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The Van Hemel Premature INCUBATOR

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THE VAN HEMEL PREMATURE INCUBATOR

Since 1968, created in Uganda out of need, there are more than 750 specially adapted incubators, now known as Van Hemel Incubator, in almost all developing countries, the majority of which are in the African continent. About 25 new incubators are delivered each year. You may wonder whether such an incubator - it costs about 700 guilders as a kit - is necessary in the perinatology of developing countries. This depends on the level of the local medical care. If ever possible in the unstable phase, all conditions should be created to take care of the newborn child with a short duration of pregnancy, whether it is combined with a too low birth weight and/or a too low Apgar score or not. This applies also for the emotional side. This care is the objective in perinatal intensive care centres in rich countries. The question is: which aspects of intensive care can be realized with simple means.

Temperature regulation

The regular rectal temperature measurement with a thermometer suitable for the newborn (electronic or mercury with a low temperature range) may deliver alarming low values. This occurs also close after birth.

The weight at birth does not reveal everything, temperature regulation gives better information about cerebral maturity. The premature brain cannot provide adequate temperature regulation. The complex cerebral process of measuring too high heat emission out of the skin and the adequate response by stopping water loss and increasing skin insulation and finally stopping the circulation in the limbs, does not manifest itself sufficiently. Even if the child tries to generate internal heat using its own energy as

much as possible, it cools down gradually to temperatures around 30 degree or even less. Internal acidity develops and the child dies a toxic death. By simply providing external heat, the child can be kept at normal body temperature.

Observation

Depending on the level of medical care, the unstable premature newborn should be observed naked. Behaviour, colour and type of breathing can give information about the illness of the child. This is imperative in the unstable phase. Dosed oxygen supply, antibiotics and gastric tube feeding are possible in most cases. Temperature regulation is above all required for maximal observation by naked nursing. Two-thirds of the optimal temperature of the child is obtained through radiation heat of the walls, not through air heat. Perspex on all sides of the professional incubator causes a serious loss through radiation. Four out of six sides of the adapted incubator are made of insulating wood.

Humidifying

Heating the air from 20 degree room temperature to 35 degree in the incubator causes a low degree of humidity with values less than 20% relative humidity. This causes dehydration in the entire respiratory tract. The humidity in the air should certainly be kept above 60%. Additionally, the heat conducting capacity of humid air is considerably better, the fact which promotes heat transfer. On top of this: humid air prevents also water loss by the child. The hygrometer is delivered standard with the kit.

Infection

Cross-infection forms an additional danger for the premature child with poor developed immune system. Therefore the air supply should contain less bacteries than room air. In industrial incubators this is achieved through a bacterial filter at the air inlet of the suction motor. The heated air is almost always re-used in this type of incubator. Because the Van Hemel incubators do not have a motor (see below) no bacterial filter is applied, but the air is not re-used also. Huysman-Evers (hospital: Onze Lieve Vrouwe Gasthuis, Amsterdam, 1973) has tested the Van Hemel incubator in the dispersion laboratory with three species of bacteries (staphylococcus aureus, pseudomonas, sarcinella). A very well-known professional incubator was installed for control purposes. The growth of colonies in the Petri dishes put in the Van Hemel incubator turned out to be significantly lower. This is probably the result of the lack of air recycling, short pasteurization, dehumidification and the subsequent humidification of the air.

Mother and child

The disadvantage of nursing newborns in incubators is the lack of body contact with the mother. So, as early as the condition of the child permits, the methodology of the Kangaroo method should be applied

(De Leeuw 1987). It is to be preceded by offering sufficient occasions for contact for the mother. This is imperative in developing countries. The armholes of the Van Hemel incubator do not have flaps but have sleeves to allow umlimited contact with the child. The sleeves decrease heat loss by preventing draughts. The mother herself is quite capable to feed by gastric tube with diluted mother's milk following example instructions.

In professional incubators the newborn is continuously exposed to sound of the electromotor. The Van Hemel incubator does not use any motor.

Feasibility

The local feasibility is much more important than the above mentioned conditions. The Van Hemel incubator is kept as simple as possible.

In mid-1988 an inspection was made of 20 hospitals in Uganda and Kenya. The inspection revealed that surprisingly many incubators of more than 15 years of service were still functioning, even in hospitals where no maintenance whatsoever was applied.

900 to 950 grams was repeatedly mentioned as the lowest weight at birth for children which were saved. The growth curves we made in 1968 for six small prematures in Uganda showed the same weight. In these curves, the growth speed is compared with six small incubator children from Amsterdam. In the first 14 days, the weight drop is congruent with the children from Amsterdam. (figure A)

In 1983 Tannemaat and Gruntjes in cooperation with Study Group Development Techniques of Twente University and the Teacher Training College of Nijmegen, wrote a study of 90 pages about the Van Hemel incubator and specified a list of physical properties to which an incubator should satisfy. The criteria were adopted from those which were specified by prof. Okken from Groningen and prof. Sauer from the Sophia children hospital of Rotterdam, both perinatologists. No big modifications were advised except some energy saving recommendations.

Incubator kit heated by warm water or electricity

The popularity gained practice of the incubator resulted in the need to use the adapted incubator also in hospitals which do not dispose of electricity for 24 hours a day. 2 litres of paraffin per day are needed to warm the incubator, including humidification, in a room from 21 degree to 34 degree. The stove and the well-insulated kettle is outside of the incubator room and is connected to the incubator inside with hoses (figure B). The same incubator kit is used, but the price is more than twice as much because of the additional elements. The total weight is 135 kg. including the packing. 2 litre of paraffin a day may be too much for the local cost pattern.

The incubator consumes 150 Watt per hour without additional insulation, which is included. The warm water kettle is provided with additional connections for the possible connection of warm water solar collectors. Other methods to acquire the needed energy are being studied, for example through solar cells and/or running the generator for a few hours a day to warm the incubator with accumulators and lamps.

Conclusion

Depending on the level of medical care, an incubator-like instrument with good possibilities of observation and local feasibility is indispensable for the perinatology of developing countries.

Dr. Oscar Van Hemel, gynaecologist Delft, ex-Uganda.

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THE VAN HEMEL PREMATURE INCUBATOR

Ordering information

As a non profit product the **Van Hemel incubator** is available as a construction kit, for 695 Dutch Guilders (in stock, off Amsterdam International Airport, Schiphol, 35 kilogramms).

The **warm water heating unit** is ready for use, including kettle, paraffin heater, connecting tubes and extra insulation. The incubator kit (ready for electricity) and the warm water heating unit are packed together in a wooden case, seized 95 x 61 width x 80 heigh, total weight 135 kilogramms. These combination cost 1500 Dutch Guilders, off Delft, on order only, not in stock, delivering time 6-12 weeks.

To be ordered from:

VAN HEMEL PREMATURE INCUBATOR
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E-mail: hemel.incubator@net.HCC.nl
Reinier de Graaf Teaching Hospital Dr. Van Hemel, NL 2625 AD, DELFT, The Netherlands.

THE VAN HEMEL PREMATURE INCUBATOR

Operation of the Van Hemel incubator

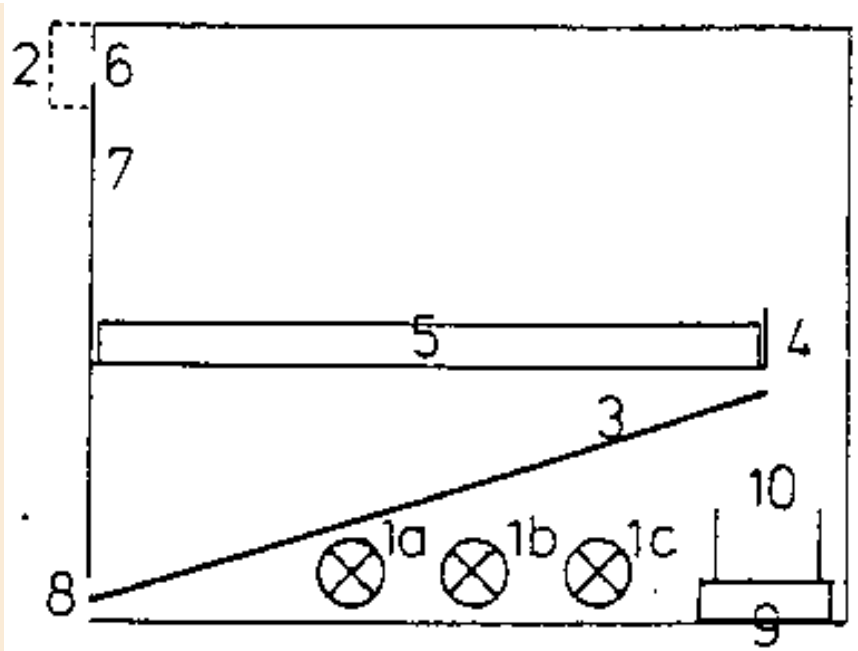
The incubator is heated by the lamps 1a, 1b and 1c, which are switched on and off by a thermostat (2). Refer to figure 1 and 2 for the numbers.

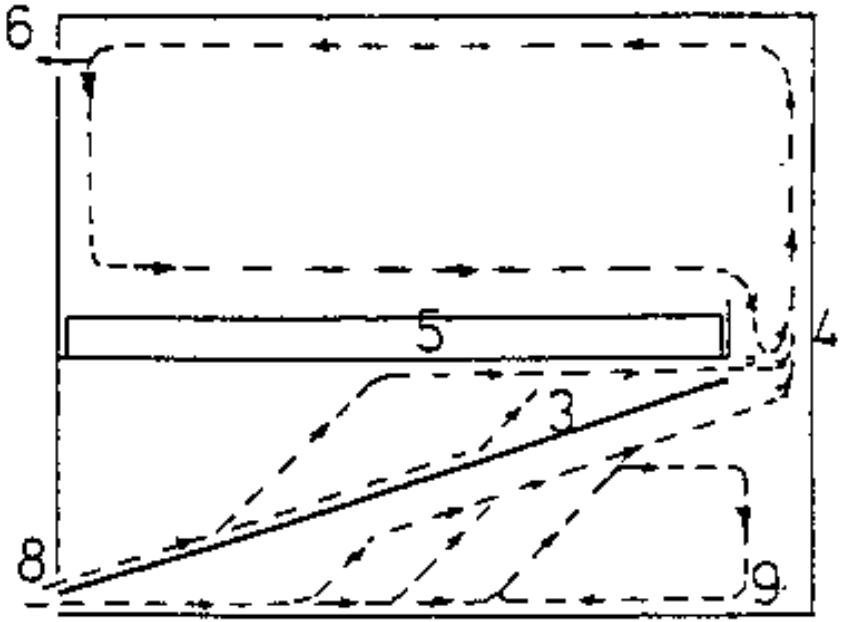
The air heated by the lamps (1a, 1b and 1c) rises along a tilted isolating baffle (3) and passes through the opening (4) to the upper compartment where the newborn lies on a by towels covered board (5). Part of the heated air escapes through the holes (6), the other part cools down and drops along the left wall (7). These air moves to the right wall and is mixed with fresh heated air at (4). Through opening (8) fresh air is sucked into the lower compartment. The air is humidified by a bowl of water (9) where strips of textile are suspended. The heated air passes by the textile (10) (see figure 1), absorbs humidity and cools down immediately. Then the humid air is sucked in the opening (4).

Because the isolating baffle (3) is also heated by the lamps (1a, 1b and 1c), the air above the plate is also heated and rises. This air goes through opening (4) with the heated air to the upper compartment.

Figure 1: Cross section of the incubator with the number indication of the elements (see text).

Figure 2: Cross section of the incubator with internal air circulation.


2
6
7
5
4
3
10
1a
1b
1c
8
9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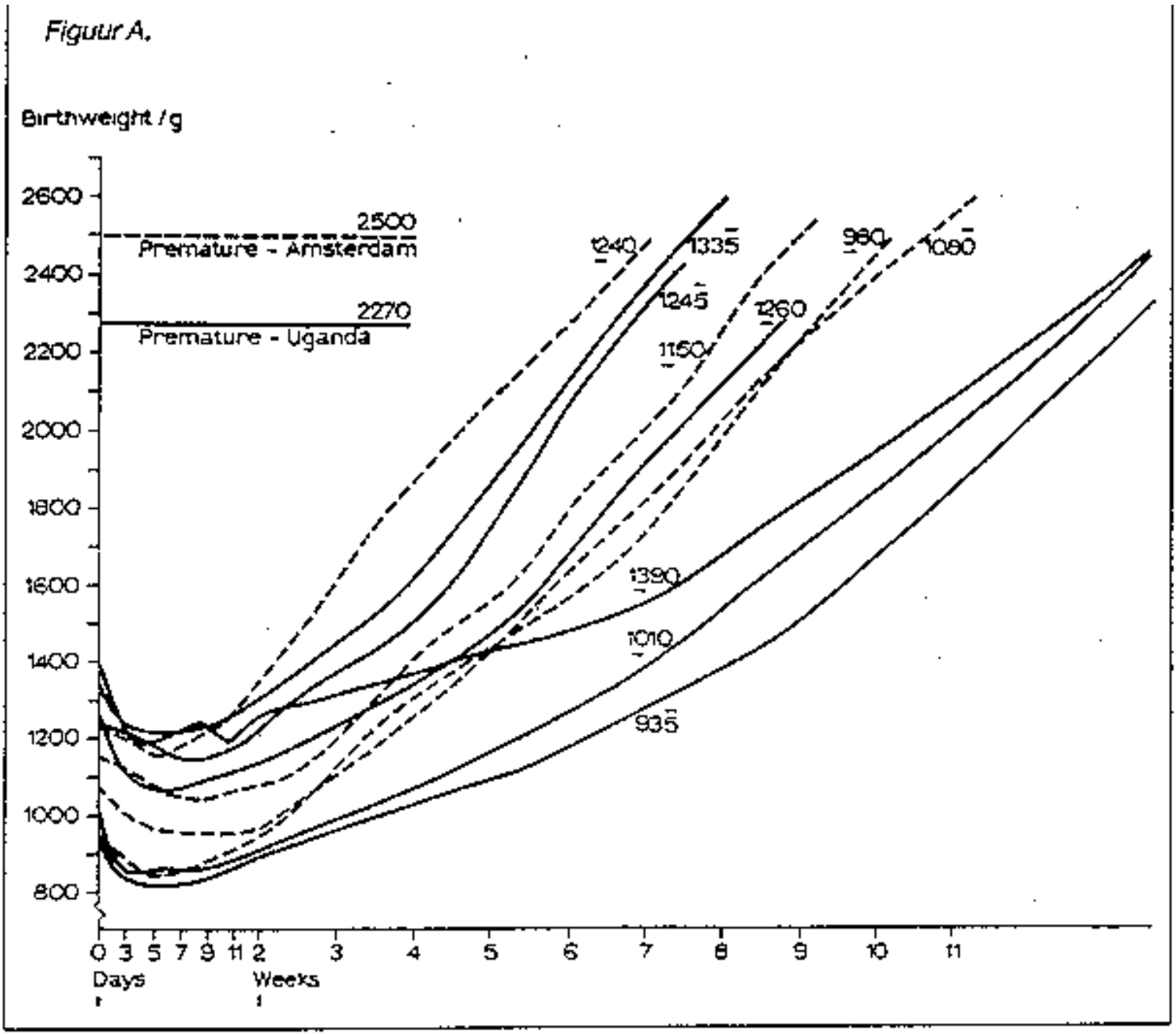
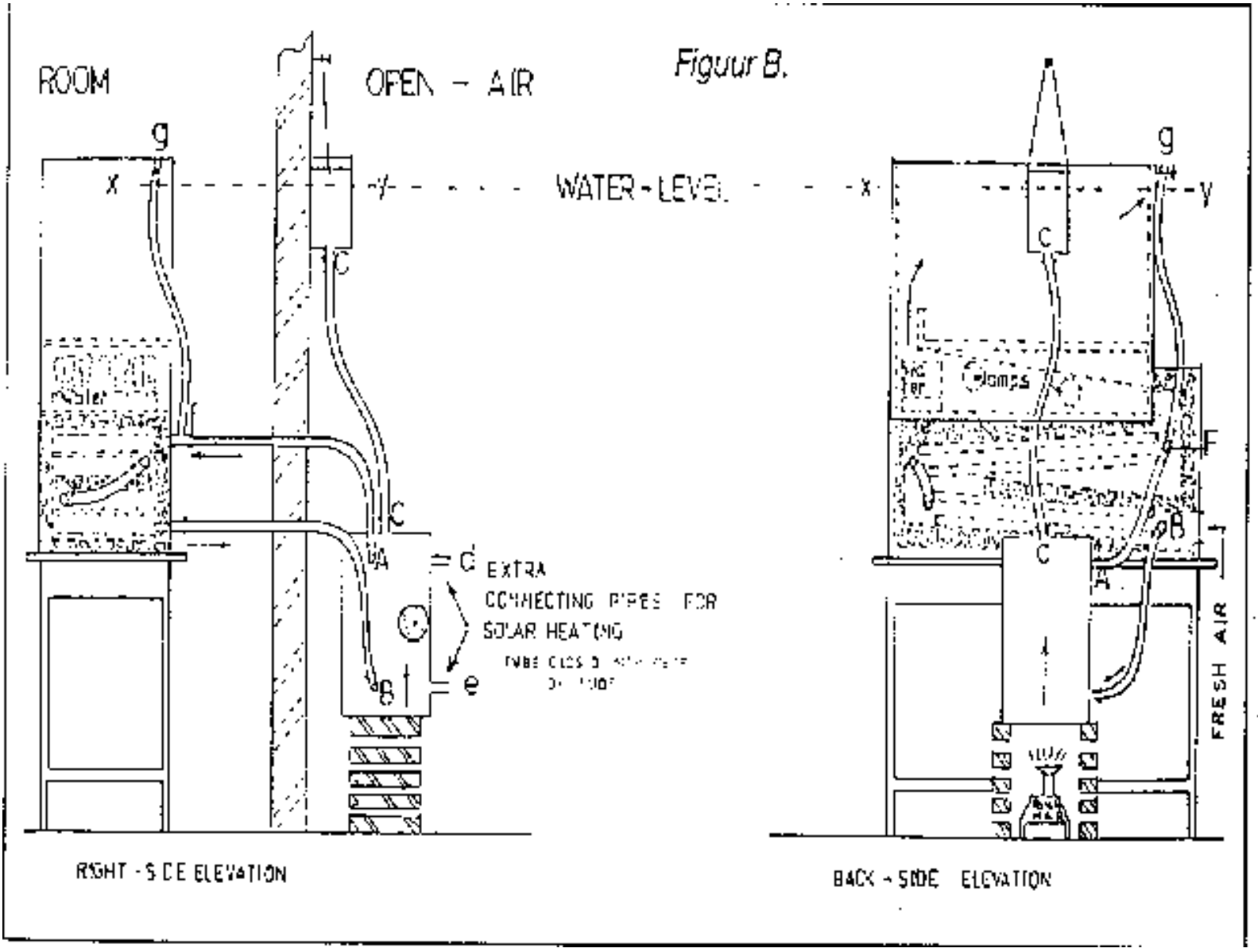

Figuur A.
Birthweight / g
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
2500
Premature - Amsterdam
2270
Premature - Uganda
1240
1335
1245
1260
1160
960
1090
1390
1010
935
0 3 5 7 9 11 2 3 4 5 6 7 8 9 10 11
Days
Weeks

Figuur B.


ROOM
OPEN - AIR
WATER-LEVEL
g
x
C
A
B
c
EXTRA
CONNECTING PIPES FOR
SOLAR HEATING
e
lamps
FRESH AIR
RIGHT - SIDE ELEVATION
BACK - SIDE ELEVATION

[Picture 1]
[Picture 2]