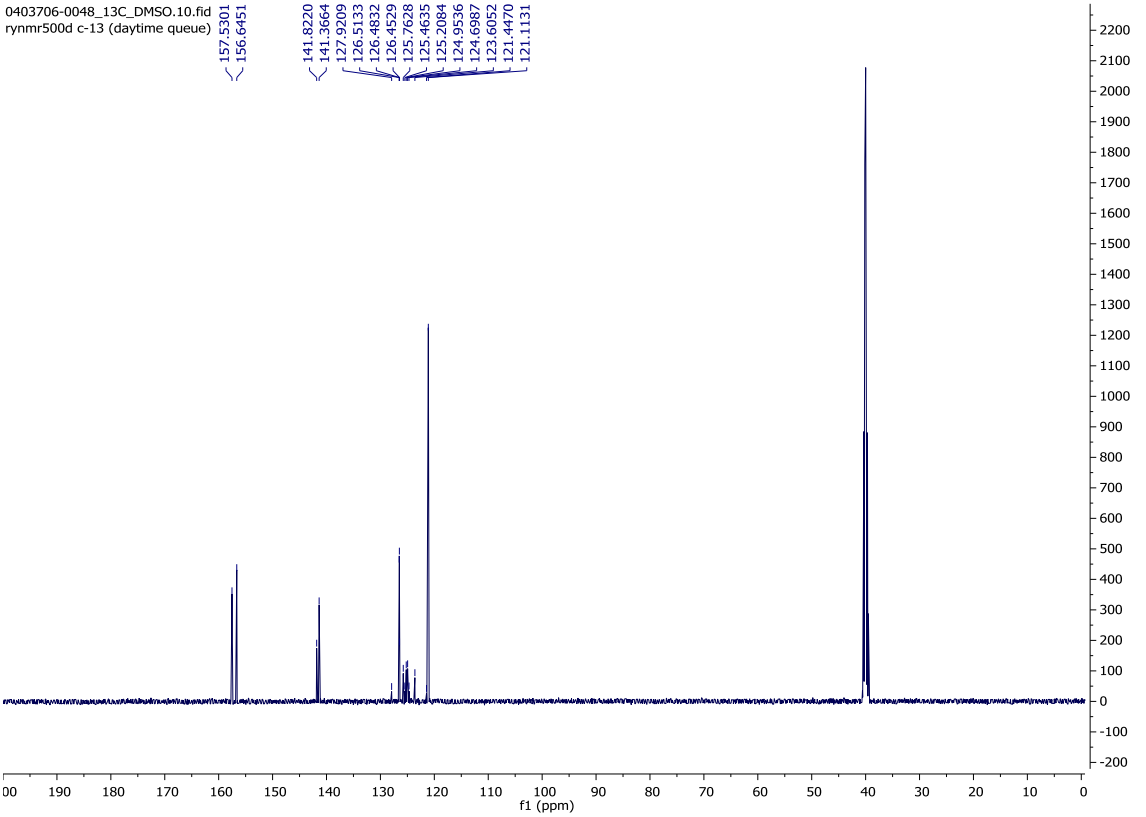

0403706-0045_13C_DMSO.10.fid
rynmr500d c-13 (daytime queue)
157.1098
156.6181
141.3979
137.1280
129.1527
128.8494
122.7261
f1 (ppm)

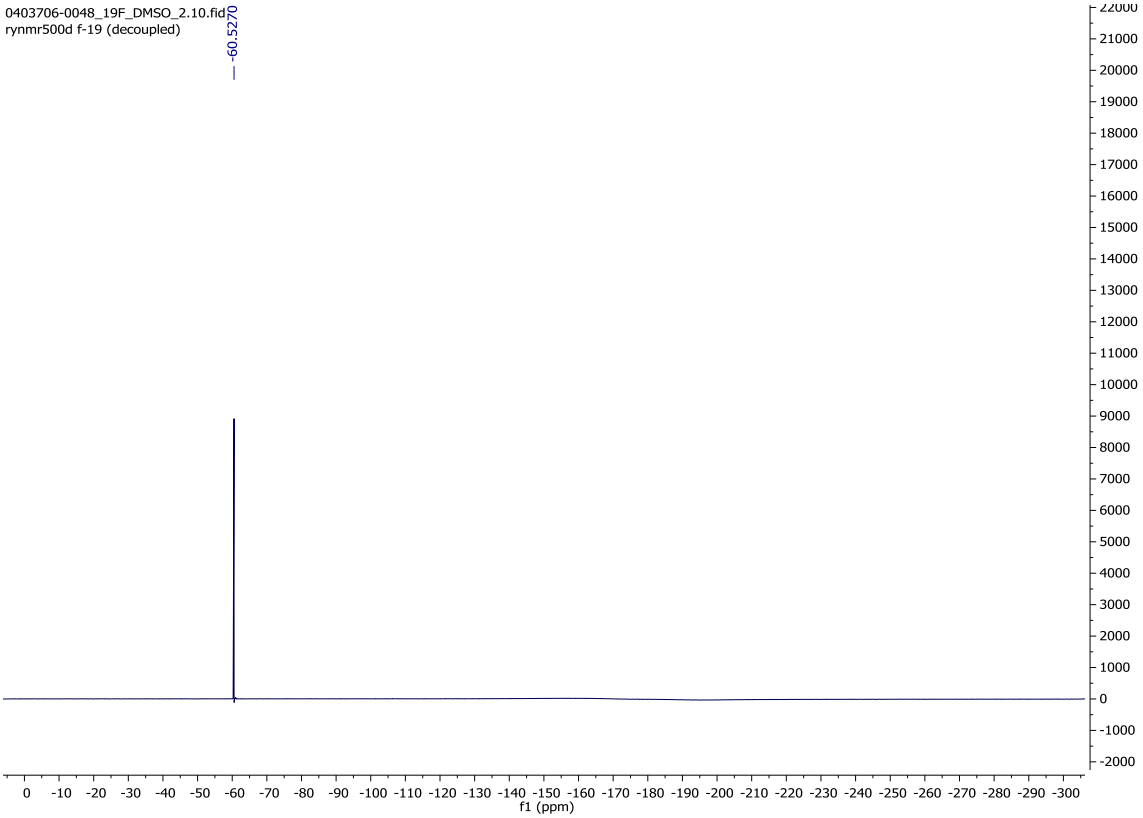

0403706-0047_DMSO.10.fid
rynmr500d h-1
2f
1.0000
1.9725
1.9400
1.9936
f1 (ppm)

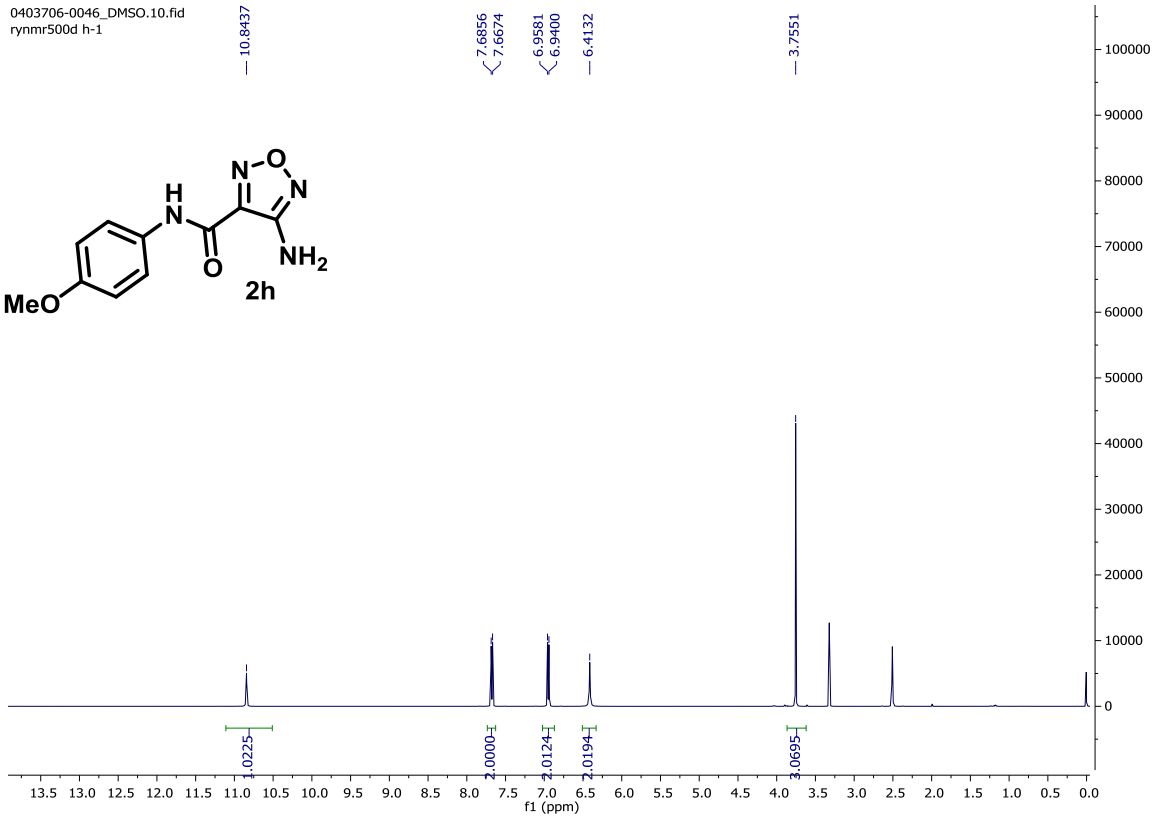

0403706-0047_13C_DMSO.10.fid
rynmr500d c-13 (daytime queue)
160.1423
158.3274
156.9646
156.6231
141.4078
134.4897
134.4687
123.1734
123.1095
115.9412
115.7633
f1 (ppm)

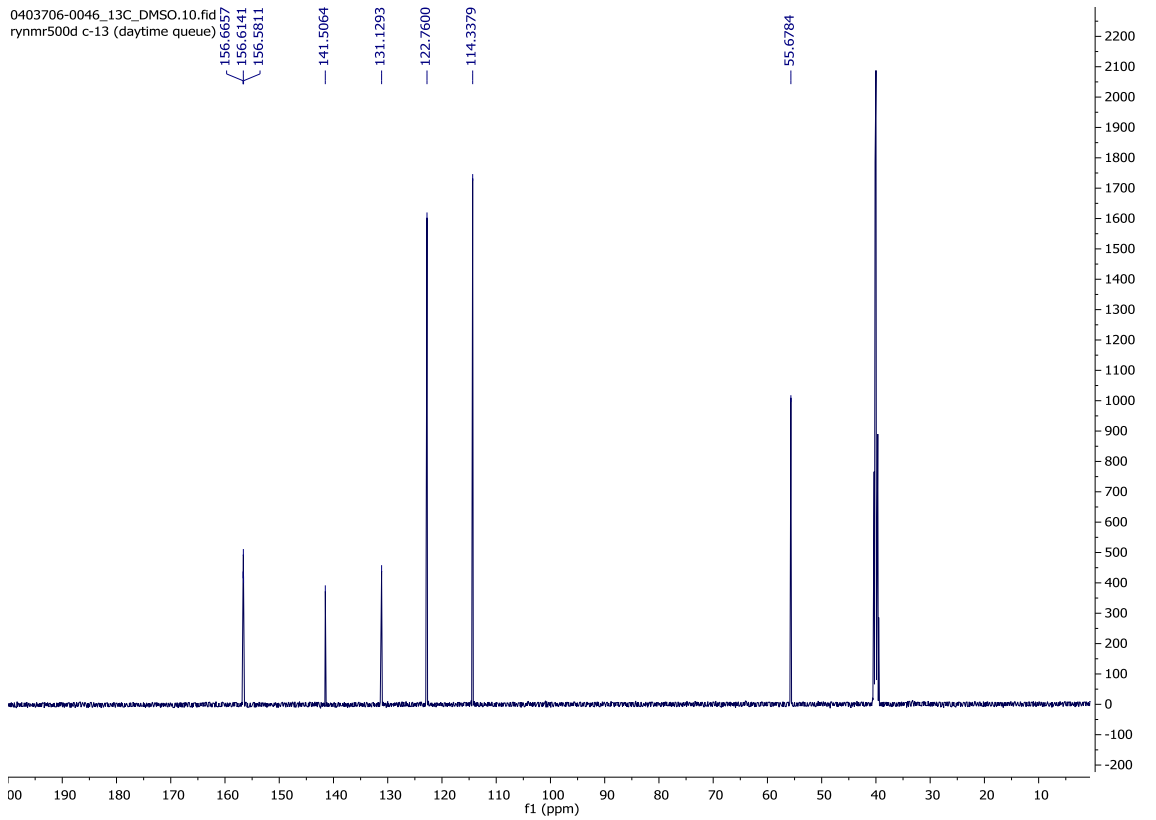

0403706-0047_19F_DMSO.10.fid
rynmr500d f-19 (decoupled)
-117.5134
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -220 -230 -240 -250 -260 -270 -280 -290 -300
f1 (ppm)

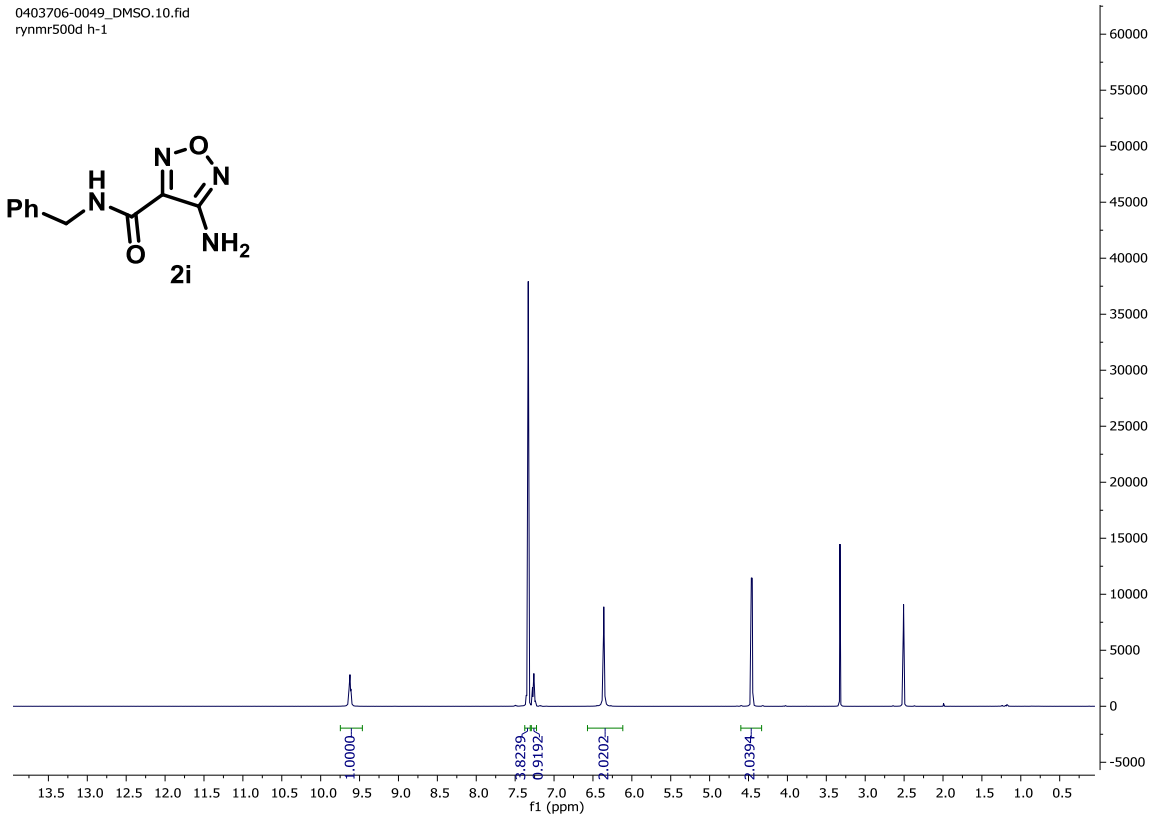

0403706-0048_DMSO.10.fid
rynmr500d h-1
11.3060
8.0171
8.0001
7.7722
7.7550
6.4675
2g
1.0000
1.9811
1.9617
1.9893
f1 (ppm)

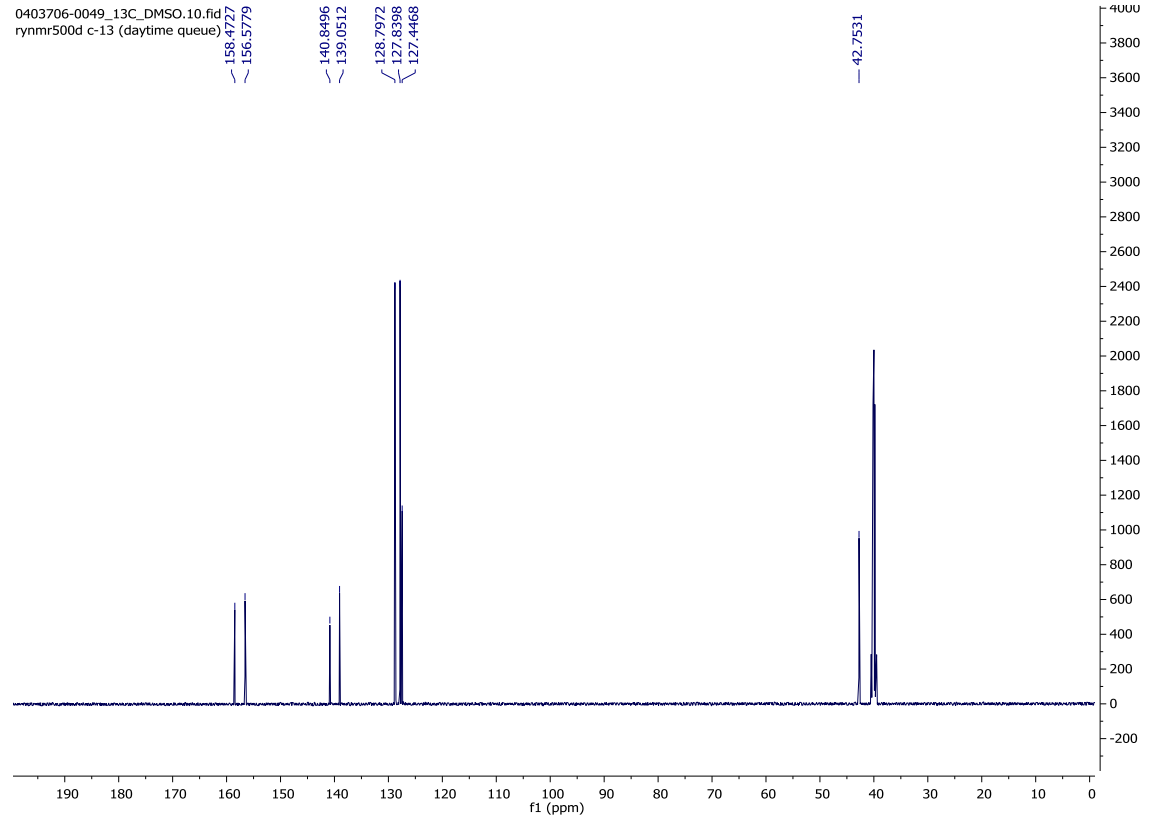

0403706-0048_13C_DMSO.10.fid
rynmr500d c-13 (daytime queue)
157.5301
156.6451
141.8220
141.3664
127.9209
126.5133
126.4832
126.4529
125.7628
125.4635
125.2084
124.9536
124.6987
123.6052
121.4470
121.1131
f1 (ppm)

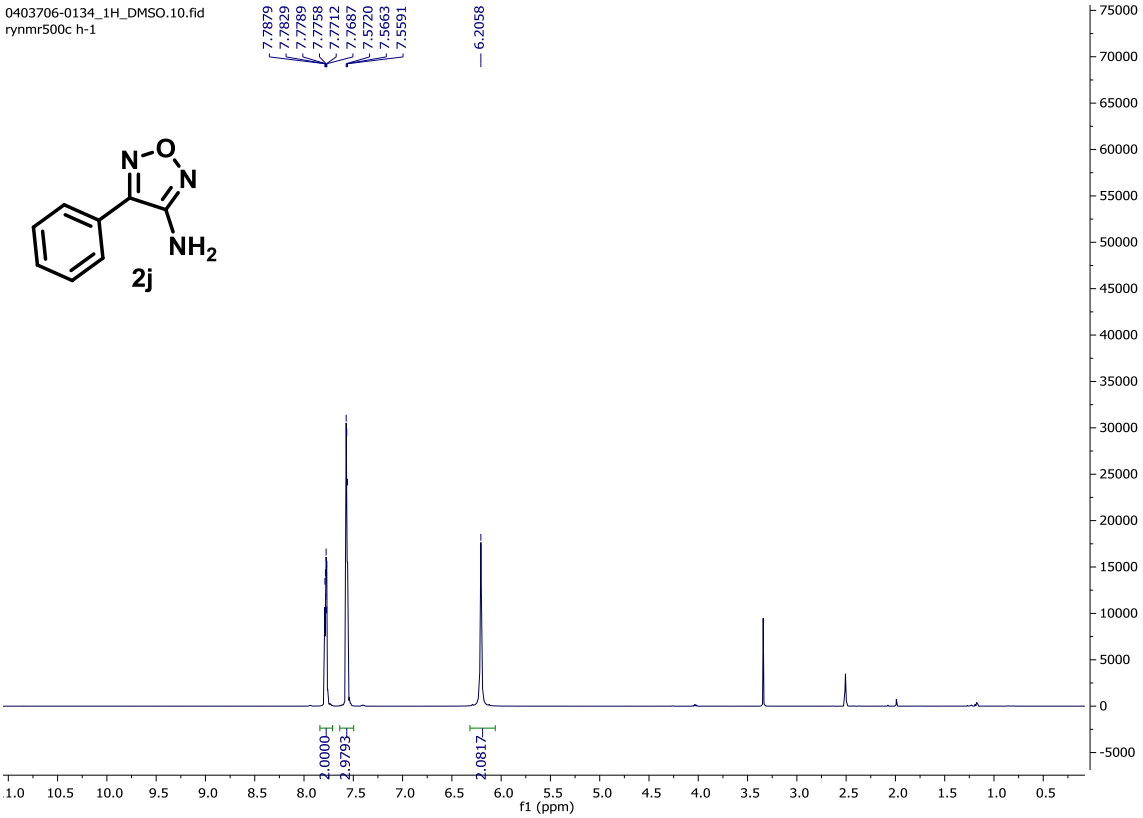

0403706-0048_19F_DMSO_2.10.fid
rynmr500d f-19 (decoupled)
-60.5270
22000
21000
20000
19000
18000
17000
16000
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
-2000
0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -220 -230 -240 -250 -260 -270 -280 -290 -300
f1 (ppm)

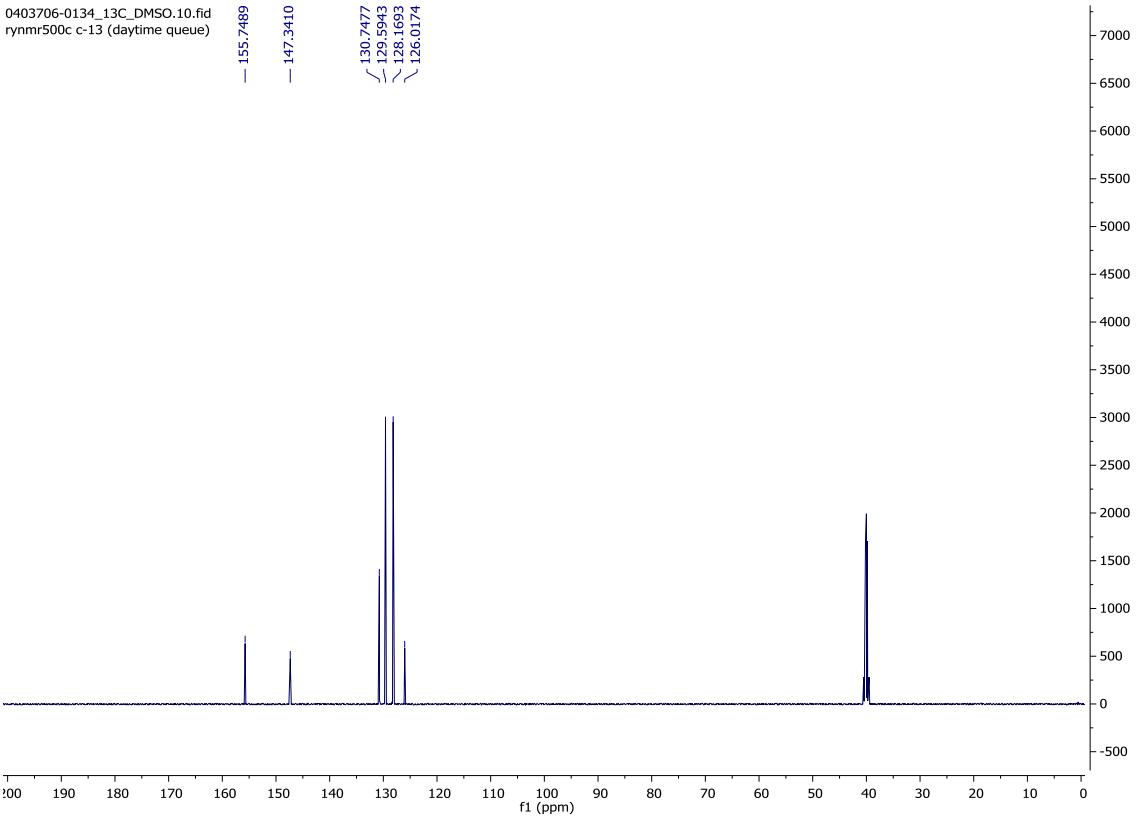

0403706-0046_DMSO.10.fid
rynmr500d h-1
10.8437
7.6856
7.6674
6.9581
6.9400
6.4132
3.7551
MeO
2h
1.0225
2.0000
2.0124
2.0194
3.0695
f1 (ppm)

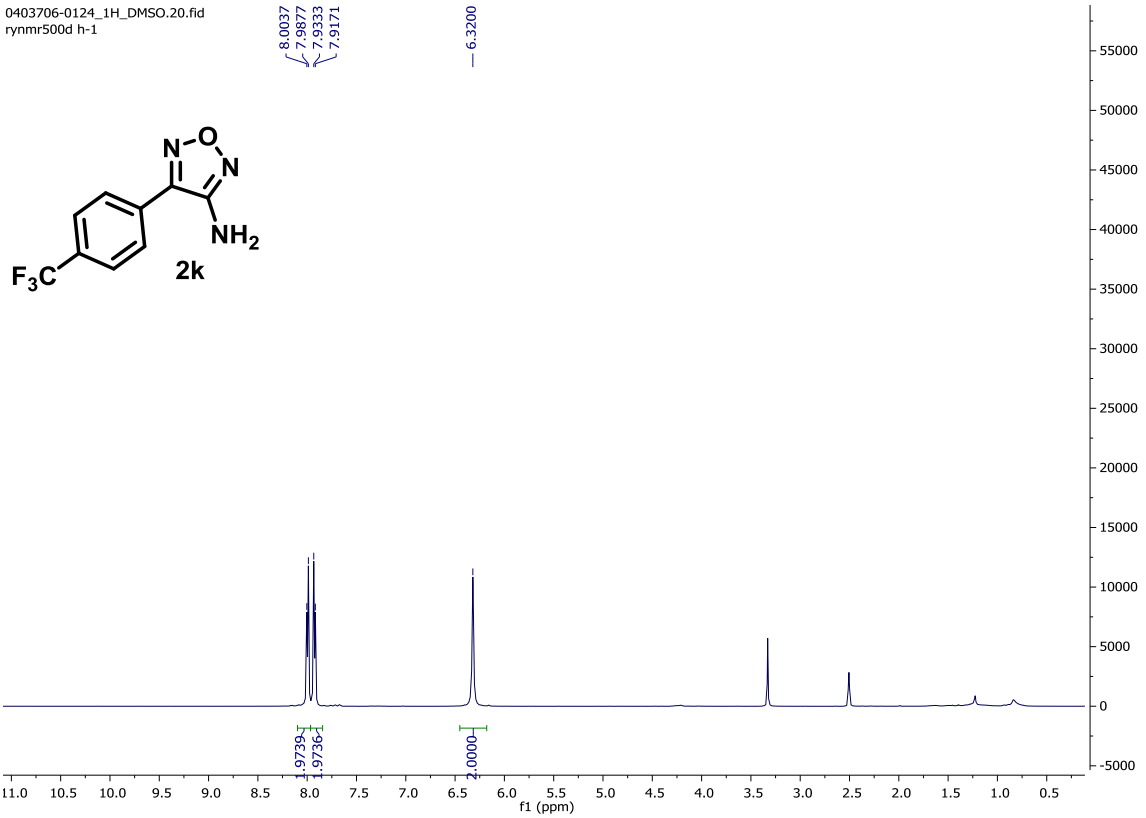

0403706-0046_13C_DMSO.10.fid
rynmr500d c-13 (daytime queue)
156.6657
156.6141
156.5811
141.5064
131.1293
122.7600
114.3379
55.6784
f1 (ppm)

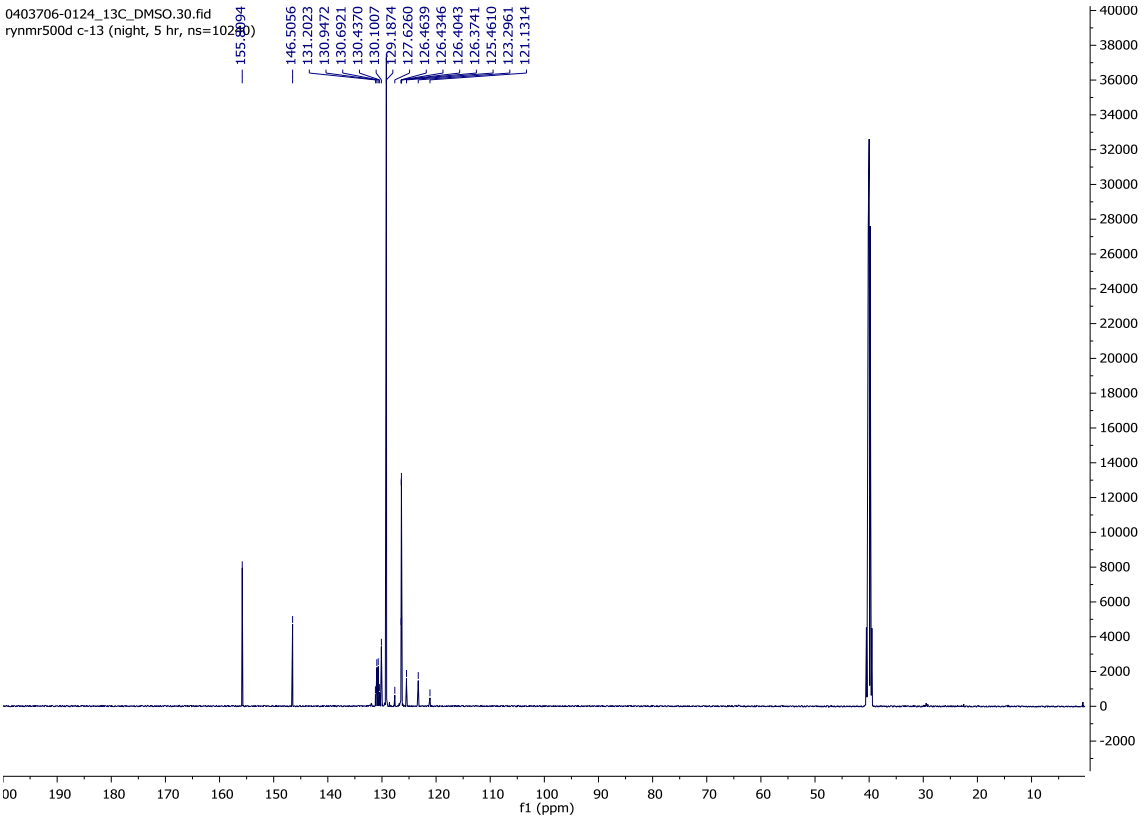

0403706-0049_DMSO.10.fid
rynmr500d h-1
Ph
H
N
O
N
O
N
NH2
2i
1.0000
3.8239
0.9192
2.0202
2.0394
f1 (ppm)

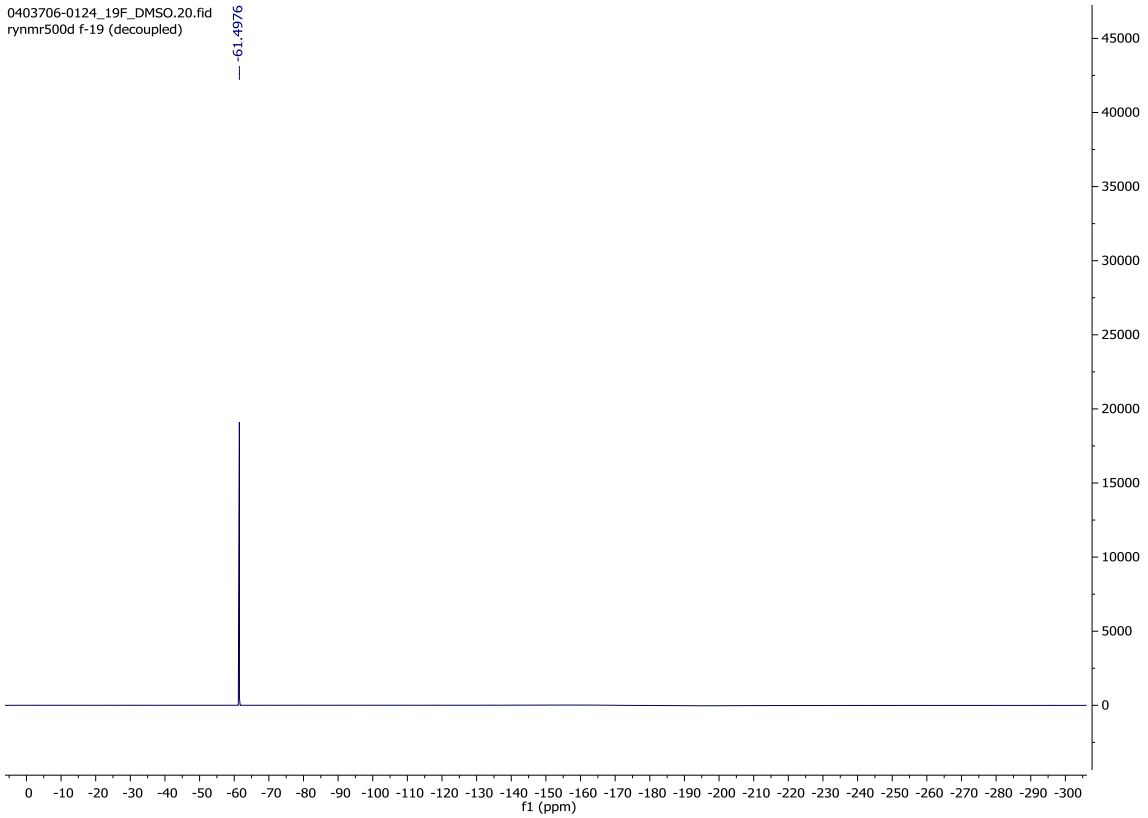

0403706-0049_13C_DMSO.10.fid
rynmr500d c-13 (daytime queue)
158.4727
156.5779
140.8496
139.0512
128.7972
127.8398
127.4468
42.7531
f1 (ppm)

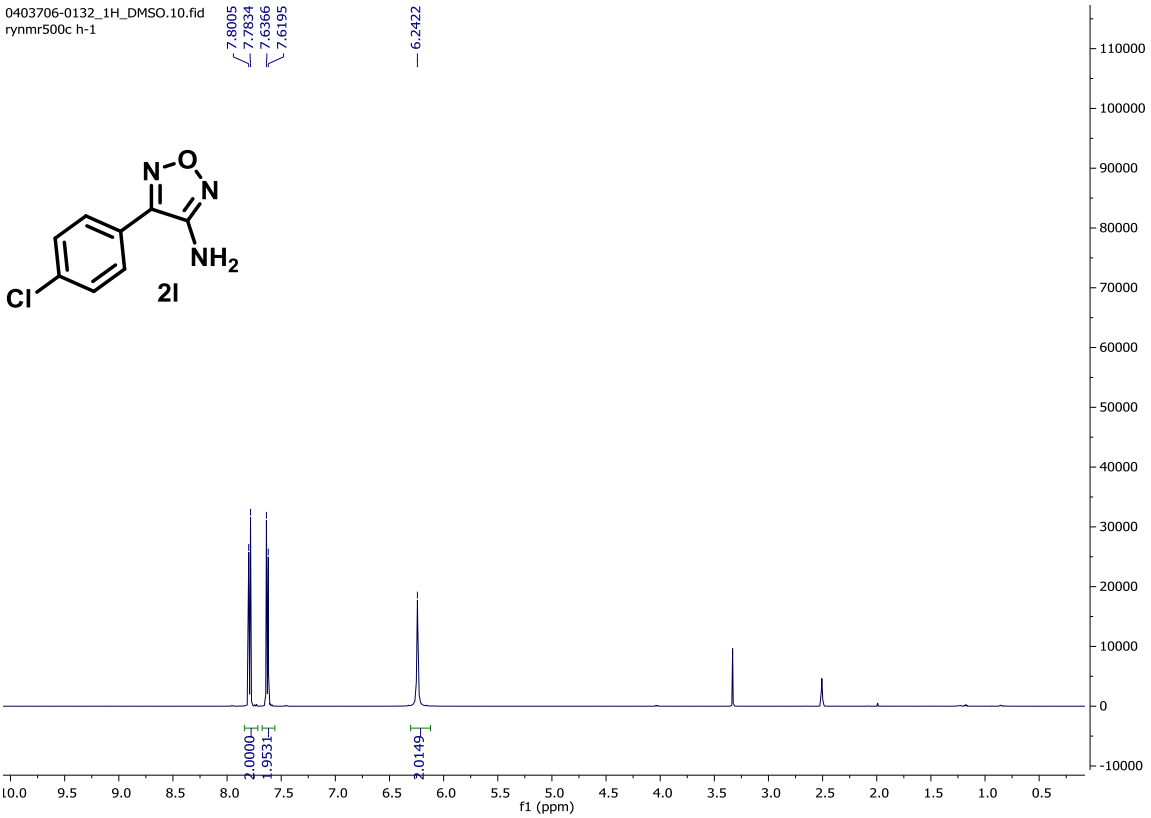

0403706-0134_1H_DMSO.10.fid
rynmr500c h-1
7.7879
7.7829
7.7789
7.7758
7.7712
7.7687
7.5720
7.5663
7.5591
6.2058
N
O
N
NH2
2j
2.0000
2.9793
2.0817
f1 (ppm)

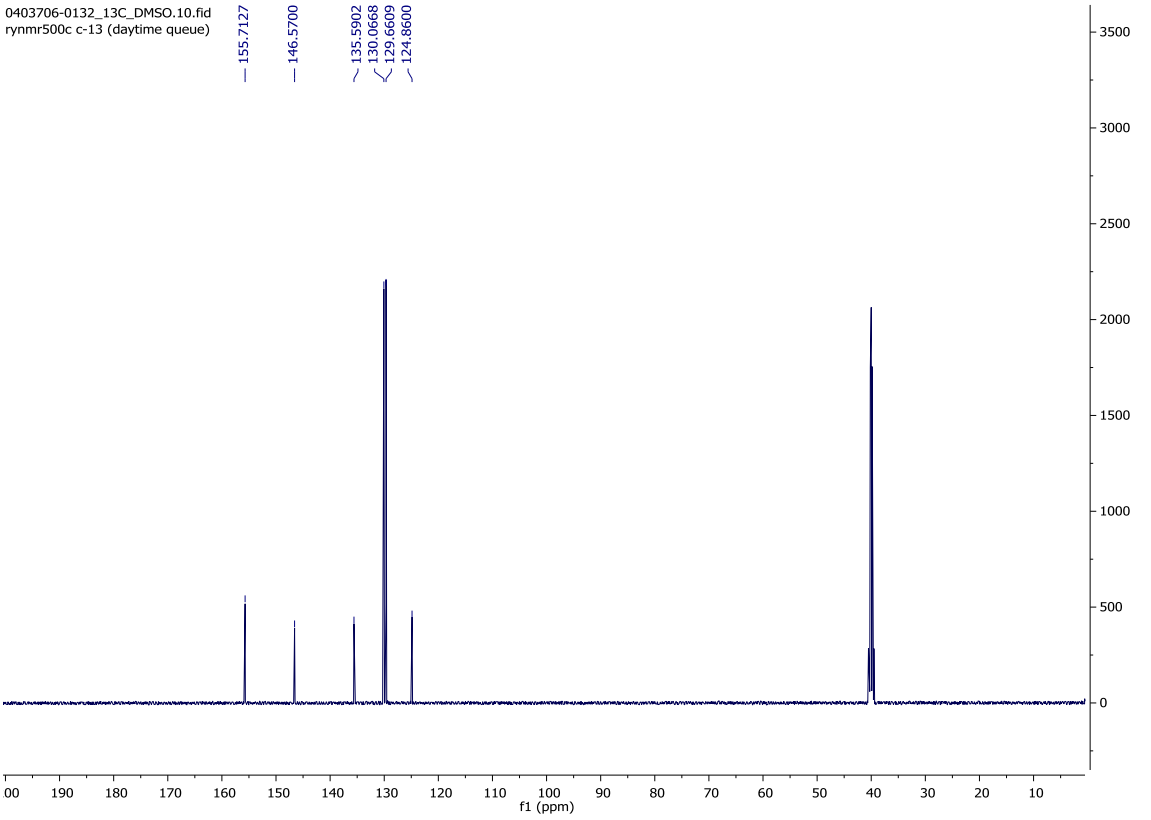

0403706-0134_13C_DMSO.10.fid
rynmr500c c-13 (daytime queue)
155.7489
147.3410
130.7477
129.5943
128.1693
126.0174
f1 (ppm)

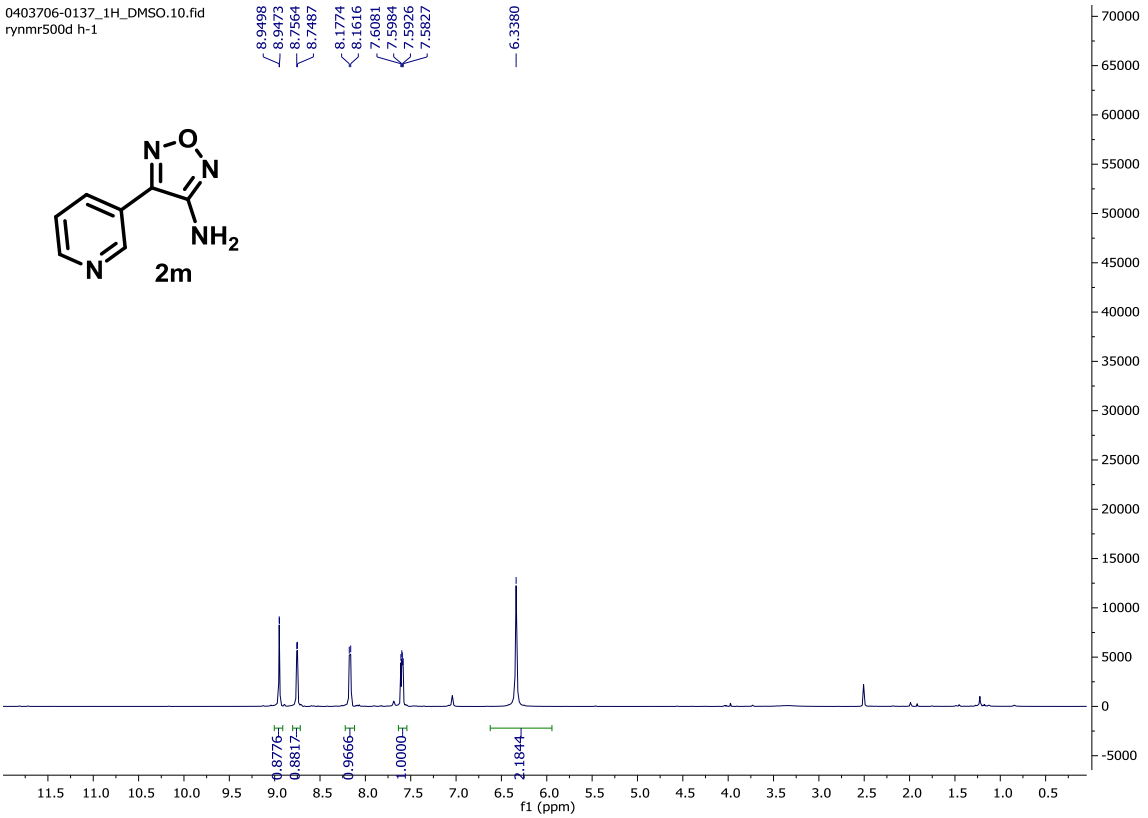

0403706-0124_1H_DMSO.20.fid
rynmr500d h-1
8.0037
7.9877
7.9333
7.9171
6.3200
N
O
N
NH2
F3C
2k
1.9739
1.9736
2.0000
f1 (ppm)

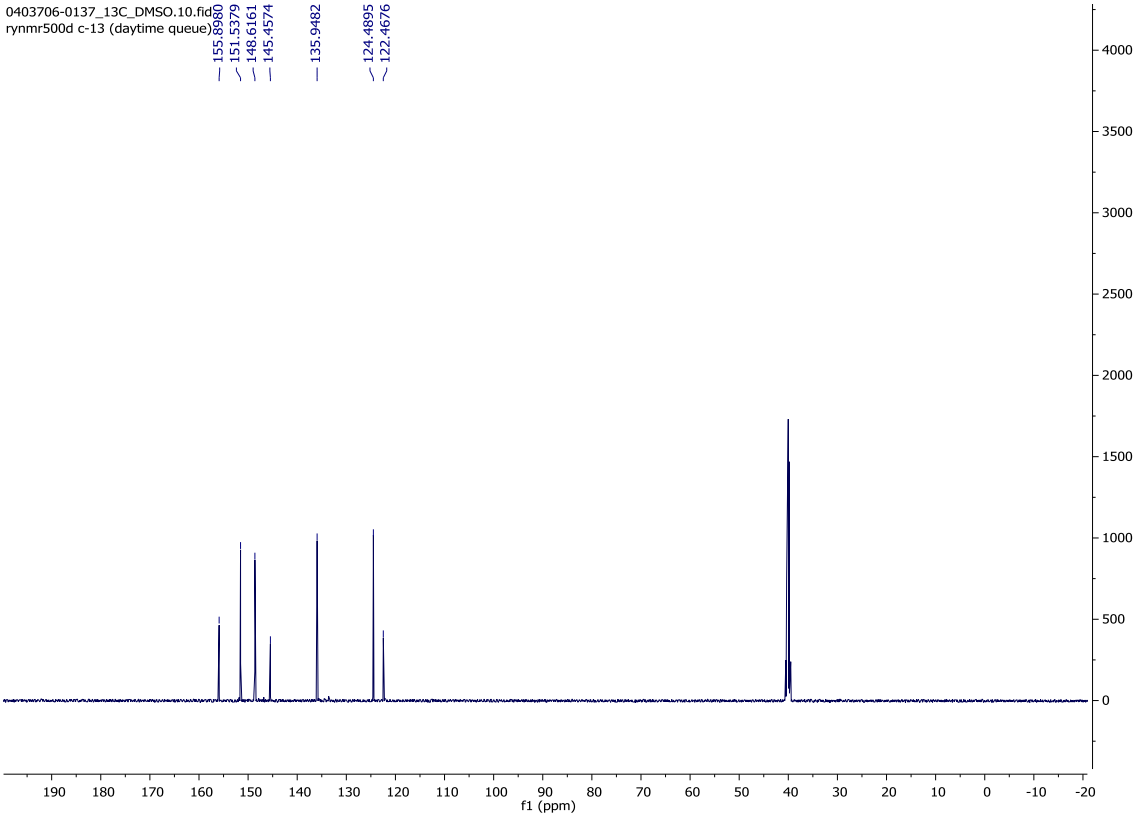

0403706-0124_13C_DMSO.30.fid
rynmr500d c-13 (night, 5 hr, ns=10240)
155.8894
146.5056
131.2023
130.9472
130.6921
130.4370
130.1007
129.1874
127.6260
126.4639
126.4346
126.4043
126.3741
125.4610
123.2961
121.1314
f1 (ppm)

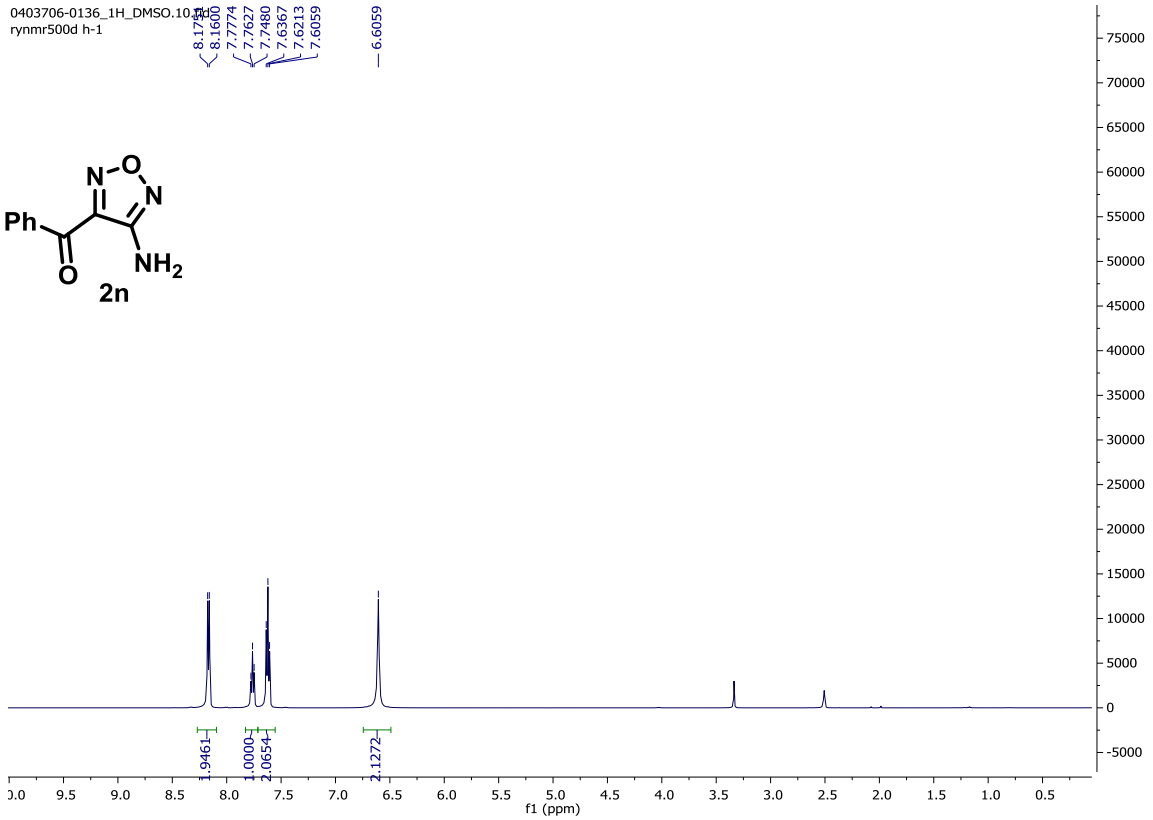

0403706-0124_19F_DMSO.20.fid
rynmr500d f-19 (decoupled)
-61.4976
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -220 -230 -240 -250 -260 -270 -280 -290 -300
f1 (ppm)

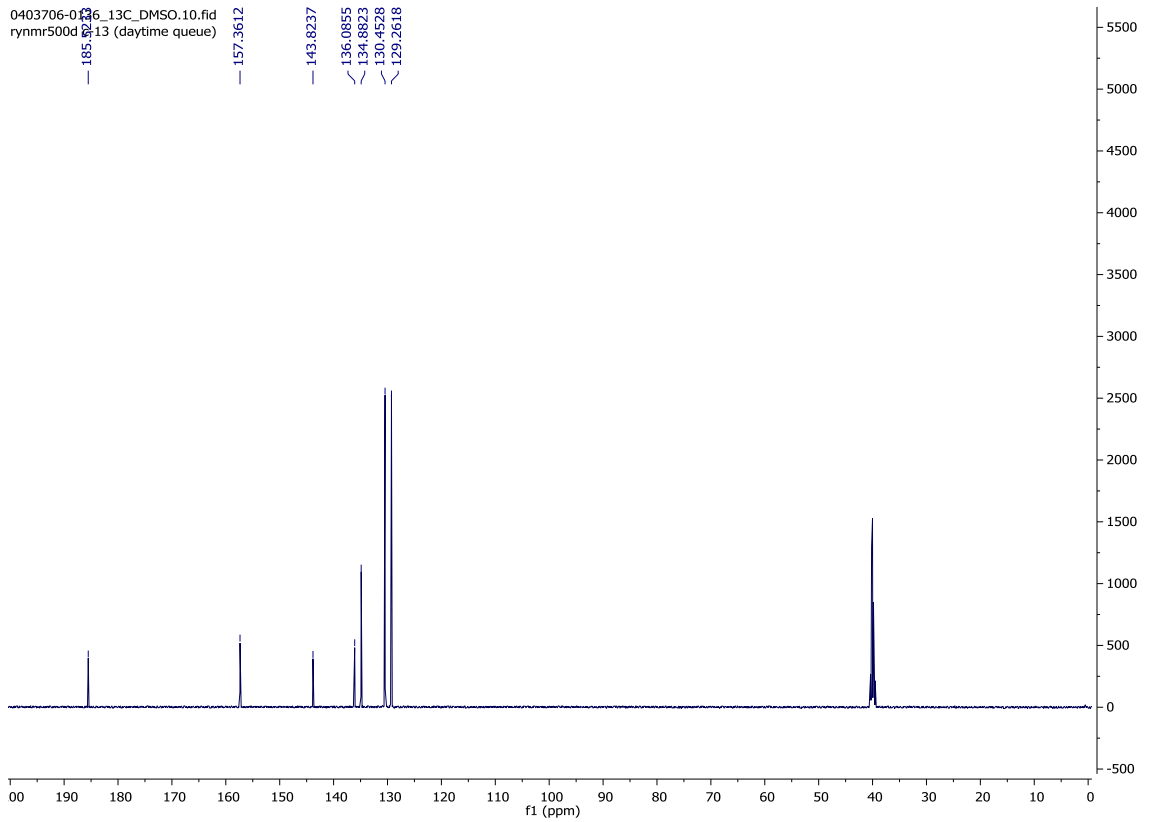

0403706-0132_1H_DMSO.10.fid
rynmr500c h-1
7.8005
7.7834
7.6366
7.6195
6.2422
N
O
N
NH2
Cl
2l
2.0000
1.9531
2.0149
f1 (ppm)


0403706-0132_13C_DMSO.10.fid
rynmr500c c-13 (daytime queue)
155.7127
146.5700
135.5902
130.0668
129.6609
124.8600
f1 (ppm)

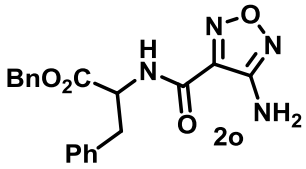

0403706-0137_1H_DMSO.10.fid
rynmr500d h-1
8.9498
8.9473
8.7564
8.7487
8.1774
8.1616
7.6081
7.5984
7.5926
7.5827
6.3380
NH2
2m
0.8776
0.8817
0.9666
1.0000
2.1844
f1 (ppm)


0403706-0137_13C_DMSO.10.fid
rynmr500d c-13 (daytime queue)
155.8980
151.5379
148.6161
145.4574
135.9482
124.4895
122.4676
f1 (ppm)


0403706-0136_1H_DMSO.10.fid
rynmr500d h-1
8.1744
8.1600
7.7774
7.7627
7.7480
7.6367
7.6213
7.6059
6.6059
Ph
O
N
O
N
NH2
2n
1.9461
1.0000
2.0654
2.1272
f1 (ppm)

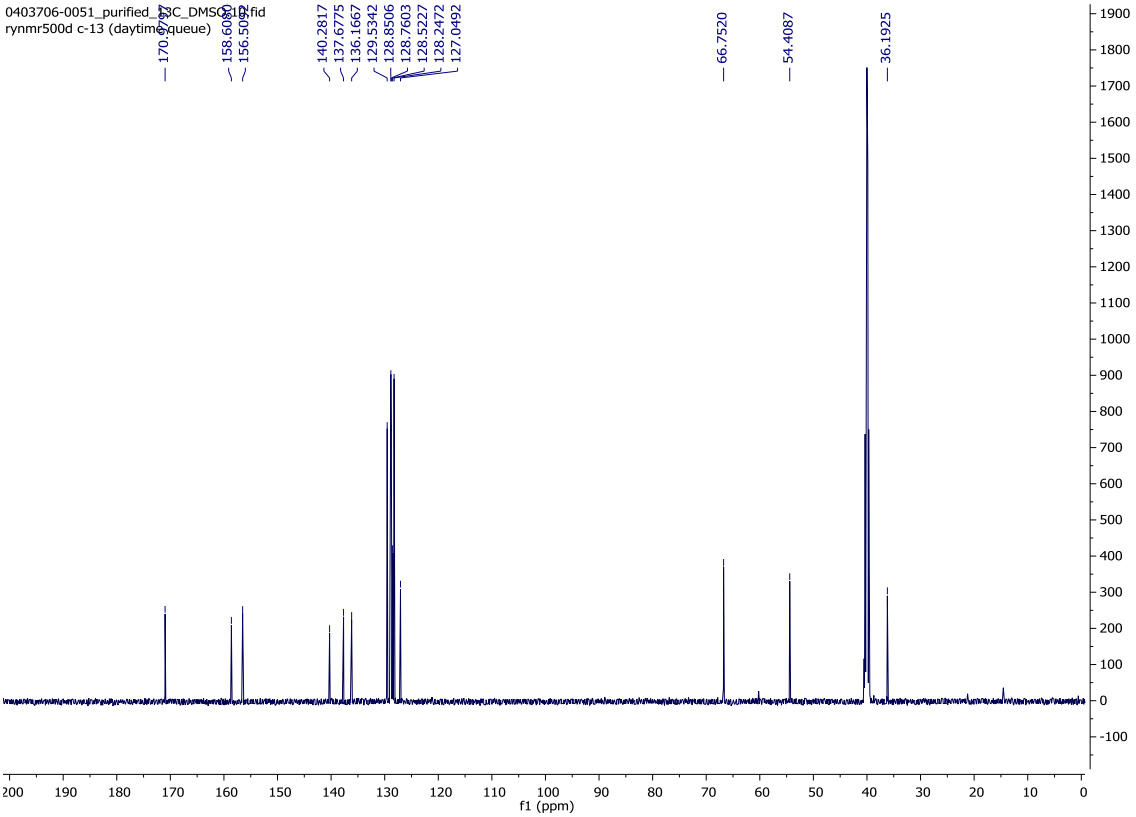

0403706-0136_13C_DMSO.10.fid
rynmr500d 2213 (daytime queue)
185.5243
157.3612
143.8237
136.0855
134.8823
130.4528
129.2618
f1 (ppm)

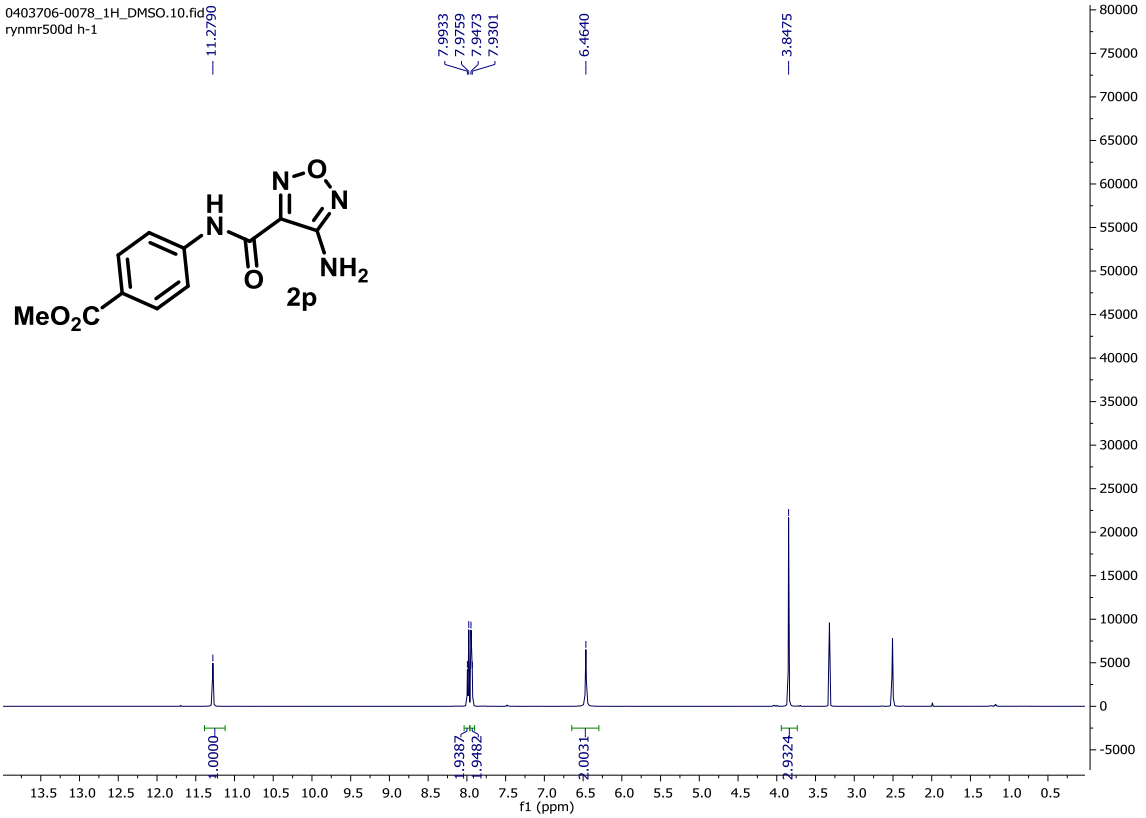
0403706-0051_purified_DMSO.10.fid
rynmr500d h-1

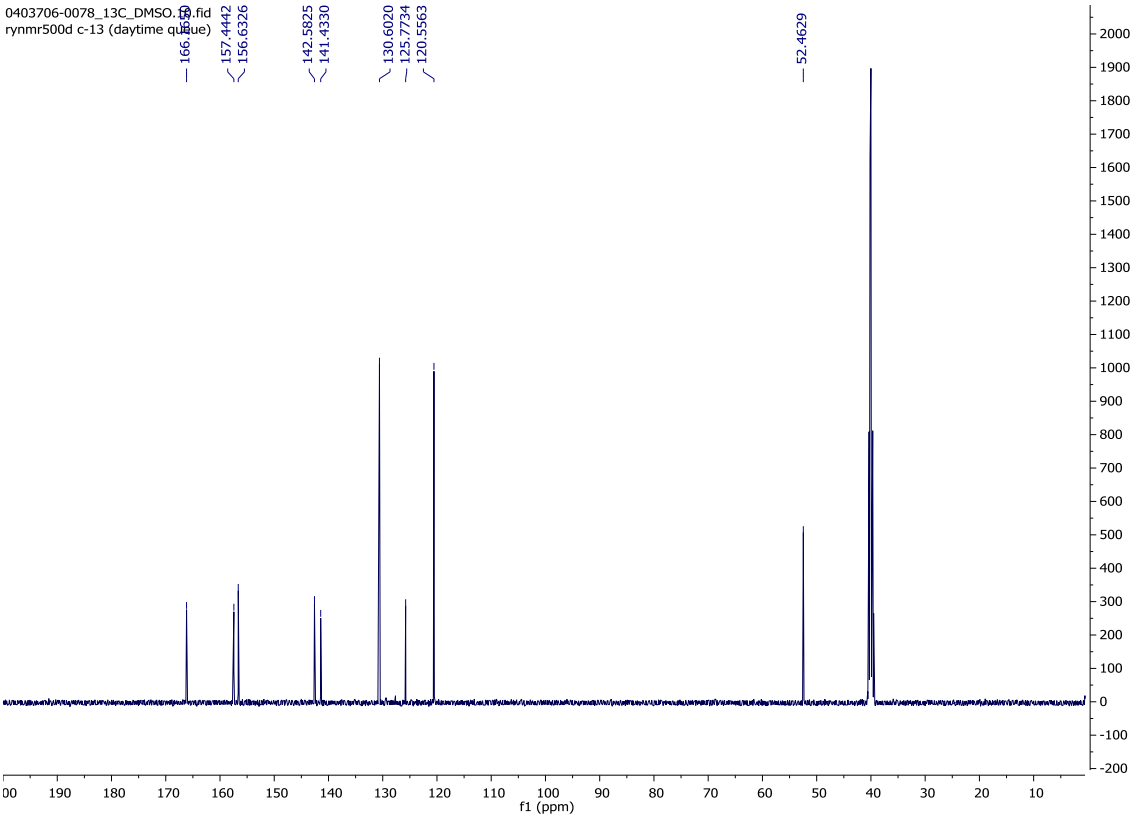


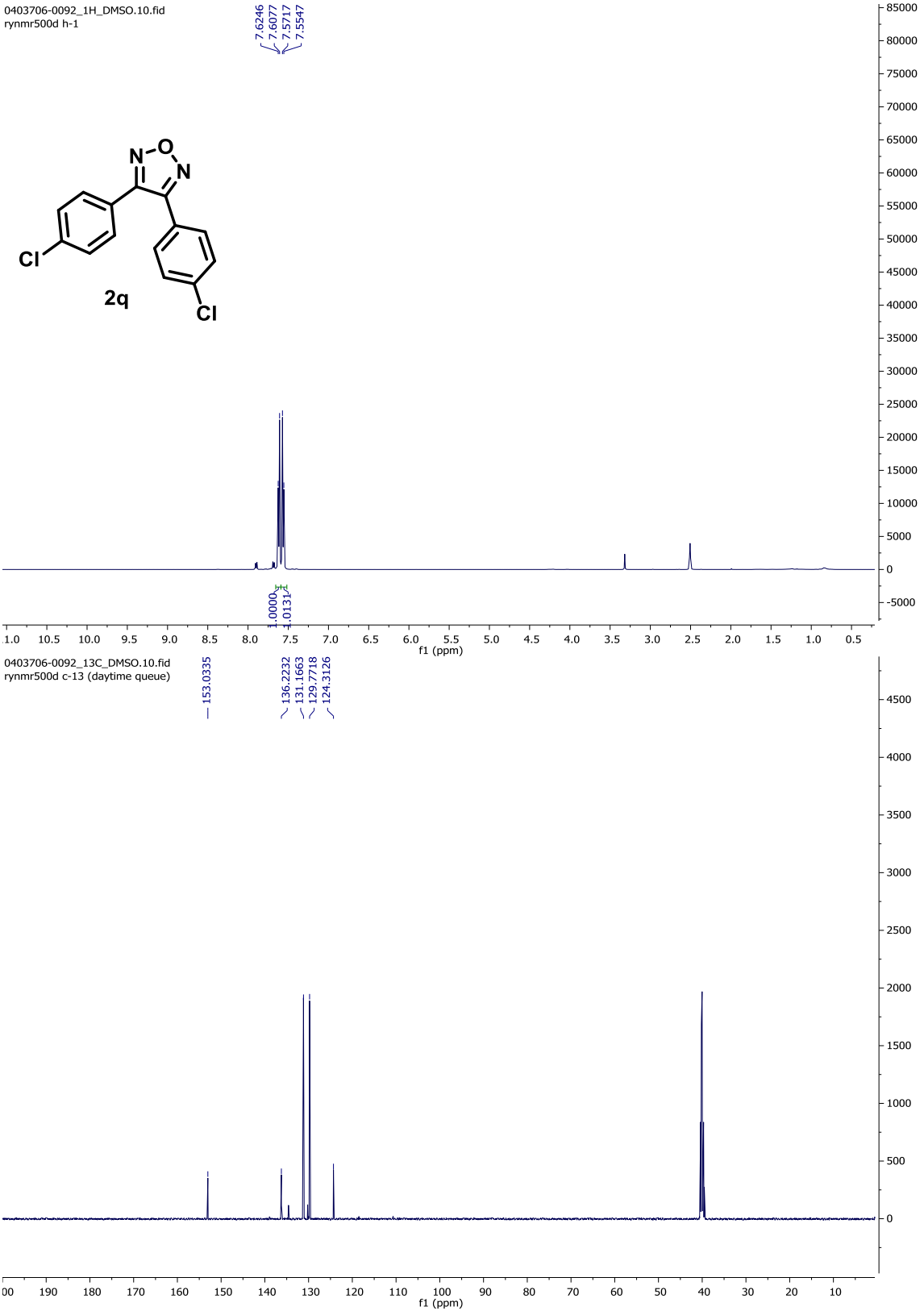
2o

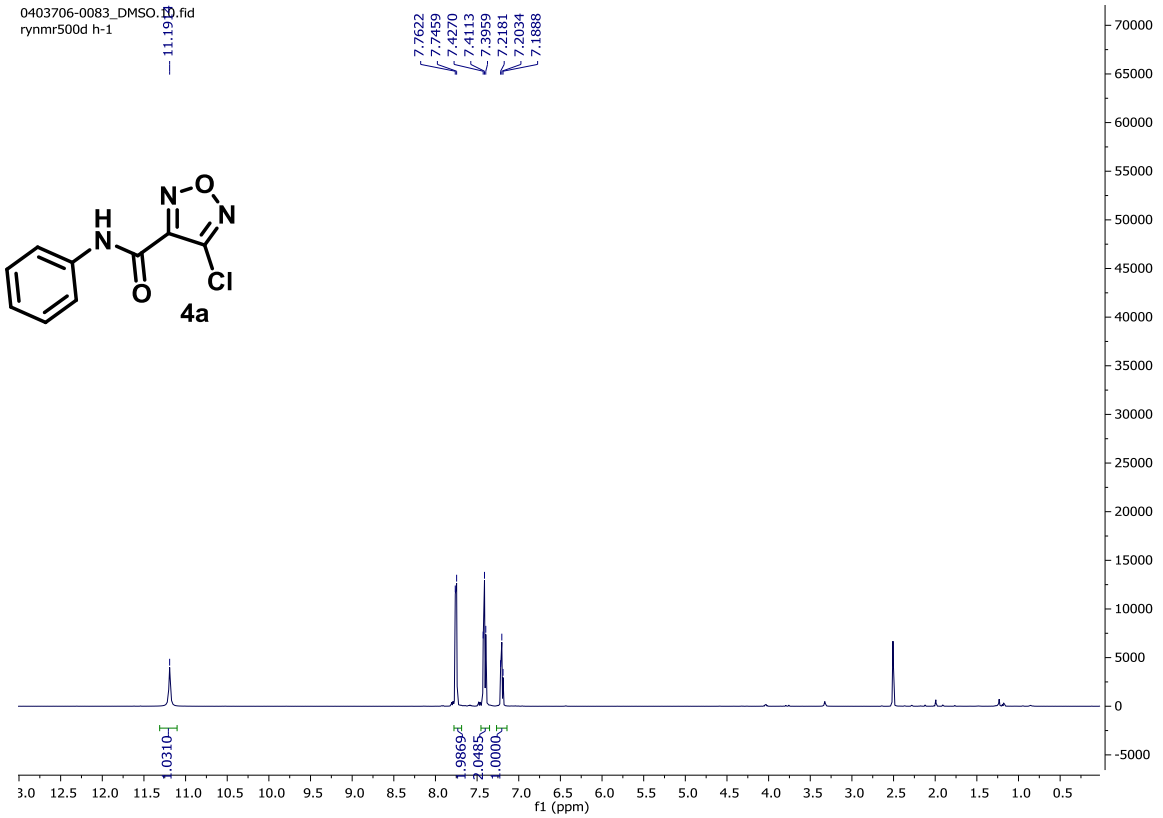
0403706-0051_purified_13C_DMSO.10.fid
rynmr500d c-13 (daytime queue)

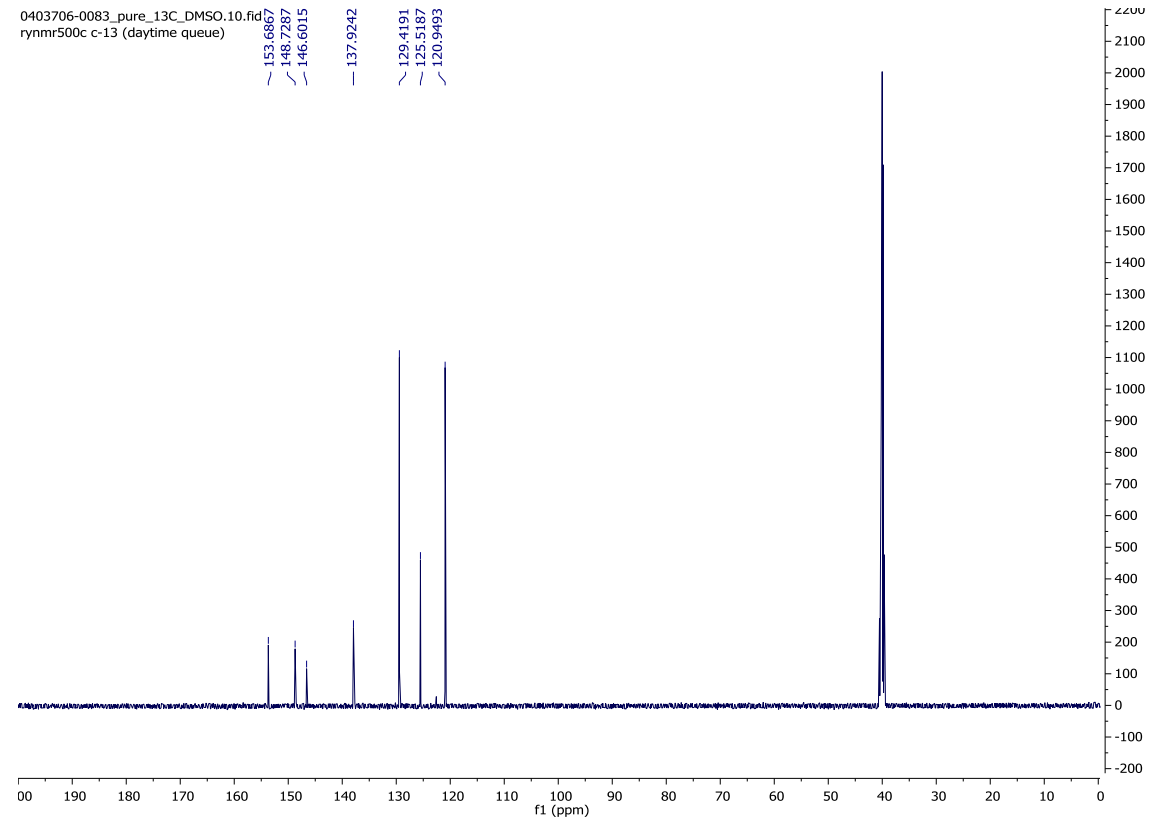


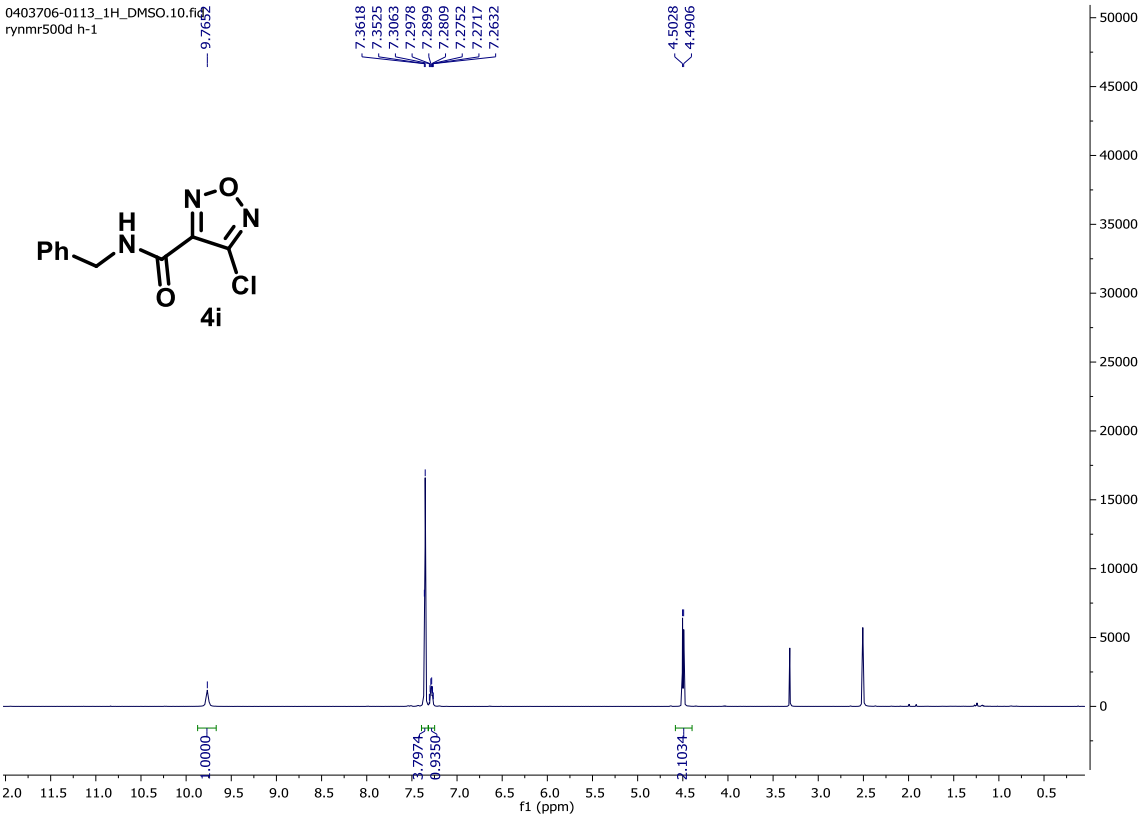

0403706-0078_1H_DMSO.10.fid
rynmr500d h-1
11.2790
7.9933
7.9759
7.9473
7.9301
6.4640
3.8475
1.0000
1.9387
1.9482
2.0031
2.9324
f1 (ppm)
2p

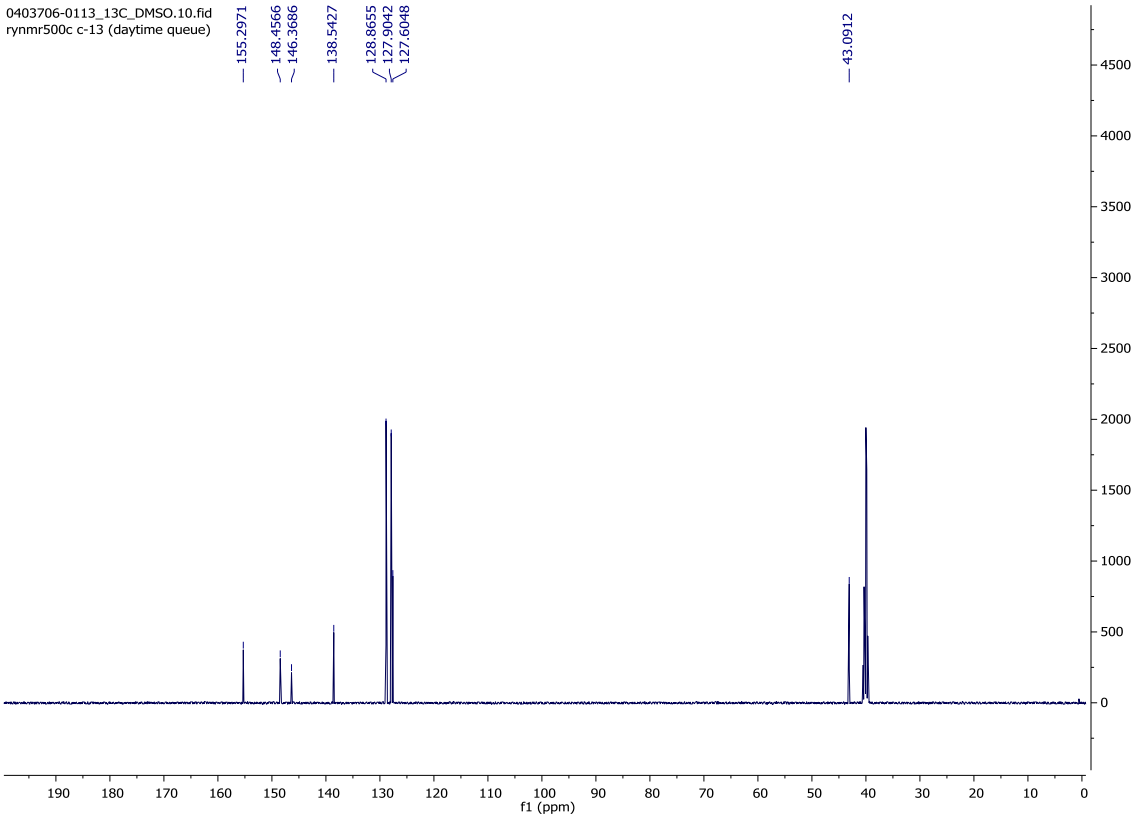

0403706-0078_13C_DMSO.10.fid
rynmr500d c-13 (daytime queue)
166.1630
157.4442
156.6326
142.5825
141.4330
130.6020
125.7734
120.5563
52.4629
f1 (ppm)

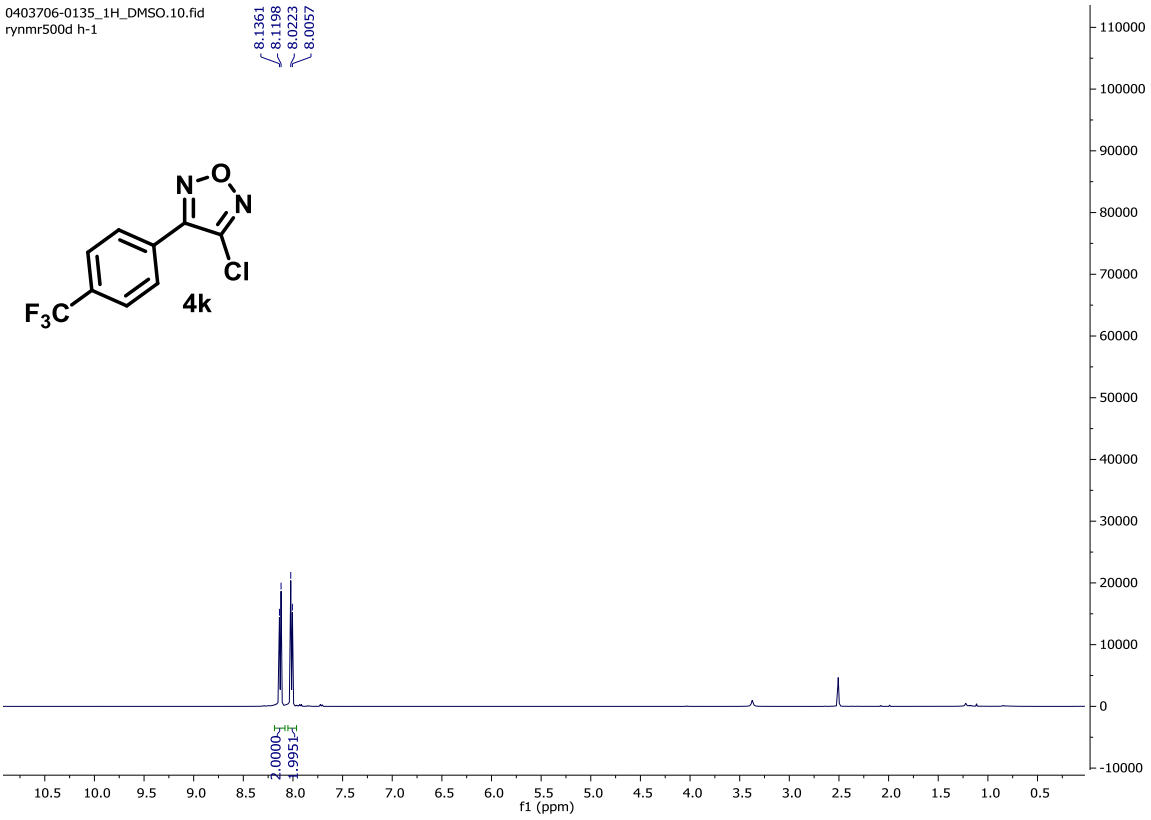

0403706-0092_1H_DMSO.10.fid
rynmr500d h-1
7.6246
7.6077
7.5717
7.5547
N
O
N
Cl
Cl
2q
1.0000
1.0131
f1 (ppm)
0403706-0092_13C_DMSO.10.fid
rynmr500d c-13 (daytime queue)
153.0335
136.2232
131.1663
129.7718
124.3126
f1 (ppm)

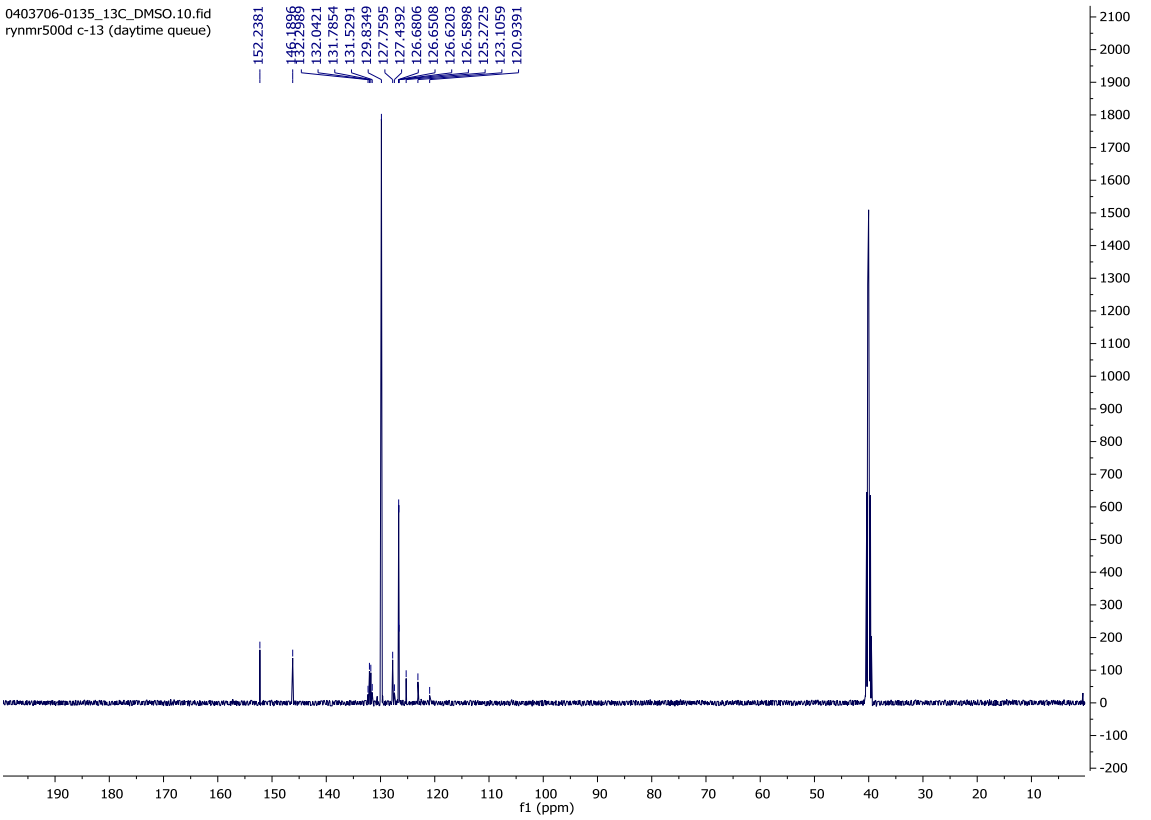

0403706-0083_DMSO.10.fid
rynmr500d h-1
11.1910
7.7622
7.7459
7.4270
7.4113
7.3959
7.2181
7.2034
7.1888
1.0310
1.9869
2.0485
1.0000
f1 (ppm)

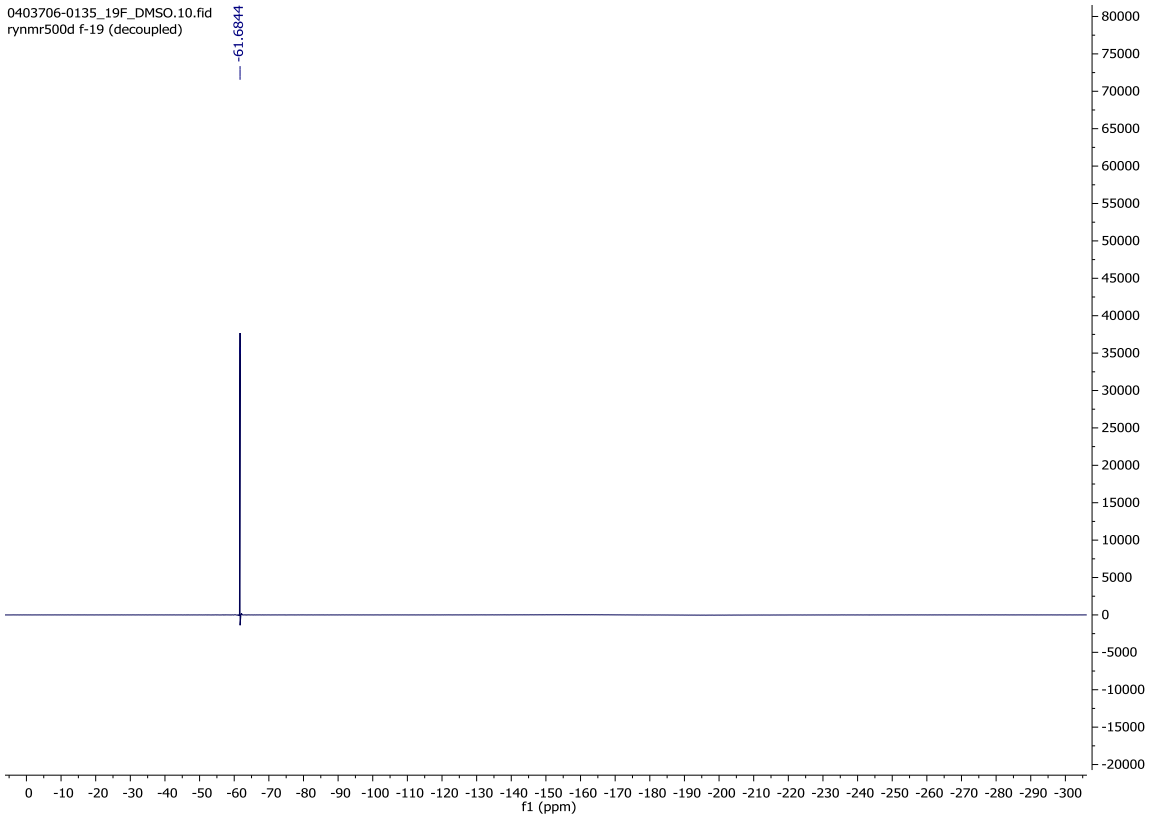

0403706-0083_pure_13C_DMSO.10.fid
rynmr500c c-13 (daytime queue)
153.6867
148.7287
146.6015
137.9242
129.4191
125.5187
120.9493
f1 (ppm)

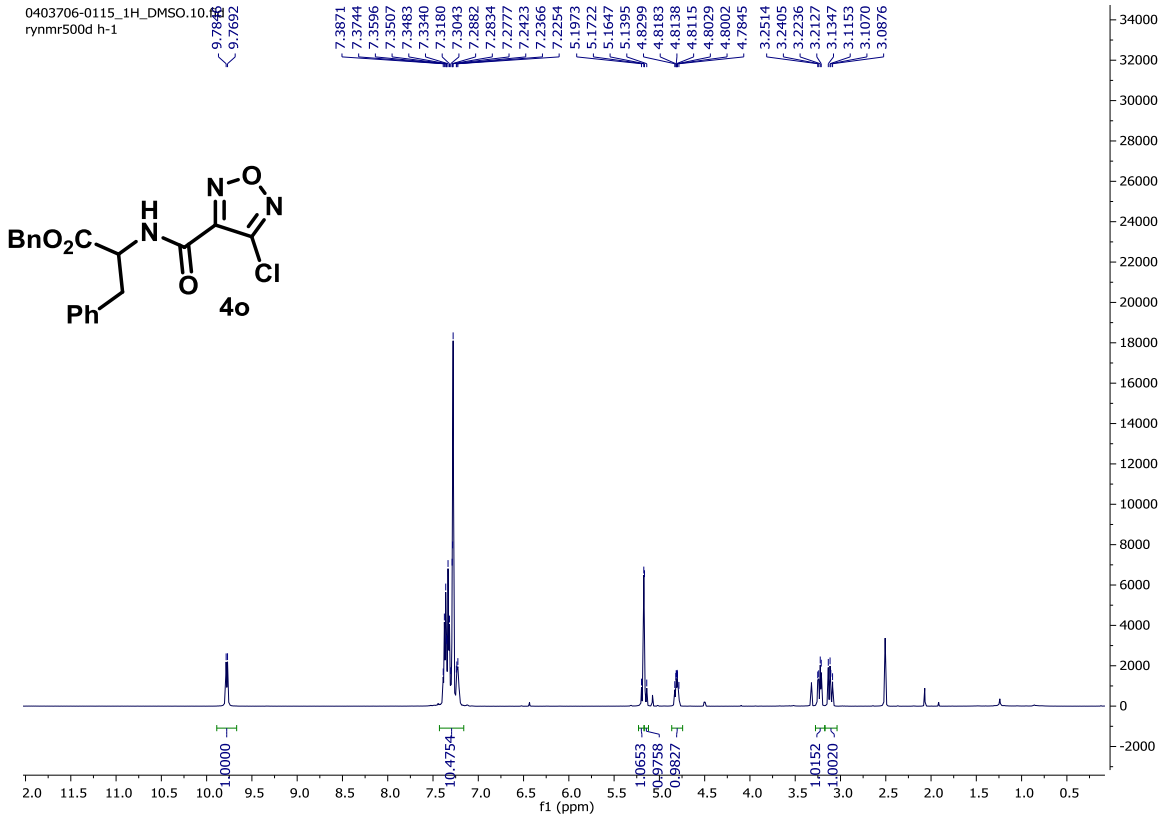

0403706-0113_1H_DMSO.10.fid
rynmr500d h-1
9.7652
7.3618
7.3525
7.3063
7.2978
7.2899
7.2809
7.2752
7.2717
7.2632
4.5028
4.4906
Ph
H
N
O
N
O
N
Cl
4i
1.0000
3.7974
0.9350
2.1034
f1 (ppm)

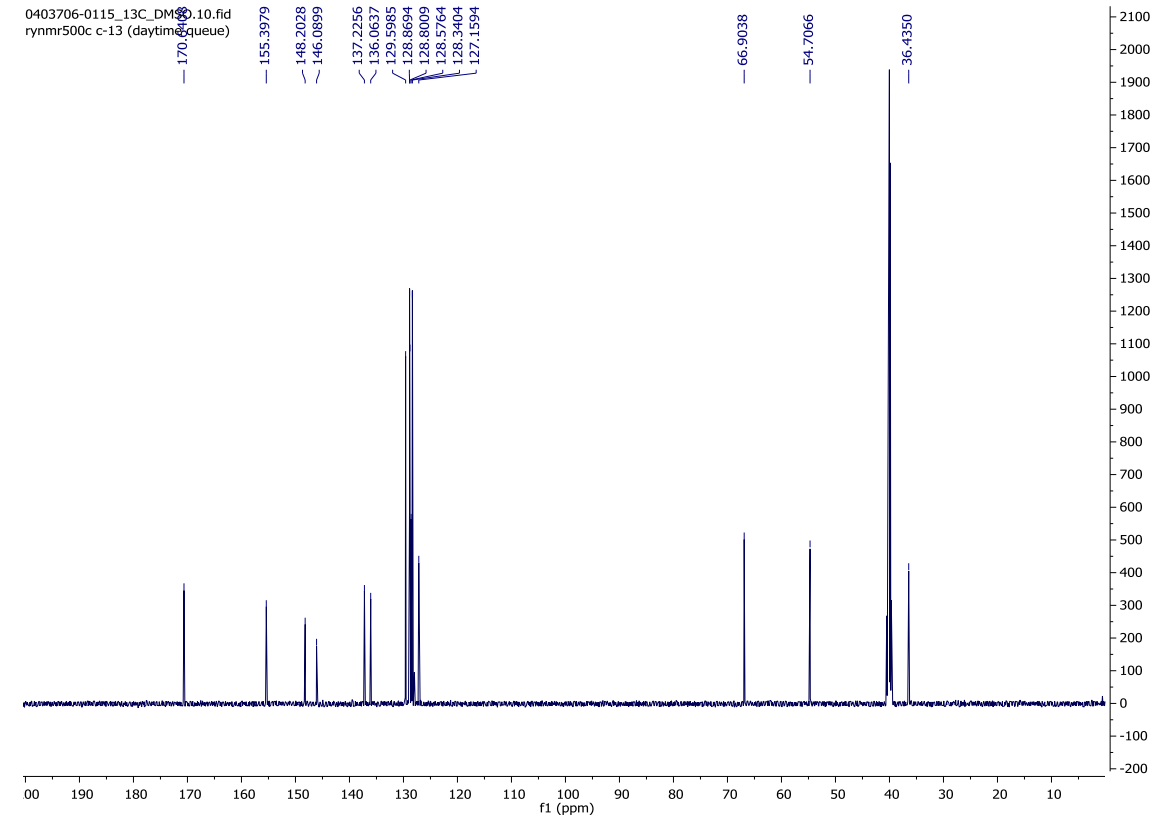

0403706-0113_13C_DMSO.10.fid
rynmr500c c-13 (daytime queue)
155.2971
148.4566
146.3686
138.5427
128.8655
127.9042
127.6048
43.0912
f1 (ppm)

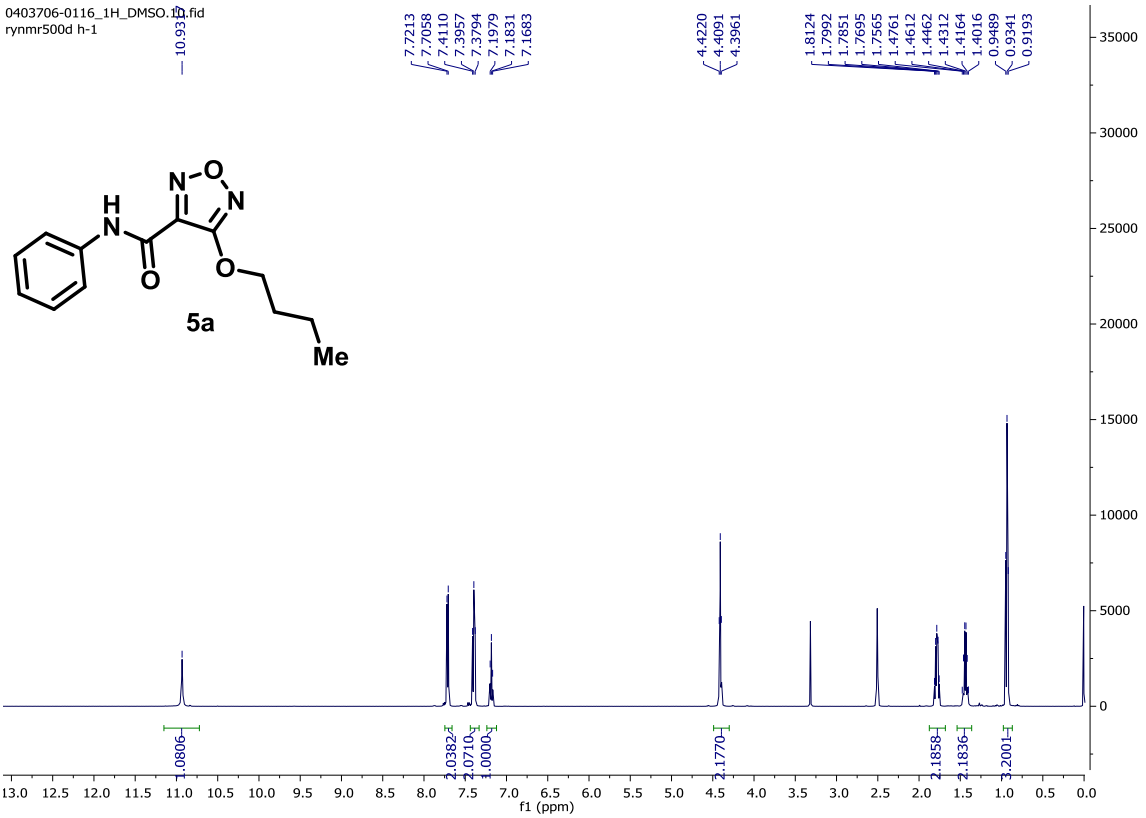

0403706-0135_1H_DMSO.10.fid
rynmr500d h-1
8.1361
8.1198
8.0223
8.0057
N
O
N
Cl
F3C
4k
2.0000
1.9951
f1 (ppm)

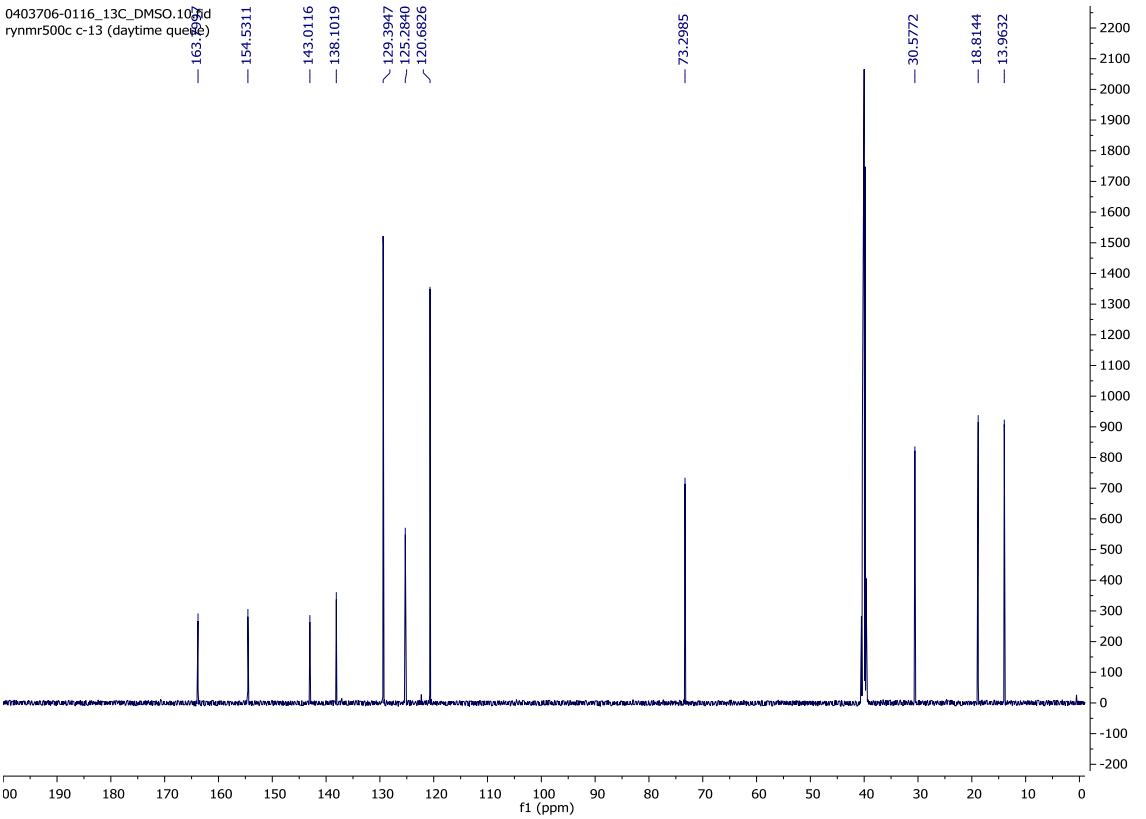

0403706-0135_13C_DMSO.10.fid
rynmr500d c-13 (daytime queue)
152.2381
132.0421
131.7854
131.5291
129.8349
127.7595
127.4392
126.6806
126.6508
126.6203
126.5898
125.2725
123.1059
120.9391
f1 (ppm)

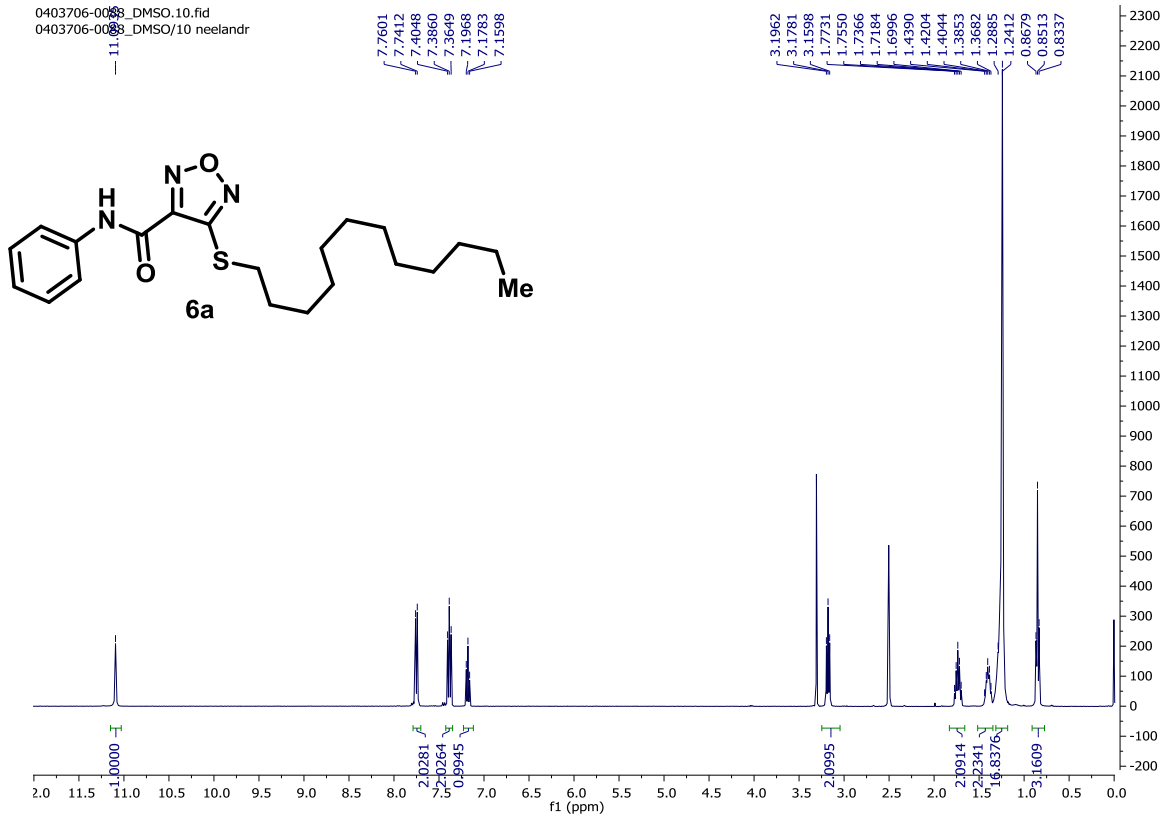

0403706-0135_19F_DMSO.10.fid
rynmr500d f-19 (decoupled)
-61.6844
80000
75000
70000
65000
60000
55000
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
-5000
-10000
-15000
-20000
0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -220 -230 -240 -250 -260 -270 -280 -290 -300
f1 (ppm)

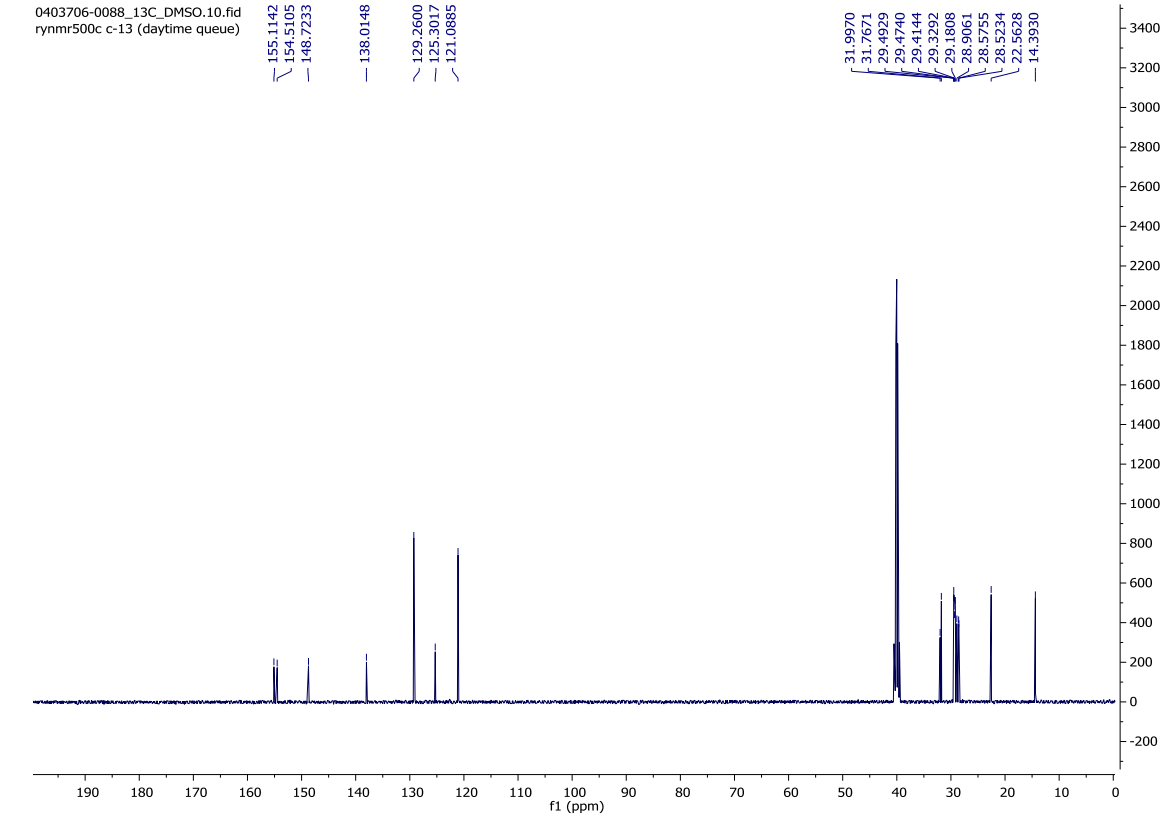

0403706-0115_1H_DMSO.10.fid
rynmr500d h-1
9.7845
9.7692
7.3871
7.3744
7.3596
7.3507
7.3483
7.3340
7.3180
7.3043
7.2882
7.2834
7.2777
7.2423
7.2366
7.2254
5.1973
5.1722
5.1647
5.1395
4.8299
4.8183
4.8138
4.8115
4.8029
4.8002
4.7845
3.2514
3.2405
3.2236
3.2127
3.1347
3.1153
3.1070
3.0876
BnO2C
H
N
N
O
N
O
Cl
Ph
4o
1.0000
10.4754
1.0653
0.9758
0.9827
1.0152
1.0020
f1 (ppm)


0403706-0115_13C_DMSO.10.fid
rynmr500c c-13 (daytime queue)
170.0414
155.3979
148.2028
146.0899
137.2256
136.0637
129.5985
128.8694
128.8009
128.5764
128.3404
127.1594
66.9038
54.7066
36.4350
f1 (ppm)

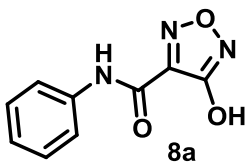

0403706-0116_1H_DMSO.10.fid
rynmr500d h-1
10.9316
7.7213
7.7058
7.4110
7.3957
7.3794
7.1979
7.1831
7.1683
4.4220
4.4091
4.3961
1.8124
1.7992
1.7851
1.7695
1.7565
1.4761
1.4612
1.4462
1.4312
1.4164
1.4016
0.9489
0.9341
0.9193
1.0806
2.0382
2.0710
1.0000
2.1770
2.1858
2.1836
3.2001
f1 (ppm)


0403706-0116_13C_DMSO.10.fid
rynmr500c c-13 (daytime queue)
163.2092
154.5311
143.0116
138.1019
129.3947
125.2840
120.6826
73.2985
30.5772
18.8144
13.9632
f1 (ppm)


0403706-0088_DMSO.10.fid
0403706-0088_DMSO/10 neelandr
11.0000
7.7601
7.7412
7.4048
7.3860
7.3649
7.1968
7.1783
7.1598
3.1962
3.1781
3.1598
1.7731
1.7550
1.7366
1.7184
1.6996
1.4390
1.4204
1.4044
1.3853
1.3682
1.2885
1.2412
0.8679
0.8513
0.8337
1.0000
2.0281
2.0264
0.9945
2.0995
2.0914
2.2341
16.8376
3.1609
f1 (ppm)


0403706-0088_13C_DMSO.10.fid
rynmr500c c-13 (daytime queue)
155.1142
154.5105
148.7233
138.0148
129.2600
125.3017
121.0885
31.9970
31.7671
29.4929
29.4740
29.4144
29.3292
29.1808
28.9061
28.5755
28.5234
22.5628
14.3930
f1 (ppm)

0403706-0126_fraction7_1H_DMSO.10.fid
rynmr500d h-1



8a

0403706-0126_fraction7_13C_DMSO.10.fid
rynmr500d c-13 (daytime queue)