

## Ethyl 2-[N-(2-Formylphenyl)benzene-sulfonamido]acetate

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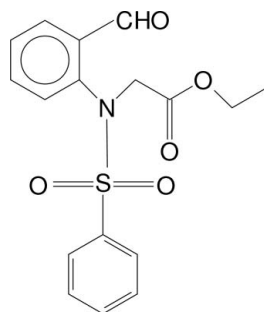
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Key indicators: single-crystal X-ray study;  $T = 293$  K; mean  $\sigma(\text{C}-\text{C}) = 0.003$  Å; R factor = 0.036; wR factor = 0.092; data-to-parameter ratio = 18.8.

In the title compound,  $\text{C}_{17}\text{H}_{17}\text{NO}_5\text{S}$ , the N atom is  $sp^3$ -hybridized and the S atom has a distorted tetrahedral configuration. The dihedral angle between the two aromatic rings is  $30.0$  ( $1^\circ$ ), and that between the ethyl acetate group and the formylphenyl ring is  $77.4$  ( $1^\circ$ ). The molecules are linked into chains along  $[100]$  by  $\text{C}-\text{H}\cdots\text{O}$  hydrogen bonds and the chains are linked *via*  $\text{C}-\text{H}\cdots\pi$  interactions.

### Related literature

For the biological properties of sulfonamide derivatives, see: Brown (1971); Nieto *et al.* (2005); Pomarnacka & Kozlarska-Kedra (2003). For related structures, see: Cameron *et al.* (1975); Cotton & Stokley (1970); Usha *et al.* (2005); Zhu *et al.* (2008).



### Experimental

#### Crystal data

$\text{C}_{17}\text{H}_{17}\text{NO}_5\text{S}$

$M_r = 347.38$

Orthorhombic,  $P2_12_12_1$

$a = 11.3442$  (5) Å

$b = 11.7731$  (6) Å

$c = 12.7809$  (6) Å

$V = 1706.97$  (14) Å<sup>3</sup>

$Z = 4$

Mo  $K\alpha$  radiation

$\mu = 0.22$  mm<sup>-1</sup>

$T = 293$  K

$0.25 \times 0.20 \times 0.20$  mm

#### Data collection

Bruker Kappa APEXII area-detector diffractometer

Absorption correction: multi-scan (SADABS; Sheldrick, 2001)

$T_{\min} = 0.948$ ,  $T_{\max} = 0.958$

10886 measured reflections

4104 independent reflections

3294 reflections with  $I > 2\sigma(I)$

$R_{\text{int}} = 0.022$

#### Refinement

$R[F^2 > 2\sigma(F^2)] = 0.036$

$wR(F^2) = 0.092$

$S = 0.95$

4104 reflections

218 parameters

H-atom parameters constrained

$\Delta\rho_{\text{max}} = 0.31$  e Å<sup>-3</sup>

$\Delta\rho_{\text{min}} = -0.23$  e Å<sup>-3</sup>

Absolute structure: Flack (1983),

1714 Friedel pairs

Flack parameter:  $-0.05$  (7)

**Table 1**

Hydrogen-bond geometry (Å, °).

| $D-H\cdots A$  | $D-H$ | $H\cdots A$ | $D\cdots A$ | $D-H\cdots A$ |
|--|-------|-------------|-------------|---------------|
| $\text{C8}-\text{H8}\cdots\text{O3}^{\text{i}}$      | 0.93  | 2.57        | 3.218 (3)   | 127           |
| $\text{C16}-\text{H16B}\cdots\text{Cg1}^{\text{ii}}$ | 0.97  | 2.73        | 3.605 (3)   | 150           |

Symmetry codes: (i)  $x - \frac{1}{2}, -y + \frac{3}{2}, -z + 1$ ; (ii)  $-x + 1, y - \frac{1}{2}, -z + \frac{1}{2}$ . Cg1 is the centroid of C1–C6 ring.

Data collection: APEX2 (Bruker, 2004); cell refinement: SAINT (Bruker, 2004); data reduction: SAINT; program(s) used to solve structure: SHELXS97 (Sheldrick, 2008); program(s) used to refine structure: SHELXL97 (Sheldrick, 2008); molecular graphics: ORTEP-3 (Farrugia, 1997) and PLATON (Spek, 2009); software used to prepare material for publication: SHELXL97.

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Supplementary data and figures for this paper are available from the IUCr electronic archives (Reference: CI2763).

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 Zhu, H.-Y., Wu, Z. & Jiang, S. (2008). *Acta Cryst.* **E64**, o596.

**supplementary materials**

*Acta Cryst.* (2009). E65, o530 [ doi:10.1107/S1600536809004413 ]

## Ethyl 2-[N-(2-Formylphenyl)benzenesulfonamido]acetate

P. R. Seshadri, B. Balakrishnan, K. Ilangoan, R. Sureshbabu and A. K. Mohanakrishnan

### Comment

Sulfonamide derivatives are well known drugs and are used to control diseases caused by bacterial infections. The antibacterial action of this group of drugs is exerted by the complete inhibition of dihydropteroate synthase enzyme towards the *p*-amino benzoate (Brown, 1971). Benzene sulfonamide derivatives are known to exhibit anticancer and HIV activities (Pomarnacka & Kozlarska-Kedra, 2003) and antibacterial activities (Nieto *et al.*, 2005). In view of this medicinal importance, the crystal structure determination of the title compound (Fig.1) was carried out and the results are presented here.

The angles around atom S1 deviate significantly from the regular tetrahedral value, with the largest deviation of 120.6 (1)° for O1—S1—O2 angle. This may be due to non-bonding interactions between S=O bonds (Cotton & Stokley, 1970). The sulfonyl oxygen O1 is syn-clinal and O2 is syn-periplanar to the phenyl ring. The dihedral angle between the best planes through the ethylacetate group (O3/O4/C14/C15/C16) and formyl phenyl ring (C7-C12) is 77.4 (1)°. The aldehyde group is slightly twisted from the plane of the ring to which it is attached as evidenced by the torsion angle C11—C12—C13—O5 of -8.5 (3)°. The relative orientations of C/N/S and O/S/O planes is determined by the hybridization nature of atom N1. The angles between planes C14/N1/S1 and O1/S1/O2 and between C7/N1/S1 and O1/S1/O2 planes are 59° and 56°, respectively. These values are close to 58° reported for *sp*<sup>3</sup> N atoms [87° for *sp*<sup>2</sup> N atoms] (Cameron *et al.*, 1975). The geometrical parameters agree well with those reported for related sulfonamide structures (Usha *et al.*, 2005; Zhu *et al.*, 2008).

In addition to van der Waals interactions, the crystal structure is stabilized by C—H···O and C—H··· $\pi$  interactions (Table 1).

### Experimental

N-(2-Formylphenyl)benzene sulfonamide (1.7 g, 6.5 mmol) was dissolved in dimethyl acetamide (25 ml). To this potassium carbonate (2.25 g, 16.2 mmol) and ethyl bromoacetate (0.86 ml, 7.8 mmol) were added. The reaction mixture was stirred at room temperature for 4 h. It was then poured over crushed ice (100 g) containing 5 ml of concentrated HCl. The precipitated solid was filtered off and the title compound was recrystallized from methanol. Yield = 1 g (45%) and m.p = 381 K.

### Refinement

All H atoms were positioned geometrically and allowed to ride on their parent atoms, with C-H = 0.93-0.97 Å and  $U_{\text{iso}}(\text{H}) = 1.5U_{\text{eq}}(\text{C})$  for methyl H atoms and  $1.2U_{\text{eq}}(\text{C})$  for other H atoms.

## Figures

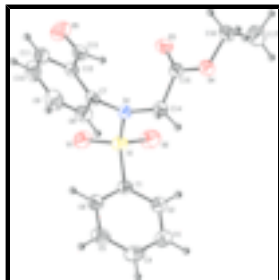


Fig. 1. Molecular structure of the title compound, showing 30% probability displacement ellipsoids.

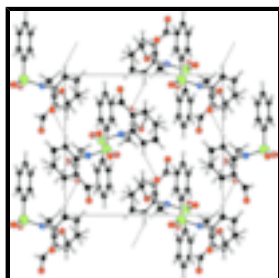


Fig. 2. Crystal packing of the title compound. Hydrogen bonds are shown as dashed lines.

## Ethyl 2-[N-(2-Formylphenyl)benzenesulfonamido]acetate

### Crystal data

$C_{17}H_{17}NO_5S$

$M_r = 347.38$

Orthorhombic,  $P2_12_12_1$

Hall symbol: P 2ac 2ab

$a = 11.3442$  (5) Å

$b = 11.7731$  (6) Å

$c = 12.7809$  (6) Å

$V = 1706.97$  (14) Å<sup>3</sup>

$Z = 4$

$F_{000} = 728$

$D_x = 1.352$  Mg m<sup>-3</sup>

Mo  $K\alpha$  radiation

$\lambda = 0.71073$  Å

Cell parameters from 4197 reflections

$\theta = 2.4$ – $28.2^\circ$

$\mu = 0.22$  mm<sup>-1</sup>

$T = 293$  K

Block, colourless

$0.25 \times 0.20 \times 0.20$  mm

### Data collection

Bruker Kappa APEXII area-detector diffractometer

Radiation source: fine-focus sealed tube

Monochromator: graphite

$T = 293$  K

$\omega$  scans

Absorption correction: multi-scan (SADABS; Sheldrick, 2001)

$T_{\min} = 0.948$ ,  $T_{\max} = 0.958$

10886 measured reflections

4104 independent reflections

3294 reflections with  $I > 2\sigma(I)$

$R_{\text{int}} = 0.022$

$\theta_{\text{max}} = 28.2^\circ$

$\theta_{\text{min}} = 2.4^\circ$

$h = -15 \rightarrow 10$

$k = -13 \rightarrow 15$

$l = -17 \rightarrow 17$

Refinement

|  |  |
|--|--|
| Refinement on $F^2$  | Hydrogen site location: inferred from neighbouring sites |
| Least-squares matrix: full                                     | H-atom parameters constrained                            |
| $R[F^2 > 2\sigma(F^2)] = 0.036$                                | $w = 1/[\sigma^2(F_o^2) + (0.0478P)^2 + 0.2327P]$        |
| $wR(F^2) = 0.092$  | where $P = (F_o^2 + 2F_c^2)/3$                           |
| $S = 0.95$   | $(\Delta/\sigma)_{\max} = 0.001$                         |
| 4104 reflections   | $\Delta\rho_{\max} = 0.31 \text{ e } \text{\AA}^{-3}$    |
| 218 parameters   | $\Delta\rho_{\min} = -0.23 \text{ e } \text{\AA}^{-3}$   |
| Primary atom site location: structure-invariant direct methods | Extinction correction: none                              |
| Secondary atom site location: difference Fourier map           | Absolute structure: Flack (1983), 1714 Friedel pairs     |
|  | Flack parameter: $-0.05$ (7)                             |

Special details

**Geometry.** All e.s.d.'s (except the e.s.d. in the dihedral angle between two l.s. planes) are estimated using the full covariance matrix. The cell e.s.d.'s are taken into account individually in the estimation of e.s.d.'s in distances, angles and torsion angles; correlations between e.s.d.'s in cell parameters are only used when they are defined by crystal symmetry. An approximate (isotropic) treatment of cell e.s.d.'s is used for estimating e.s.d.'s involving l.s. planes.

**Refinement.** Refinement of  $F^2$  against ALL reflections. The weighted  $R$ -factor  $wR$  and goodness of fit  $S$  are based on  $F^2$ , conventional  $R$ -factors  $R$  are based on  $F$ , with  $F$  set to zero for negative  $F^2$ . The threshold expression of  $F^2 > \sigma(F^2)$  is used only for calculating  $R$ -factors(gt) *etc.* and is not relevant to the choice of reflections for refinement.  $R$ -factors based on  $F^2$  are statistically about twice as large as those based on  $F$ , and  $R$ -factors based on ALL data will be even larger.

Fractional atomic coordinates and isotropic or equivalent isotropic displacement parameters ( $\text{\AA}^2$ )

|     | $x$          | $y$          | $z$          | $U_{\text{iso}}^*/U_{\text{eq}}$ |
|-----|--------------|--------------|--------------|----------------------------------|
| S1  | 0.53613 (4)  | 0.77486 (4)  | 0.23609 (3)  | 0.04875 (13)                     |
| N1  | 0.57693 (13) | 0.74419 (13) | 0.35602 (12) | 0.0458 (4)                       |
| O1  | 0.58109 (13) | 0.88549 (13) | 0.21568 (11) | 0.0627 (4)                       |
| O2  | 0.56980 (14) | 0.68125 (16) | 0.17264 (13) | 0.0734 (5)                       |
| O3  | 0.75001 (14) | 0.59352 (14) | 0.41673 (16) | 0.0749 (5)                       |
| O4  | 0.61531 (12) | 0.47431 (12) | 0.48118 (11) | 0.0576 (4)                       |
| O5  | 0.89664 (14) | 0.90059 (16) | 0.34906 (17) | 0.0833 (6)                       |
| C1  | 0.38089 (15) | 0.77875 (16) | 0.23788 (14) | 0.0433 (4)                       |
| C2  | 0.3190 (2)   | 0.68510 (18) | 0.20483 (17) | 0.0559 (5)                       |
| H2  | 0.3585       | 0.6215       | 0.1798       | 0.067*                           |
| C3  | 0.1975 (2)   | 0.6866 (2)   | 0.2093 (2)   | 0.0693 (6)                       |
| H3  | 0.1546       | 0.6237       | 0.1870       | 0.083*                           |
| C4  | 0.1400 (2)   | 0.7802 (2)   | 0.24649 (19) | 0.0705 (6)                       |
| H4  | 0.0581       | 0.7806       | 0.2496       | 0.085*                           |
| C5  | 0.2021 (2)   | 0.8738 (2)   | 0.27923 (18) | 0.0660 (6)                       |
| H5A | 0.1622       | 0.9371       | 0.3046       | 0.079*                           |
| C6  | 0.32367 (19) | 0.87418 (18) | 0.27450 (16) | 0.0547 (5)                       |

## supplementary materials

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|      |              |              |              |             |
|------|--------------|--------------|--------------|-------------|
| H6   | 0.3663       | 0.9376       | 0.2956       | 0.066*      |
| C7   | 0.60070 (16) | 0.83376 (15) | 0.42938 (14) | 0.0430 (4)  |
| C8   | 0.51433 (19) | 0.86705 (19) | 0.49933 (16) | 0.0585 (5)  |
| H8   | 0.4400       | 0.8338       | 0.4967       | 0.070*      |
| C9   | 0.5382 (3)   | 0.9487 (2)   | 0.57219 (17) | 0.0717 (6)  |
| H9   | 0.4799       | 0.9708       | 0.6192       | 0.086*      |
| C10  | 0.6472 (3)   | 0.9983 (2)   | 0.57653 (17) | 0.0713 (7)  |
| H10  | 0.6630       | 1.0529       | 0.6273       | 0.086*      |
| C11  | 0.7342 (2)   | 0.96779 (17) | 0.50592 (16) | 0.0585 (5)  |
| H11  | 0.8075       | 1.0030       | 0.5082       | 0.070*      |
| C12  | 0.71158 (17) | 0.88403 (15) | 0.43139 (14) | 0.0444 (4)  |
| C13  | 0.80492 (18) | 0.85128 (18) | 0.35747 (16) | 0.0525 (5)  |
| H13  | 0.7919       | 0.7886       | 0.3148       | 0.063*      |
| C14  | 0.54423 (19) | 0.63341 (16) | 0.39786 (16) | 0.0529 (4)  |
| H14A | 0.5022       | 0.5908       | 0.3447       | 0.064*      |
| H14B | 0.4917       | 0.6437       | 0.4570       | 0.064*      |
| C15  | 0.65033 (19) | 0.56723 (17) | 0.43213 (15) | 0.0485 (4)  |
| C16  | 0.7055 (2)   | 0.39708 (18) | 0.51686 (18) | 0.0642 (6)  |
| H16A | 0.7631       | 0.4372       | 0.5591       | 0.077*      |
| H16B | 0.7457       | 0.3630       | 0.4577       | 0.077*      |
| C17  | 0.6461 (3)   | 0.3085 (2)   | 0.5799 (3)   | 0.1089 (12) |
| H17A | 0.6111       | 0.3426       | 0.6406       | 0.163*      |
| H17B | 0.7027       | 0.2525       | 0.6012       | 0.163*      |
| H17C | 0.5858       | 0.2729       | 0.5386       | 0.163*      |

### Atomic displacement parameters ( $\text{\AA}^2$ )

|     | $U^{11}$    | $U^{22}$    | $U^{33}$    | $U^{12}$     | $U^{13}$     | $U^{23}$     |
|-----|-------------|-------------|-------------|--------------|--------------|--------------|
| S1  | 0.0432 (2)  | 0.0579 (3)  | 0.0451 (2)  | 0.0008 (2)   | 0.0015 (2)   | -0.0029 (2)  |
| N1  | 0.0426 (8)  | 0.0414 (8)  | 0.0535 (8)  | 0.0000 (7)   | -0.0064 (6)  | 0.0046 (7)   |
| O1  | 0.0607 (9)  | 0.0714 (10) | 0.0559 (8)  | -0.0149 (8)  | -0.0027 (7)  | 0.0166 (7)   |
| O2  | 0.0594 (10) | 0.0918 (12) | 0.0692 (9)  | 0.0096 (9)   | 0.0088 (7)   | -0.0290 (9)  |
| O3  | 0.0449 (9)  | 0.0622 (10) | 0.1175 (14) | 0.0016 (8)   | -0.0120 (9)  | 0.0194 (9)   |
| O4  | 0.0636 (9)  | 0.0468 (8)  | 0.0622 (8)  | 0.0010 (7)   | -0.0076 (7)  | 0.0095 (7)   |
| O5  | 0.0478 (9)  | 0.0929 (13) | 0.1093 (14) | -0.0136 (9)  | 0.0124 (9)   | -0.0077 (11) |
| C1  | 0.0411 (9)  | 0.0509 (10) | 0.0380 (8)  | 0.0016 (8)   | -0.0043 (7)  | -0.0017 (9)  |
| C2  | 0.0555 (13) | 0.0491 (11) | 0.0630 (12) | 0.0033 (10)  | -0.0050 (9)  | -0.0037 (9)  |
| C3  | 0.0548 (13) | 0.0680 (14) | 0.0852 (16) | -0.0116 (12) | -0.0057 (12) | -0.0013 (12) |
| C4  | 0.0466 (11) | 0.0937 (18) | 0.0712 (14) | 0.0004 (13)  | 0.0025 (10)  | 0.0003 (14)  |
| C5  | 0.0592 (13) | 0.0776 (15) | 0.0612 (13) | 0.0218 (13)  | -0.0023 (11) | -0.0129 (12) |
| C6  | 0.0576 (12) | 0.0564 (12) | 0.0502 (10) | 0.0069 (10)  | -0.0082 (9)  | -0.0095 (9)  |
| C7  | 0.0454 (10) | 0.0408 (9)  | 0.0429 (9)  | 0.0049 (8)   | -0.0035 (8)  | 0.0058 (8)   |
| C8  | 0.0522 (12) | 0.0656 (13) | 0.0576 (11) | 0.0071 (10)  | 0.0076 (9)   | 0.0062 (10)  |
| C9  | 0.0859 (17) | 0.0712 (14) | 0.0579 (12) | 0.0135 (15)  | 0.0170 (14)  | -0.0028 (11) |
| C10 | 0.111 (2)   | 0.0521 (12) | 0.0508 (12) | 0.0063 (13)  | -0.0067 (13) | -0.0087 (10) |
| C11 | 0.0719 (15) | 0.0488 (11) | 0.0547 (12) | -0.0025 (11) | -0.0150 (10) | 0.0027 (9)   |
| C12 | 0.0463 (10) | 0.0420 (9)  | 0.0449 (9)  | 0.0045 (8)   | -0.0050 (8)  | 0.0067 (8)   |
| C13 | 0.0432 (11) | 0.0538 (11) | 0.0605 (12) | 0.0035 (10)  | -0.0014 (9)  | 0.0079 (9)   |

|     |             |             |             |              |              |             |
|-----|-------------|-------------|-------------|--------------|--------------|-------------|
| C14 | 0.0452 (11) | 0.0452 (10) | 0.0684 (11) | -0.0022 (10) | -0.0031 (10) | 0.0073 (9)  |
| C15 | 0.0523 (12) | 0.0427 (10) | 0.0505 (10) | -0.0004 (9)  | -0.0091 (9)  | -0.0037 (8) |
| C16 | 0.0804 (16) | 0.0486 (11) | 0.0635 (13) | 0.0096 (11)  | -0.0243 (11) | 0.0018 (10) |
| C17 | 0.132 (3)   | 0.0725 (18) | 0.122 (3)   | -0.0193 (18) | -0.047 (2)   | 0.0430 (18) |

*Geometric parameters (Å, °)*

|            |             |               |             |
|------------|-------------|---------------|-------------|
| S1—O1      | 1.4229 (15) | C7—C8         | 1.383 (3)   |
| S1—O2      | 1.4206 (16) | C7—C12        | 1.390 (3)   |
| S1—N1      | 1.6414 (15) | C8—C9         | 1.365 (3)   |
| S1—C1      | 1.7618 (18) | C8—H8         | 0.93        |
| N1—C7      | 1.437 (2)   | C9—C10        | 1.370 (4)   |
| N1—C14     | 1.458 (2)   | C9—H9         | 0.93        |
| O3—C15     | 1.189 (2)   | C10—C11       | 1.385 (3)   |
| O4—C15     | 1.322 (2)   | C10—H10       | 0.93        |
| O4—C16     | 1.443 (2)   | C11—C12       | 1.395 (3)   |
| O5—C13     | 1.196 (3)   | C11—H11       | 0.93        |
| C1—C6      | 1.379 (3)   | C12—C13       | 1.471 (3)   |
| C1—C2      | 1.374 (3)   | C13—H13       | 0.93        |
| C2—C3      | 1.380 (3)   | C14—C15       | 1.499 (3)   |
| C2—H2      | 0.93        | C14—H14A      | 0.97        |
| C3—C4      | 1.367 (3)   | C14—H14B      | 0.97        |
| C3—H3      | 0.93        | C16—C17       | 1.480 (4)   |
| C4—C5      | 1.373 (3)   | C16—H16A      | 0.97        |
| C4—H4      | 0.93        | C16—H16B      | 0.97        |
| C5—C6      | 1.381 (3)   | C17—H17A      | 0.96        |
| C5—H5A     | 0.93        | C17—H17B      | 0.96        |
| C6—H6      | 0.93        | C17—H17C      | 0.96        |
| O1—S1—O2   | 120.6 (1)   | C8—C9—H9      | 119.8       |
| O1—S1—N1   | 105.7 (1)   | C10—C9—H9     | 119.8       |
| O2—S1—N1   | 106.7 (1)   | C9—C10—C11    | 120.4 (2)   |
| O1—S1—C1   | 109.7 (1)   | C9—C10—H10    | 119.8       |
| O2—S1—C1   | 107.2 (1)   | C11—C10—H10   | 119.8       |
| N1—S1—C1   | 106.0 (1)   | C10—C11—C12   | 119.8 (2)   |
| C7—N1—C14  | 117.7 (2)   | C10—C11—H11   | 120.1       |
| C7—N1—S1   | 120.1 (1)   | C12—C11—H11   | 120.1       |
| C14—N1—S1  | 117.9 (1)   | C7—C12—C11    | 118.69 (19) |
| C15—O4—C16 | 117.27 (16) | C7—C12—C13    | 121.86 (18) |
| C6—C1—C2   | 121.17 (18) | C11—C12—C13   | 119.45 (19) |
| C6—C1—S1   | 119.73 (15) | O5—C13—C12    | 123.8 (2)   |
| C2—C1—S1   | 119.08 (15) | O5—C13—H13    | 118.1       |
| C3—C2—C1   | 119.2 (2)   | C12—C13—H13   | 118.1       |
| C3—C2—H2   | 120.4       | N1—C14—C15    | 111.6 (2)   |
| C1—C2—H2   | 120.4       | N1—C14—H14A   | 109.3       |
| C2—C3—C4   | 120.1 (2)   | C15—C14—H14A  | 109.3       |
| C2—C3—H3   | 120.0       | N1—C14—H14B   | 109.3       |
| C4—C3—H3   | 120.0       | C15—C14—H14B  | 109.3       |
| C5—C4—C3   | 120.6 (2)   | H14A—C14—H14B | 108.0       |
| C5—C4—H4   | 119.7       | O3—C15—O4     | 125.4 (2)   |

## supplementary materials

|              |              |                 |              |
|--------------|--------------|-----------------|--------------|
| C3—C4—H4     | 119.7        | O3—C15—C14      | 125.5 (2)    |
| C4—C5—C6     | 120.1 (2)    | O4—C15—C14      | 109.11 (17)  |
| C4—C5—H5A    | 120.0        | O4—C16—C17      | 107.0 (2)    |
| C6—C5—H5A    | 120.0        | O4—C16—H16A     | 110.3        |
| C1—C6—C5     | 118.9 (2)    | C17—C16—H16A    | 110.3        |
| C1—C6—H6     | 120.6        | O4—C16—H16B     | 110.3        |
| C5—C6—H6     | 120.6        | C17—C16—H16B    | 110.3        |
| C8—C7—C12    | 120.55 (19)  | H16A—C16—H16B   | 108.6        |
| C8—C7—N1     | 119.79 (18)  | C16—C17—H17A    | 109.5        |
| C12—C7—N1    | 119.63 (17)  | C16—C17—H17B    | 109.5        |
| C9—C8—C7     | 120.0 (2)    | H17A—C17—H17B   | 109.5        |
| C9—C8—H8     | 120.0        | C16—C17—H17C    | 109.5        |
| C7—C8—H8     | 120.0        | H17A—C17—H17C   | 109.5        |
| C8—C9—C10    | 120.5 (2)    | H17B—C17—H17C   | 109.5        |
| O1—S1—N1—C7  | 24.90 (17)   | C14—N1—C7—C12   | 119.11 (18)  |
| O2—S1—N1—C7  | 154.43 (15)  | S1—N1—C7—C12    | -84.75 (19)  |
| C1—S1—N1—C7  | -91.53 (15)  | C12—C7—C8—C9    | -1.0 (3)     |
| O1—S1—N1—C14 | -179.00 (14) | N1—C7—C8—C9     | 177.16 (19)  |
| O2—S1—N1—C14 | -49.47 (17)  | C7—C8—C9—C10    | 0.1 (3)      |
| C1—S1—N1—C14 | 64.58 (16)   | C8—C9—C10—C11   | 1.1 (4)      |
| O1—S1—C1—C6  | -33.51 (18)  | C9—C10—C11—C12  | -1.5 (3)     |
| O2—S1—C1—C6  | -166.12 (17) | C8—C7—C12—C11   | 0.6 (3)      |
| N1—S1—C1—C6  | 80.23 (17)   | N1—C7—C12—C11   | -177.55 (16) |
| O1—S1—C1—C2  | 148.00 (16)  | C8—C7—C12—C13   | -179.43 (17) |
| O2—S1—C1—C2  | 15.4 (2)     | N1—C7—C12—C13   | 2.4 (3)      |
| N1—S1—C1—C2  | -98.26 (16)  | C10—C11—C12—C7  | 0.6 (3)      |
| C6—C1—C2—C3  | -0.5 (3)     | C10—C11—C12—C13 | -179.32 (19) |
| S1—C1—C2—C3  | 177.94 (18)  | C7—C12—C13—O5   | 171.5 (2)    |
| C1—C2—C3—C4  | -0.2 (3)     | C11—C12—C13—O5  | -8.5 (3)     |
| C2—C3—C4—C5  | 0.3 (4)      | C7—N1—C14—C15   | -80.8 (2)    |
| C3—C4—C5—C6  | 0.2 (4)      | S1—N1—C14—C15   | 122.49 (16)  |
| C2—C1—C6—C5  | 1.1 (3)      | C16—O4—C15—O3   | -1.5 (3)     |
| S1—C1—C6—C5  | -177.41 (17) | C16—O4—C15—C14  | 177.78 (17)  |
| C4—C5—C6—C1  | -0.9 (3)     | N1—C14—C15—O3   | -8.5 (3)     |
| C14—N1—C7—C8 | -59.1 (2)    | N1—C14—C15—O4   | 172.19 (15)  |
| S1—N1—C7—C8  | 97.09 (19)   | C15—O4—C16—C17  | 173.1 (2)    |

### Hydrogen-bond geometry ( $\text{\AA}$ , $^\circ$ )

| $D-H\cdots A$                       | $D-H$ | $H\cdots A$ | $D\cdots A$ | $D-H\cdots A$ |
|-------------------------------------|-------|-------------|-------------|---------------|
| C8—H8 $\cdots$ O3 <sup>i</sup>      | 0.93  | 2.57        | 3.218 (3)   | 127           |
| C16—H16B $\cdots$ Cg1 <sup>ii</sup> | 0.97  | 2.73        | 3.605 (3)   | 150           |

Symmetry codes: (i)  $x-1/2, -y+3/2, -z+1$ ; (ii)  $-x+1, y-1/2, -z+1/2$ .



Fig. 1

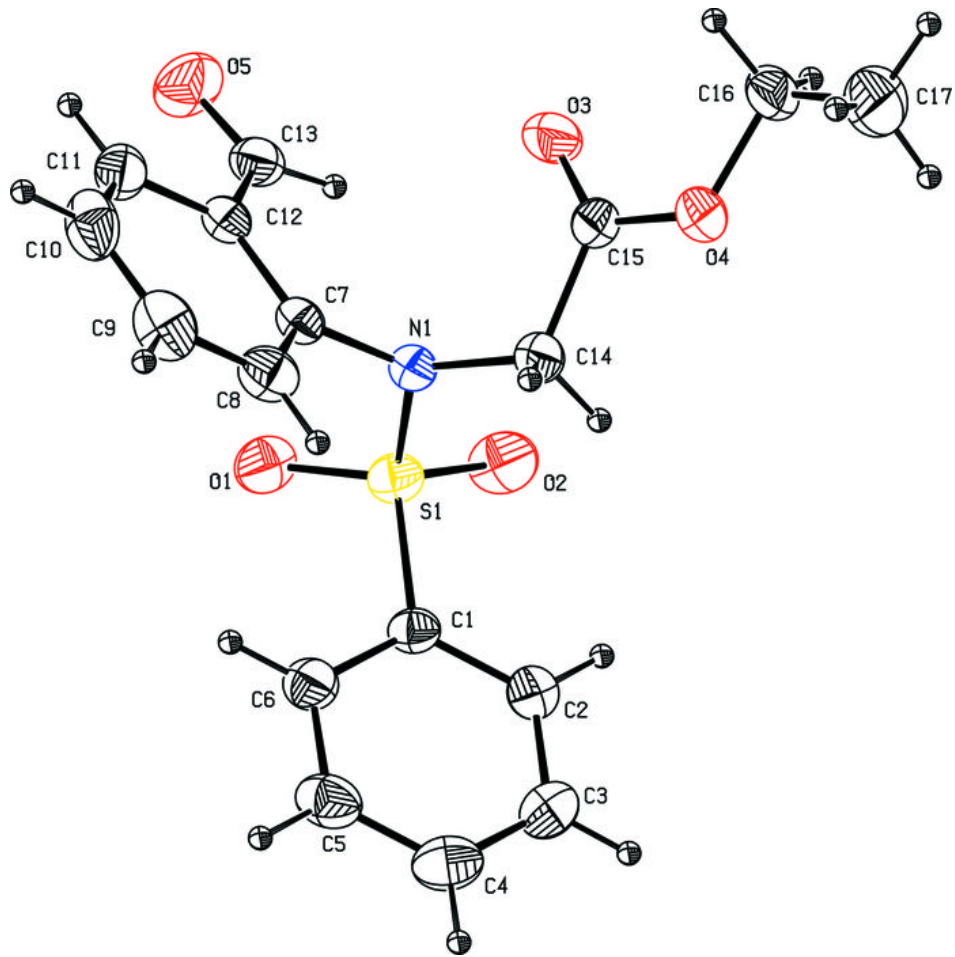


Fig. 2

