

## 2-[4-Acetyl-5-(biphenyl-4-yl)-4,5-dihydro-1,3,4-oxadiazol-2-yl]phenyl acetate

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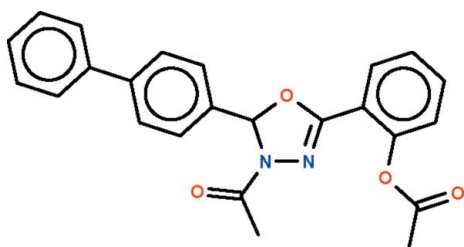
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Key indicators: single-crystal X-ray study;  $T = 293$  K; mean  $\sigma(\text{C}-\text{C}) = 0.004$  Å;  $R$  factor = 0.035;  $wR$  factor = 0.100; data-to-parameter ratio = 7.4.

In the title molecule,  $\text{C}_{24}\text{H}_{20}\text{N}_2\text{O}_4$ , the five-membered oxadiazole ring is nearly planar (r.m.s. deviation = 0.053 Å) and the phenyl ring of the biphenyl unit attached to it forms a dihedral angle of 73.2 (1)°; the other phenyl ring is close to coplanar with the oxadiazole ring [dihedral angle = 6.2 (2)°].

### Related literature

For the crystal structures of other 2,3-dihydro-1,3,4-oxadiazoles, see: Jin *et al.* (2006); Somogyi *et al.* (1992); Song *et al.* (2006); He & Zhu (2008).



### Experimental

#### Crystal data

$\text{C}_{24}\text{H}_{20}\text{N}_2\text{O}_4$	$V = 2005.6(4) \text{ \AA}^3$
$M_r = 400.42$	$Z = 4$
Orthorhombic, $P2_12_12_1$	Mo $K\alpha$ radiation
$a = 8.6750(11) \text{ \AA}$	$\mu = 0.09 \text{ mm}^{-1}$
$b = 12.0279(14) \text{ \AA}$	$T = 293 \text{ K}$
$c = 19.221(2) \text{ \AA}$	$0.30 \times 0.20 \times 0.10 \text{ mm}$

#### Data collection

Bruker SMART APEX diffractometer	2029 independent reflections
16090 measured reflections	1534 reflections with $I > 2\sigma(I)$
	$R_{\text{int}} = 0.056$

#### Refinement

$R[F^2 > 2\sigma(F^2)] = 0.035$	274 parameters
$wR(F^2) = 0.100$	H-atom parameters constrained
$S = 1.00$	$\Delta\rho_{\text{max}} = 0.11 \text{ e \AA}^{-3}$
2029 reflections	$\Delta\rho_{\text{min}} = -0.13 \text{ e \AA}^{-3}$

Data collection: *APEX2* (Bruker, 2009); cell refinement: *SAINT* (Bruker, 2009); data reduction: *SAINT*; program(s) used to solve structure: *SHELXS97* (Sheldrick, 2008); program(s) used to refine structure: *SHELXL97* (Sheldrick, 2008); molecular graphics: *X-SEED* (Barbour, 2001); software used to prepare material for publication: *publCIF* (Westrip, 2010).

We thank the University of Malaya for supporting this study.

Supplementary data and figures for this paper are available from the IUCr electronic archives (Reference: PV2264).

### References

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**supplementary materials**

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## 2-[4-Acetyl-5-(biphenyl-4-yl)-4,5-dihydro-1,3,4-oxadiazol-2-yl]phenyl acetate

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### Comment

The Schiff base reactant, *N'*-(4-phenylbenzylidene)-2-hydroxybenzohydrazide, features an  $-C(=O)-NH-N=CH$  linkage between the two aromatic systems that can be induced to form an oxadiazole. In this study, the oxadiazole is indeed formed when cyclized in acetic anhydride. The nitrogen atom in the 3-position of the ring has also been acetylated; interestingly, the hydroxy group also undergoes acetylation to yield a bis-acetylated product, the title compound. The crystal structure of the title compound is reported in this article (Fig. 1).

### Experimental

The Schiff base, *N'*-(4-phenylbenzylidene)-2-hydroxybenzohydrazide, was synthesized by condensing 4-phenylbenzaldehyde with 2-hydroxybenzhydrazide. The compound (0.5 g, 1.58 mmol) was heated in acetic anhydride (5 ml) for 2 h. The solution was cooled and then poured into crushed ice. The solid that separated solid was collected and recrystallized from methanol to give the title compound as well-formed prisms.

### Refinement

The H-atoms were placed in calculated positions (C—H 0.93–98 Å) and were included in the refinement in the riding model approximation, with  $U_{iso}(H)$  set to 1.2–1.5 $U_{eq}(C)$ . Due to insufficient anomalous dispersion effects, an absolute configuration could not be established. Therefore, 1495 Friedel pairs were merged.

### Figures

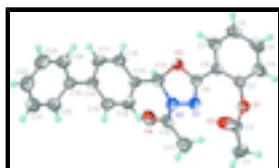


Fig. 1. Thermal ellipsoid plot (Barbour, 2001) of the title compound; ellipsoids are drawn at the 50% probability level and H atoms are of arbitrary radii.

## 2-[4-Acetyl-5-(biphenyl-4-yl)-4,5-dihydro-1,3,4-oxadiazol-2-yl]phenyl acetate

### Crystal data

$C_{24}H_{20}N_2O_4$

$M_r = 400.42$

Orthorhombic,  $P2_12_12_1$

Hall symbol: P 2ac 2ab

$a = 8.6750$  (11) Å

$F(000) = 840$

$D_x = 1.326$  Mg m<sup>-3</sup>

Mo  $K\alpha$  radiation,  $\lambda = 0.71073$  Å

Cell parameters from 2292 reflections

$\theta = 2.6$ – $19.9^\circ$

# supplementary materials

$b = 12.0279$  (14) Å  
 $c = 19.221$  (2) Å  
 $V = 2005.6$  (4) Å<sup>3</sup>  
 $Z = 4$

$\mu = 0.09$  mm<sup>-1</sup>  
 $T = 293$  K  
Prism, colorless  
 $0.30 \times 0.20 \times 0.10$  mm

## Data collection

Bruker SMART APEX  
diffractometer  
Radiation source: fine-focus sealed tube  
graphite  
 $\omega$  scans  
16090 measured reflections  
2029 independent reflections

1534 reflections with  $I > 2\sigma(I)$   
 $R_{\text{int}} = 0.056$   
 $\theta_{\text{max}} = 25.0^\circ$ ,  $\theta_{\text{min}} = 2.0^\circ$   
 $h = -10 \rightarrow 10$   
 $k = -14 \rightarrow 14$   
 $l = -22 \rightarrow 22$

## Refinement

Refinement on  $F^2$   
Least-squares matrix: full  
 $R[F^2 > 2\sigma(F^2)] = 0.035$   
 $wR(F^2) = 0.100$   
 $S = 1.00$   
2029 reflections  
274 parameters  
0 restraints  
Primary atom site location: structure-invariant direct methods

Secondary atom site location: difference Fourier map  
Hydrogen site location: inferred from neighbouring sites  
H-atom parameters constrained  
 $w = 1/[\sigma^2(F_o^2) + (0.0598P)^2 + 0.076P]$   
where  $P = (F_o^2 + 2F_c^2)/3$   
 $(\Delta/\sigma)_{\text{max}} = 0.001$   
 $\Delta\rho_{\text{max}} = 0.11$  e Å<sup>-3</sup>  
 $\Delta\rho_{\text{min}} = -0.13$  e Å<sup>-3</sup>  
Extinction correction: SHELXL97 (Sheldrick, 2008),  
 $F_c^* = kF_c[1 + 0.001x F_c^2 \lambda^3 / \sin(2\theta)]^{-1/4}$   
Extinction coefficient: 0.0082 (18)

## Fractional atomic coordinates and isotropic or equivalent isotropic displacement parameters (Å<sup>2</sup>)

	<i>x</i>	<i>y</i>	<i>z</i>	$U_{\text{iso}}^*/U_{\text{eq}}$
O1	-0.0208 (3)	1.13163 (16)	0.16056 (10)	0.0571 (6)
O2	-0.1684 (3)	1.0247 (2)	0.22783 (14)	0.0894 (9)
O3	0.3885 (2)	0.96800 (17)	0.22120 (10)	0.0540 (5)
O4	0.4949 (3)	1.19201 (19)	0.37185 (12)	0.0706 (7)
N1	0.2135 (3)	1.09315 (19)	0.25521 (13)	0.0513 (6)
N2	0.3385 (3)	1.09851 (19)	0.30133 (13)	0.0537 (7)
C1	-0.1667 (5)	1.2206 (3)	0.2462 (2)	0.0806 (11)
H1A	-0.2221	1.2060	0.2884	0.121*
H1B	-0.2307	1.2627	0.2151	0.121*
H1C	-0.0751	1.2622	0.2566	0.121*
C2	-0.1239 (4)	1.1146 (3)	0.21312 (17)	0.0589 (8)
C3	0.0343 (4)	1.0375 (2)	0.12550 (15)	0.0488 (7)
C4	-0.0388 (4)	1.0074 (3)	0.06492 (16)	0.0618 (9)
H4	-0.1250	1.0465	0.0497	0.074*

C5	0.0166 (5)	0.9191 (3)	0.02688 (17)	0.0693 (10)
H5	-0.0325	0.8978	-0.0140	0.083*
C6	0.1450 (4)	0.8622 (3)	0.04945 (17)	0.0631 (9)
H6	0.1821	0.8024	0.0238	0.076*
C7	0.2189 (4)	0.8933 (2)	0.10977 (15)	0.0534 (8)
H7	0.3055	0.8541	0.1244	0.064*
C8	0.1655 (3)	0.9829 (2)	0.14935 (14)	0.0442 (7)
C9	0.2499 (3)	1.0175 (2)	0.21116 (15)	0.0451 (7)
C10	0.3703 (4)	1.1884 (2)	0.34137 (16)	0.0550 (8)
C11	0.2494 (5)	1.2753 (3)	0.34728 (19)	0.0733 (10)
H11A	0.2971	1.3461	0.3556	0.110*
H11B	0.1818	1.2576	0.3852	0.110*
H11C	0.1913	1.2784	0.3048	0.110*
C12	0.4469 (4)	1.0077 (2)	0.28773 (15)	0.0518 (7)
H12	0.5521	1.0363	0.2827	0.062*
C13	0.4419 (3)	0.9151 (2)	0.34025 (15)	0.0443 (7)
C14	0.3338 (4)	0.9088 (3)	0.39249 (16)	0.0534 (8)
H14	0.2617	0.9654	0.3975	0.064*
C15	0.3307 (4)	0.8198 (3)	0.43733 (16)	0.0562 (8)
H15	0.2570	0.8177	0.4724	0.067*
C16	0.4350 (3)	0.7333 (2)	0.43137 (15)	0.0463 (7)
C17	0.5437 (4)	0.7399 (3)	0.37835 (17)	0.0568 (8)
H17	0.6146	0.6826	0.3728	0.068*
C18	0.5483 (4)	0.8292 (2)	0.33416 (16)	0.0557 (8)
H18	0.6234	0.8325	0.2997	0.067*
C19	0.4308 (3)	0.6360 (2)	0.47964 (15)	0.0486 (7)
C20	0.4008 (4)	0.6501 (3)	0.54999 (17)	0.0651 (9)
H20	0.3819	0.7210	0.5673	0.078*
C21	0.3985 (5)	0.5602 (3)	0.5946 (2)	0.0803 (12)
H21	0.3795	0.5708	0.6418	0.096*
C22	0.4242 (5)	0.4550 (3)	0.5693 (2)	0.0804 (12)
H22	0.4192	0.3942	0.5991	0.096*
C23	0.4573 (5)	0.4395 (3)	0.5002 (2)	0.0758 (11)
H23	0.4778	0.3685	0.4834	0.091*
C24	0.4601 (4)	0.5292 (3)	0.45577 (18)	0.0610 (8)
H24	0.4819	0.5181	0.4089	0.073*

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

	$U^{11}$	$U^{22}$	$U^{33}$	$U^{12}$	$U^{13}$	$U^{23}$
O1	0.0657 (14)	0.0503 (12)	0.0552 (12)	0.0078 (10)	0.0035 (11)	0.0030 (10)
O2	0.103 (2)	0.0775 (17)	0.0877 (18)	-0.0177 (17)	0.0411 (16)	-0.0123 (16)
O3	0.0576 (13)	0.0552 (12)	0.0492 (11)	0.0090 (10)	0.0011 (10)	-0.0022 (10)
O4	0.0828 (18)	0.0671 (15)	0.0619 (14)	-0.0174 (13)	-0.0126 (14)	-0.0039 (12)
N1	0.0569 (16)	0.0432 (14)	0.0538 (15)	-0.0015 (12)	-0.0060 (13)	-0.0069 (13)
N2	0.0579 (16)	0.0417 (13)	0.0614 (15)	0.0022 (12)	-0.0096 (14)	-0.0074 (13)
C1	0.080 (3)	0.080 (3)	0.082 (3)	0.029 (2)	-0.003 (2)	-0.010 (2)
C2	0.0554 (19)	0.067 (2)	0.0539 (19)	0.0090 (17)	0.0042 (17)	-0.0071 (18)

## supplementary materials

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C3	0.0570 (18)	0.0457 (16)	0.0438 (16)	-0.0027 (15)	0.0071 (15)	0.0039 (14)
C4	0.0587 (19)	0.077 (2)	0.0496 (19)	-0.0057 (19)	0.0016 (17)	0.0002 (17)
C5	0.072 (2)	0.088 (3)	0.0487 (19)	-0.020 (2)	0.0041 (18)	-0.0086 (19)
C6	0.074 (2)	0.061 (2)	0.055 (2)	-0.0131 (19)	0.0136 (19)	-0.0187 (17)
C7	0.0576 (19)	0.0507 (18)	0.0518 (18)	-0.0051 (16)	0.0093 (16)	-0.0033 (15)
C8	0.0528 (16)	0.0371 (14)	0.0429 (16)	-0.0075 (13)	0.0058 (14)	0.0042 (13)
C9	0.0511 (16)	0.0368 (15)	0.0474 (17)	0.0009 (13)	0.0030 (14)	0.0021 (14)
C10	0.077 (2)	0.0436 (17)	0.0445 (17)	-0.0122 (17)	-0.0019 (18)	0.0036 (14)
C11	0.101 (3)	0.0514 (19)	0.067 (2)	0.003 (2)	0.000 (2)	-0.0150 (18)
C12	0.0507 (16)	0.0515 (18)	0.0532 (18)	-0.0041 (15)	-0.0030 (15)	-0.0049 (15)
C13	0.0403 (15)	0.0447 (15)	0.0480 (16)	-0.0029 (13)	-0.0015 (14)	-0.0043 (14)
C14	0.0498 (18)	0.0476 (18)	0.063 (2)	0.0096 (15)	0.0021 (16)	0.0006 (16)
C15	0.0501 (17)	0.0585 (19)	0.0600 (19)	0.0033 (16)	0.0147 (16)	0.0026 (17)
C16	0.0420 (16)	0.0461 (16)	0.0507 (17)	-0.0021 (14)	0.0002 (15)	-0.0069 (14)
C17	0.0542 (18)	0.0513 (18)	0.0651 (19)	0.0118 (16)	0.0066 (17)	-0.0032 (16)
C18	0.0538 (18)	0.0588 (18)	0.0546 (18)	0.0054 (16)	0.0115 (16)	0.0020 (16)
C19	0.0398 (16)	0.0527 (18)	0.0534 (18)	0.0000 (14)	-0.0006 (14)	-0.0025 (15)
C20	0.074 (2)	0.061 (2)	0.059 (2)	0.0033 (18)	0.0058 (19)	-0.0022 (18)
C21	0.092 (3)	0.087 (3)	0.062 (2)	0.006 (2)	0.008 (2)	0.012 (2)
C22	0.081 (3)	0.076 (3)	0.085 (3)	0.007 (2)	0.012 (2)	0.030 (2)
C23	0.076 (2)	0.057 (2)	0.094 (3)	0.0040 (19)	0.012 (2)	0.012 (2)
C24	0.062 (2)	0.0540 (19)	0.067 (2)	0.0000 (18)	0.0093 (18)	-0.0013 (17)

### *Geometric parameters (Å, °)*

O1—C2	1.365 (4)	C11—H11B	0.9600
O1—C3	1.401 (3)	C11—H11C	0.9600
O2—C2	1.183 (4)	C12—C13	1.503 (4)
O3—C9	1.356 (4)	C12—H12	0.9800
O3—C12	1.456 (3)	C13—C14	1.376 (4)
O4—C10	1.230 (4)	C13—C18	1.390 (4)
N1—C9	1.283 (3)	C14—C15	1.374 (4)
N1—N2	1.402 (3)	C14—H14	0.9300
N2—C10	1.355 (4)	C15—C16	1.384 (4)
N2—C12	1.465 (4)	C15—H15	0.9300
C1—C2	1.472 (4)	C16—C17	1.391 (4)
C1—H1A	0.9600	C16—C19	1.494 (4)
C1—H1B	0.9600	C17—C18	1.370 (4)
C1—H1C	0.9600	C17—H17	0.9300
C3—C4	1.374 (4)	C18—H18	0.9300
C3—C8	1.392 (4)	C19—C20	1.387 (4)
C4—C5	1.377 (5)	C19—C24	1.387 (4)
C4—H4	0.9300	C20—C21	1.381 (5)
C5—C6	1.377 (5)	C20—H20	0.9300
C5—H5	0.9300	C21—C22	1.374 (5)
C6—C7	1.376 (4)	C21—H21	0.9300
C6—H6	0.9300	C22—C23	1.371 (5)
C7—C8	1.398 (4)	C22—H22	0.9300
C7—H7	0.9300	C23—C24	1.377 (5)

C8—C9	1.456 (4)	C23—H23	0.9300
C10—C11	1.485 (5)	C24—H24	0.9300
C11—H11A	0.9600		
C2—O1—C3	117.3 (2)	H11B—C11—H11C	109.5
C9—O3—C12	106.9 (2)	O3—C12—N2	100.2 (2)
C9—N1—N2	105.1 (2)	O3—C12—C13	109.7 (2)
C10—N2—N1	123.6 (3)	N2—C12—C13	114.4 (2)
C10—N2—C12	124.4 (3)	O3—C12—H12	110.7
N1—N2—C12	110.4 (2)	N2—C12—H12	110.7
C2—C1—H1A	109.5	C13—C12—H12	110.7
C2—C1—H1B	109.5	C14—C13—C18	118.2 (3)
H1A—C1—H1B	109.5	C14—C13—C12	123.4 (3)
C2—C1—H1C	109.5	C18—C13—C12	118.3 (3)
H1A—C1—H1C	109.5	C15—C14—C13	120.9 (3)
H1B—C1—H1C	109.5	C15—C14—H14	119.5
O2—C2—O1	121.9 (3)	C13—C14—H14	119.5
O2—C2—C1	127.3 (3)	C14—C15—C16	121.4 (3)
O1—C2—C1	110.8 (3)	C14—C15—H15	119.3
C4—C3—C8	122.1 (3)	C16—C15—H15	119.3
C4—C3—O1	117.6 (3)	C15—C16—C17	117.4 (3)
C8—C3—O1	120.1 (3)	C15—C16—C19	121.5 (3)
C3—C4—C5	119.5 (3)	C17—C16—C19	121.1 (3)
C3—C4—H4	120.3	C18—C17—C16	121.3 (3)
C5—C4—H4	120.3	C18—C17—H17	119.4
C4—C5—C6	119.9 (3)	C16—C17—H17	119.4
C4—C5—H5	120.1	C17—C18—C13	120.7 (3)
C6—C5—H5	120.1	C17—C18—H18	119.6
C7—C6—C5	120.5 (3)	C13—C18—H18	119.6
C7—C6—H6	119.8	C20—C19—C24	118.0 (3)
C5—C6—H6	119.8	C20—C19—C16	120.9 (3)
C6—C7—C8	120.9 (3)	C24—C19—C16	121.0 (3)
C6—C7—H7	119.6	C21—C20—C19	120.8 (3)
C8—C7—H7	119.6	C21—C20—H20	119.6
C3—C8—C7	117.1 (3)	C19—C20—H20	119.6
C3—C8—C9	123.0 (3)	C22—C21—C20	119.9 (3)
C7—C8—C9	119.9 (3)	C22—C21—H21	120.1
N1—C9—O3	115.8 (3)	C20—C21—H21	120.1
N1—C9—C8	128.2 (3)	C23—C22—C21	120.2 (3)
O3—C9—C8	115.9 (2)	C23—C22—H22	119.9
O4—C10—N2	118.5 (3)	C21—C22—H22	119.9
O4—C10—C11	124.0 (3)	C22—C23—C24	119.8 (3)
N2—C10—C11	117.5 (3)	C22—C23—H23	120.1
C10—C11—H11A	109.5	C24—C23—H23	120.1
C10—C11—H11B	109.5	C23—C24—C19	121.1 (3)
H11A—C11—H11B	109.5	C23—C24—H24	119.4
C10—C11—H11C	109.5	C19—C24—H24	119.4
H11A—C11—H11C	109.5		
C9—N1—N2—C10	158.3 (3)	C10—N2—C12—O3	-154.2 (3)

## supplementary materials

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C9—N1—N2—C12	-8.2 (3)	N1—N2—C12—O3	12.1 (3)
C3—O1—C2—O2	-1.7 (4)	C10—N2—C12—C13	88.5 (3)
C3—O1—C2—C1	178.1 (3)	N1—N2—C12—C13	-105.2 (3)
C2—O1—C3—C4	95.3 (3)	O3—C12—C13—C14	-104.7 (3)
C2—O1—C3—C8	-89.4 (3)	N2—C12—C13—C14	7.0 (4)
C8—C3—C4—C5	1.4 (5)	O3—C12—C13—C18	72.7 (3)
O1—C3—C4—C5	176.6 (3)	N2—C12—C13—C18	-175.6 (3)
C3—C4—C5—C6	-0.5 (5)	C18—C13—C14—C15	-0.1 (4)
C4—C5—C6—C7	-0.2 (5)	C12—C13—C14—C15	177.3 (3)
C5—C6—C7—C8	0.0 (5)	C13—C14—C15—C16	-0.5 (5)
C4—C3—C8—C7	-1.6 (4)	C14—C15—C16—C17	0.3 (4)
O1—C3—C8—C7	-176.6 (2)	C14—C15—C16—C19	-179.4 (3)
C4—C3—C8—C9	176.3 (3)	C15—C16—C17—C18	0.6 (4)
O1—C3—C8—C9	1.3 (4)	C19—C16—C17—C18	-179.7 (3)
C6—C7—C8—C3	0.9 (4)	C16—C17—C18—C13	-1.3 (5)
C6—C7—C8—C9	-177.1 (3)	C14—C13—C18—C17	1.0 (4)
N2—N1—C9—O3	0.1 (3)	C12—C13—C18—C17	-176.5 (3)
N2—N1—C9—C8	-175.7 (3)	C15—C16—C19—C20	-39.6 (4)
C12—O3—C9—N1	7.9 (3)	C17—C16—C19—C20	140.8 (3)
C12—O3—C9—C8	-175.8 (2)	C15—C16—C19—C24	141.8 (3)
C3—C8—C9—N1	6.3 (4)	C17—C16—C19—C24	-37.8 (4)
C7—C8—C9—N1	-175.9 (3)	C24—C19—C20—C21	-0.7 (5)
C3—C8—C9—O3	-169.5 (2)	C16—C19—C20—C21	-179.3 (3)
C7—C8—C9—O3	8.3 (4)	C19—C20—C21—C22	-0.8 (6)
N1—N2—C10—O4	-168.8 (3)	C20—C21—C22—C23	2.2 (7)
C12—N2—C10—O4	-4.3 (4)	C21—C22—C23—C24	-2.0 (6)
N1—N2—C10—C11	12.9 (4)	C22—C23—C24—C19	0.4 (6)
C12—N2—C10—C11	177.4 (3)	C20—C19—C24—C23	0.9 (5)
C9—O3—C12—N2	-11.5 (3)	C16—C19—C24—C23	179.6 (3)
C9—O3—C12—C13	109.3 (3)		



Fig. 1

