СООБЩЕНИЯ
ОБЪЕДИНЕННОГО
ИНСТИТУТА
ЯДЕРНЫХ
ИССЛЕДОВАНИЙ

Дубна

95-254

E13-95-254
ATLAS Internal Note
TILE-CAL-NO-52

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ATLAS BARREL HADRON CALORIMETER: MODULE ASSEMBLY AND TOOLING DESIGN DESCRIPTION

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1995

Tooling design description for module assembly

Tooling for module assembly consists of the base, face brackets and horizontal platforms (Fig.'s 1, 2, 3).

The base (Fig. 4) is welded using I-beams 240 mm in height, two structural channels 140 mm in height and stiffening ribs 6 mm thick, and support plates 20 mm thick. After welding, the base has to be annealed to remove the internal stresses. The bottom and top supporting surfaces of the plates are milled. The center top support plates have 27 mm diameter holes used to attach to the girder when the module is assembled. The outer top support plates have 18 mm diameter holes with which to fix the face brackets.

The face brackets (Fig. 5) are welded from 10 to 30 mm thick plates and after that they have to be annealed.

The datum surfaces of the brackets are machined. The allowed nonperpendicularity of these surfaces is 0.12 mm.

The left face bracket (Fig. 1 and 2) is installed against the girder. The right face bracket is installed with 40 mm clearance. This positioning of the bracket is suitable for installing the final, 19-th, submodule. The right face bracket (Fig. 5) uses M12 bolts (two bolts are on the top and two on the bottom) for adjusting the submodule along Z-axis.

Left and right face brackets have 22 holes in the middle of vertical wall to allow the possibility for inserting 6 mm diameter studs (tubes) into the module without moving the brackets.

The horizontal platforms P_1, P_2 are attached to the side surfaces of the brackets. These platforms are welded using structural channels 120 mm in height. The surfaces of these platforms are covered with checkered steel plates. These platform edges have brackets for attaching to the face brackets.

The platforms are supported at their center with columns. The platform supports have special bolts (Fig. 6) for adjusting the ϕ-angle of the submodule's position. The position of these bolts (Fig. 2) is adjacent to the center of each submodule.

The platforms are used as supporting area by the assembly personnel.

Annealing of these platforms after welding is not required.

The weight of tooling is about 3 tons.

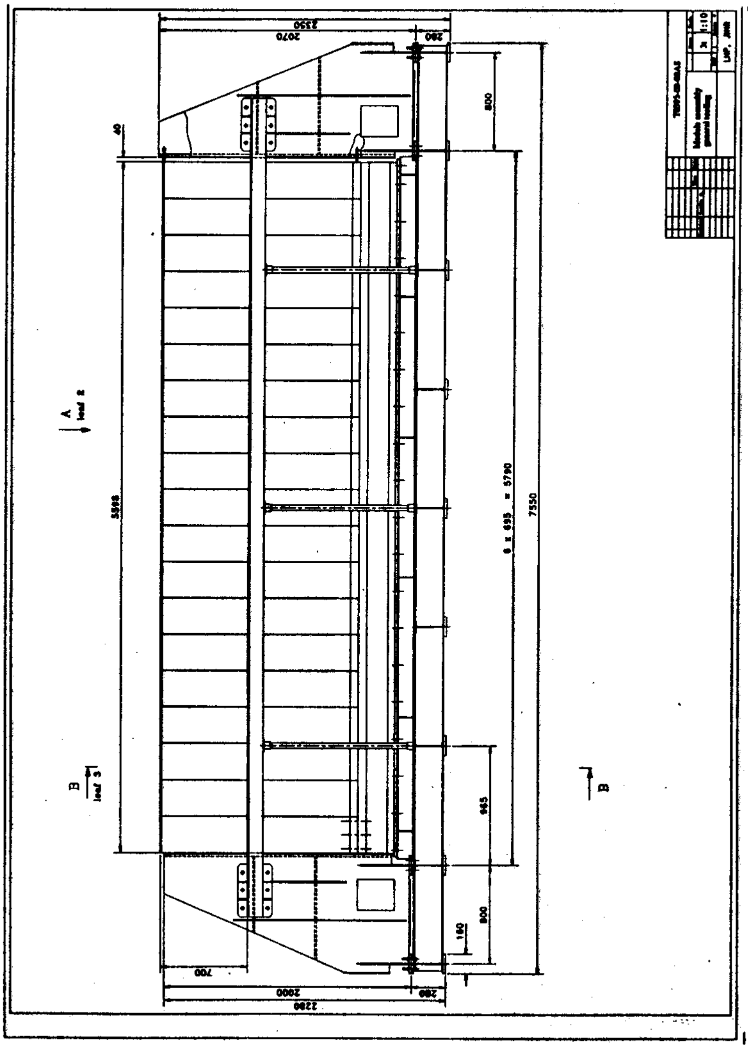
2350
2070
280
800
40
6 x 695 = 5790
7550
965
180
700
2000
2280
A
B
1:10

Figure 1

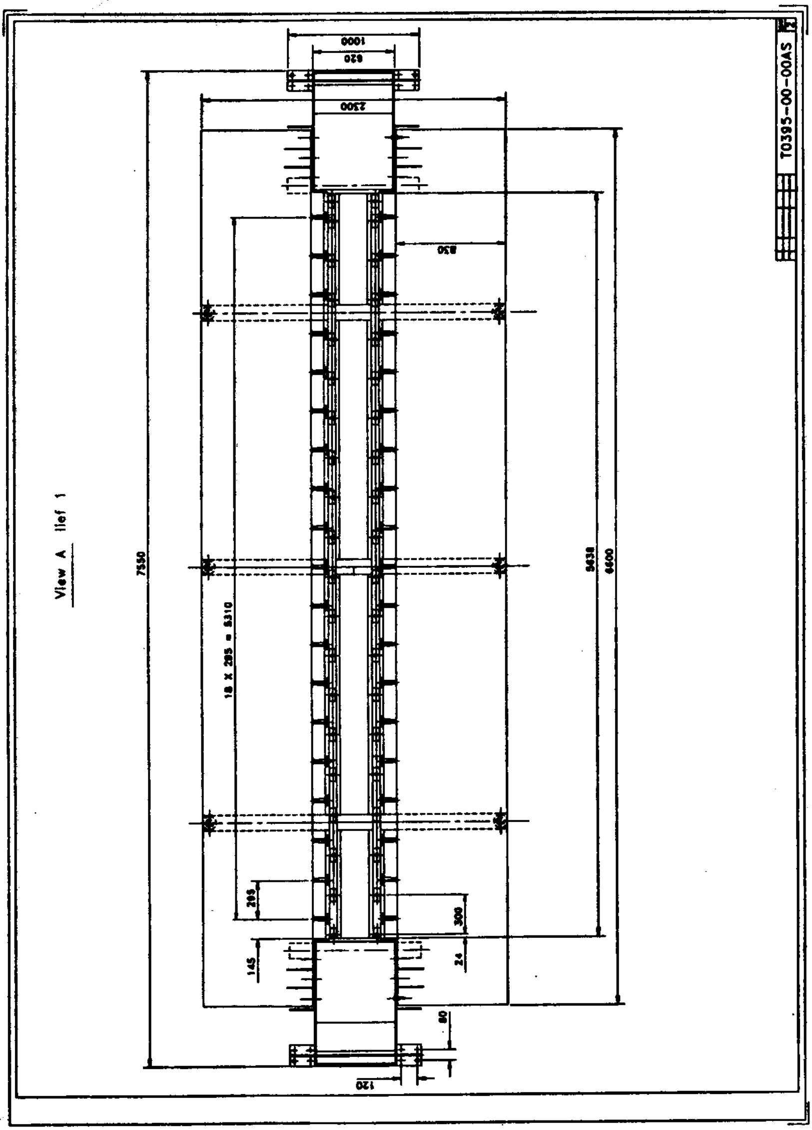
View A llef 1
7550
18 X 295 = 5310
5638
6400
2300
1000
620
850
295
300
145
24
80
120
T0395-00-00AS

Figure 2

Module assembly technology

In Dubna the module assembly is carried out in a building equiped with a bridge crane of 30t and 100t load-carrying capacity. Assembly site is $8 \times 10\ m^2$ in area.

An area beside the module assembly will also be used for temporary storage of submodules (before module assembly) and of assembled modules.

The assembly tooling (Fig.'s 1, 2, 3) is positioned on a steel floor and will be used for the module assembly. The assembly tooling consists of the base, two face brackets, and two platforms (Fig.'s 1, 2, 3).

The girder will be positioned on the assembly tooling base and connected using M24 bolts. The top surface of the girder is leveled horizontally to $\pm$ 0.5 mm precision on the 5638 mm length and to $\pm$ 0.1 mm precision in the transverse direction. The face brackets will be mounted on the assembly tooling base (Fig. 1). They are located perpendicular to the top surface of the girder's projection by using a precision square.

The left face bracket is mounted against the left end of the girder. The right face bracket is mounted 40 mm away from the right end of the girder. The first submodule is mounted on the girder against the left face bracket. The submodule vertical position relative to the vertical plane is checked with a level gauge. For this operation a special plate is inserted in the 125 mm wide small end key way. The upper end of the control rule is placed against the edge of the special plate. The bottom of the rule rests against the edge of the 181 mm wide girder projection.

On this control ruler the level gauge is placed and with its help the vertical axis is controlled.

The submodule is joined to the girder using six M20 bolts. After the bolts were tighthened the submodule's vertical position is again checked.

If it is necessary to adjust the module vertical position shims will be inserted between the girder and the submodule bar.

After first submodule is installed the next 16 submodules are mounted in the same way.

The bolts which connect these submodules to the girder are inserted but are not tighthened. Since every submodule has the length tolerance of $^{+0.00}_{-0.25}$ mm the maximum gap between adjoining modules will be no more than $0.25 \times 2 = 0.5$ mm and the sum of all gaps between modules will be no more than

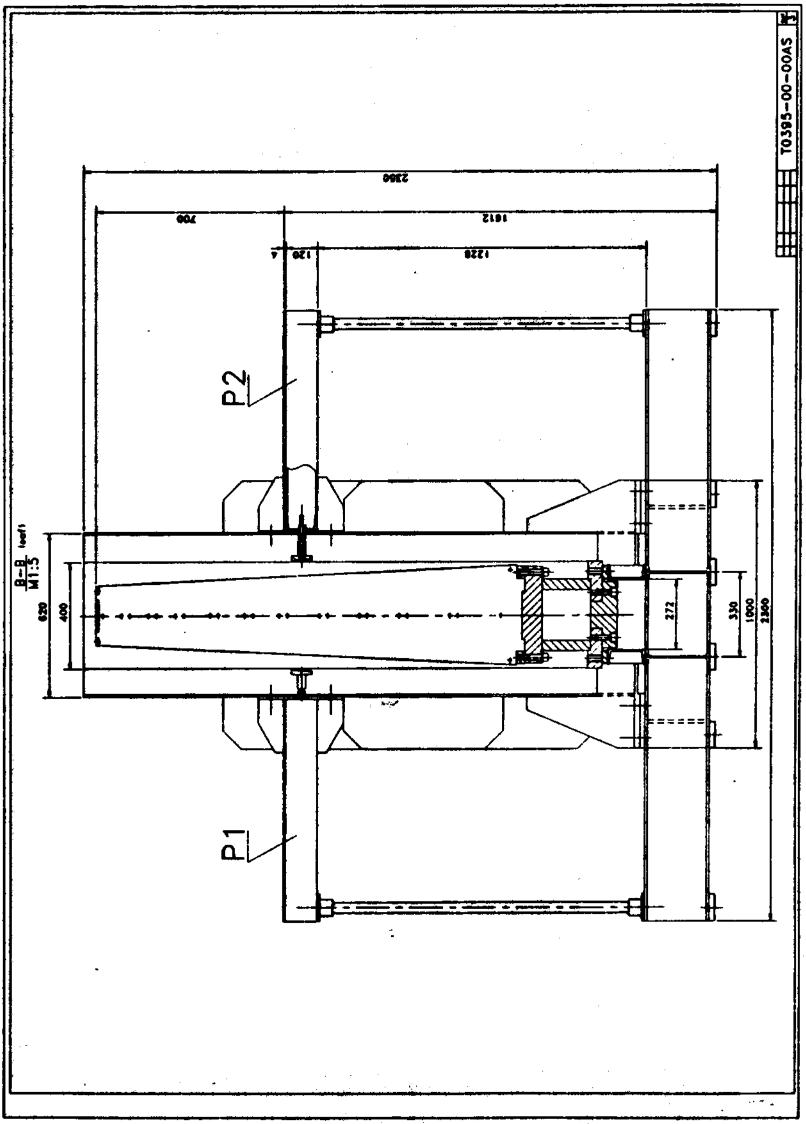

Figure 3

$0.25 \times 19 = 5$ mm. Now the 18th submodule is mounted in the same way as the first one. All the bolts are tighthened and the 18th submodule vertical position is checked using the level gauge. If necessary the adjusting shims will be inserted. After this the 19th submodule is mounted. The bolts which fix this submodule to the girder are not tighthened. The two platforms of the assembly tooling are then installed. The key way straightness of the module small end is then checked. The reference surfaces for checking are the two lateral surfaces of the key ways of the first and of the eighteenth submodules.

The vertical position of the submodules can be corrected by using adjusting bolts on the platform suppotrt.

The module's length at the small end is checked. The difference between this length and girder's length can be no more than $\pm$ 0.5 mm. The plate with 10×125 mm^2 cross-section and 5660 mm length is inserted in the key way. In the module's left end this strip projects from the first submodule by 20 mm to accommodate the end-plate.

After the end plate is mounted all bolts, which fix the submodules to the girder are tighthened. The straightness of the ϕ surfaces module, which is formed by master plates, at the small end is checked. The tolerance on the module surface straightnees is 0.4 mm. This tolerance can be achieved by using of the correcting shims between the submodules and the girder if necessary. The tubes and 6 mm diameter, 5650 mm long studs are then inserted in the module. After that the inner radius plate is welded to the first submodule. To prevent the plate deformation in the horizontal plane the welding is done alternately on opposite sides with weld length of no more than 50 mm. When the plate is welded to the first submodule, it must be cooled to the room temperature. Then welding has to be executed with every other submodule at the same way.

After welding is finished on the whole plate length, the straightness of the upper module has to be checked again. The straightness can be corrected by means of additional welding if necessary.

Then the platforms and face brackets are taken off the base of the assembly tooling. The end plates are attached to the module by means of welding to the plate at the small end and by the bolts and pins to the girder at the bottom.

At the right end of the module the plate is cut flush with the end plate.

The bolts, which connect the girder and the base of the assembly tooling are removed.

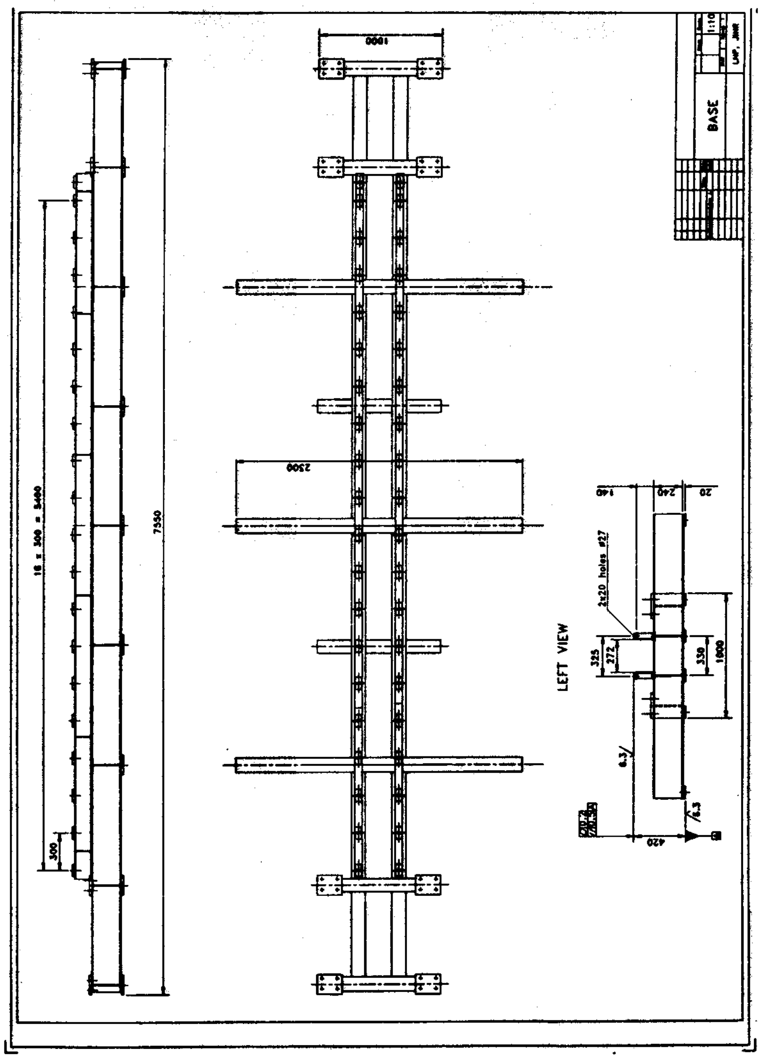
BASE
1:10
LEFT VIEW
7550
16 x 300 = 5400
300
1800
2500
2x20 holes ø27
325
272
330
1800
140
240
20
420
6.3

Figure 4

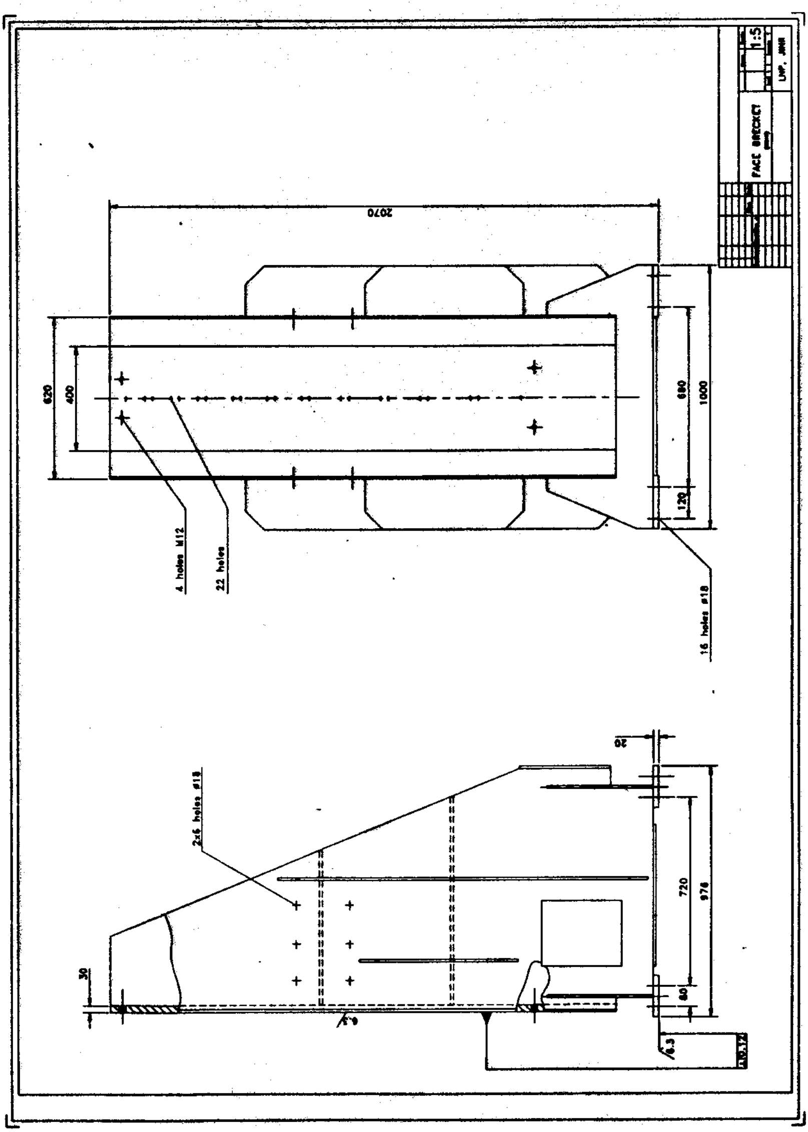
2070
620
400
4 holes M12
22 holes
680
1000
120
2x6 holes ø18
720
976
80
30
20
1:5

Figure 5

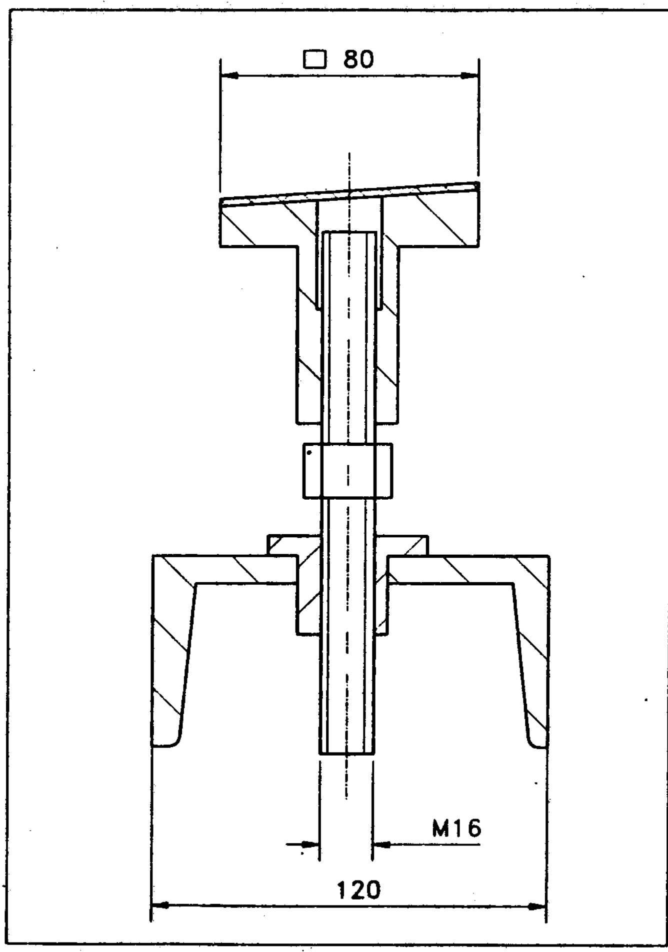

Figure 6

Module inspection is then executed: geometric dimensions and weld quality are checked. Then the plate and small end of module is painted for anticorrosive protection.

The module is now ready for further assembly, tiles installation, fibers and electronic equipment.

Proposal anticorrosive protection for submodules and module

Steel corrosion is very small in the dry, clean air at constant temperature.

Corrosion is an electrochemical process in a electrolyte. The electrolyte is the thin film of moisture, which absorbs from the air sulfuride gas and chloride salts. The quantity of these components in our case is small and the working condition for module is "good". Modules' plates can be stored for long period of time without corrosion, therefore corrosion protection can be provided by painting with the primer paint and folloving colour painting the external submodules' surfaces.

Before painting the outside submodule's surfaces have to be degreased with an organic solvent (petrol, white-spirit). The inside submodule's surfaces have to be degreased before assembly and before application of the glue.

The priming is carried out by immersing the submodule into tub of primer paint with submodule's plates in vertical position.

The primer paint is then allowed to air dry of room tempeatue.

The surfaces of the small end key way sould be masked prior to priming to protect them to be welded. (All submodule holes must be protected from priming too.) These surfaces are primered suplementary after mask deleting, welding and module assembly. After that all external submodule's surfaces are painted with identical choosen for all submodules' producers colour paint.

Thus:

- For the submodule's and module corrosion protection painting with the paint and following external surfaces coulor paint is sufficient.
- The phosphatization is unnecessary because it has not enough reason and it is too expensive and timeconsuming.

Received by Publishing Department
on June 14, 1995.

Будагов Ю.А. и др. E13-95-254

Описание конструкции сборочного приспособления и технологии сборки модуля барреля адронного калориметра установки АТЛАС

Представлены конструкция сборочного приспособления и технология сборки 6-метрового модуля. Изложены предложения по антикоррозионному покрытию субмодулей и модулей.

Работа выполнена в Лаборатории ядерных проблем ОИЯИ.

Сообщение Объединенного института ядерных исследований. Дубна, 1995

Budagov J.A. et al. E13-95-254

ATLAS Barrel Hadron Calorimeter:

Module Assembly and Tooling Design Description

Here we present the tooling design description for module assembly and the module assembly technology. The proposals anticorrosive protection for submodules and module are presented.

The investigation has been performed at the Laboratory of Nuclear Problems, JINR.

Communication of the Joint Institute for Nuclear Research. Dubna, 1995

Макет Т.Е.Попеко

Подписано в печать 23.06.95
Формат 60 90/16. Офсетная печать. Уч.-изд.листов 1,09
Тираж 370. Заказ 48311. Цена 654 р.

Издательский отдел Объединенного института ядерных исследований
Дубна Московской области