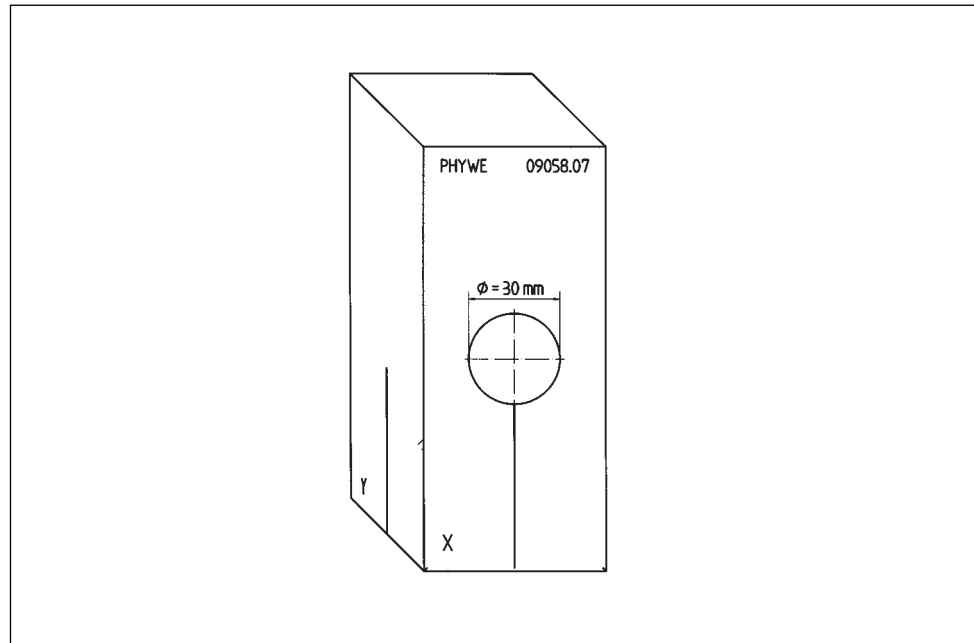Operating Instructions

Fig. 1

1 PURPOSE AND DESCRIPTION

This model implant (see Fig. 1) is for use with the Phywe basic X-ray unit 09058.99. It allows a determination not only of the length but also of the spatial position of a metal pin which is enclosed in the upper region of the block of wood and is not visible from the outside. The metal pin has a length of $l = 60.0$ mm. A metal disk of 30.0 mm diameter, which is inserted flush in the x, z surface, and is symmetrical to the longitudinal axis of the model, serves as the comparison object. The base edges of the block are marked with x or y.

2 HANDLING

Two X-ray photographs must be taken to determine the length and position of the metal pin implant. The first of these is to show the circular comparison object full face against the direction of the radiation, i.e. with the x axis of the block parallel to the plane film surface. The second photograph is to be taken with the implant model turned through 90°, to show the comparison object turned sideways to the direction of the radiation, i.e with the y axis parallel to the plane film surface.

Fit a sheet of X-ray or polaroid film in a film holder (09058.08), with the holder in the middle position. Place the film holder in the experimenting area so that the magnetic foil on the front of the holder is positioned at, and plane with, the fluorescent screen inner wall, and the centre of the film holder corresponds roughly with the radiation axis. Now place the block of wood immediately in front of the film. The distance between the front edge of the block of wood and the radiation outlet should be approx. 28 cm. Do not use any radiation restricting diaphragm!

When, for example, a tube with copper anode is used as the source of X-rays, the exposure time should be 1 minute, the anode voltage $U_A = 35$ kV and the anode current $i_A = 1$ mA. In the case of overexposure or underexposure, either reduce the anode current or increase the exposure time.
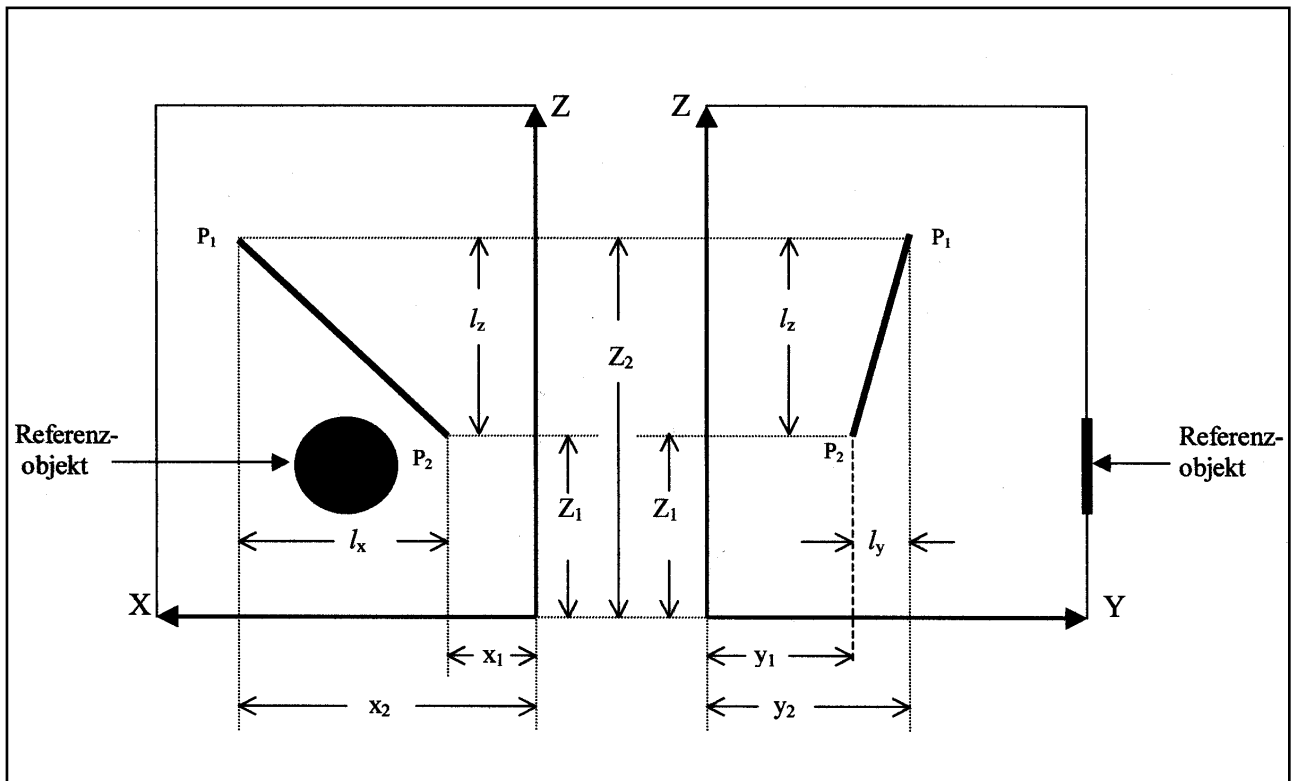
Fig. 2

3 CALCULATION OF THE LENGTH AND POSITION OF THE METAL PIN

Fig. 2 is a diagramatic representation of the projection of the metal pin in the x, z plane (on the left) and in the y, z plane (on the right). The end points of the pin, which is lying in an oblique position, are given by the coordinates $P_1(x_1,y_1,z_1)$ and $P_2(x_2,y_2,z_2)$.

l is given by:

$$l = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$$
$$= \sqrt{l_x^2 + l_y^2 + l_z^2}$$

The actual length of the pin l^* is given by $l^* = l/V$, where V is the average magnification factor and is given by $V = d/d^*$ (where d = the pictured diameter of the reference object, and d^* = the actual diameter of the reference object).
To determine the angular position of the metal pin in relation to the positive axes of the coordinate system, we must consider a straight line through the origin which runs parallel to the metal pin, and for which the following relationships are given for the directional cosines:

$$\cos \alpha = l_x/l, \qquad \cos \beta = l_y/l, \qquad \cos \gamma = l_z/l,$$

We recommend that the pictures of the metal pin and the reference object be carefully copied onto transparent paper for the determination of the lengths of the appropriate lines.

4 RECOMMENDED ACCESSORIES

Film holder	09058.08
Polaroid film (ISO 3000), (9 x 12) cm, 20 sheets	09058.20
Polaroid adapter	09058.21
or	
X-ray film (90 x 120) mm, 10 sheets	06696.03
X-ray film developer for 4.5 l	06696.20
X-ray film fixing for 4.5 l	06696.30