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Beamline Standard Component Designs for The Advanced Photon Source

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Abstract

The Advanced Photon Source (APS) has initiated a design standardization and modularization activity for the APS synchrotron radiation beamline components. These standard components are included in components library, sub-components library and experimental station library. This paper briefly describes these standard components using both technical specifications and side view drawings.

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1. Introduction

The Advanced Photon Source (APS) currently under construction at Argonne National Laboratory will generate high brilliance and intense synchrotron radiation from its insertion devices [1] and is scheduled for completion in early 1996. In response to a call for sector beamline proposals, the APS received over 20 from prospective Collaborative Access Teams (CATs)[2].

In 1990, at the start of the APS front-end components development, the APS Experimental Facilities Division initiated a design standardization and modularization activity for the APS beamline components. During the past four years, the APS standard components, which were based on the APS front-end development experiences, passed through many design reviews and prototype R&D activities. Currently, over 25 different beamline standard components, as well as many subcomponents have been developed and more than 1000 detailed AutoCAD[3] drawings have been released to the APS design exchange system, which is accessible by the APS CATs.

In this paper, a brief technical specification as well as side view drawings of these standard components are presented.

2. APS generic beamline

Fig. 1 shows a typical APS beamline, which we call the "TOM-CAT" beamline. It is an insertion device beamline using the APS standard Undulator A as the source [4]. This example shows that the user can design a beamline in which the main beamline components are standardized.

3. Components library

The components library contains the designs for filters, slits, shutters, monochromators, mirror mounts, beam position monitors, shielded beam transports and supports. To organize the drawing library, a two-character component name has been identified for each standard component. The first character represents the function of the component, such as P for shutters and L for slits. The second

character represents the type of component, such as L2 for ID monochromatic-beam slits, and L5 for ID undulator white-beam slits. In some cases, a minor design change has been given to the standard components to suit an application requirement. Therefore, another two digits may follow the first two characters to specify the modified component. For example, T6-21 and T6-26 are two similarly designed optical tables that have the same kinematic mounting structure but different support bases. Fig. 2 shows some of the beamline components designed by the APS. (The KOHZU monochromator was specified by the APS and designed by Kohzu-Seiki Co.)

Fig. 2 also shows a brief specification for each main component, such as the component flange-to-flange distance (F-F), the optical aperture size (O.A.), the bremsstrahlung shielding aperture size (B.A.) etc. The detailed specifications can be found in many other publications [5-11].

4. Subcomponents library

Fig. 3 shows a part of the APS standard subcomponents library. These subcomponents are frequently being used in the APS main components. For example, linear actuators are major sub-components for slits and shutters, and vacuum bellows are used in large quantities in a beamline assembly. The use of standardized and modularly designed subcomponents should result in reduced engineering effort and cost savings for CATs in the areas of beamline special components design.

5. Experimental station enclosures library

The APS experimental station construction is modular with standard self-supporting steel-lead-steel sandwich panels. Fig. 4 shows a typical first optics enclosure. The modular panel design provides users the advantage of being able to expand or modify the enclosure in the future. This drawing library also includes pneumatically operated, as well as manually operated, sliding doors designed for the experimental stations.

6. Design toolbox for beamline general layout

To simplify the beamline general layout design process, an APS standard components design toolbox has been created. There are two AutoCAD version 12 drawing block libraries in the toolbox, one for the layout sideview and one for the topview. Each drawing block contains the component assembly layout, which is ready to be inserted in the general layout using the AutoCAD insert command or an external reference command. The block reference point is always set on the center of the upstream vacuum flange.

It is possible to put the flange coordinate information of the beamline component into a spreadsheet software, then program AutoCAD using the script command so that AutoCAD can generate the layout automatically by the external reference method using the spreadsheet information [12].

7. Summary

The APS beamline standard component libraries were described briefly in this paper. Most of the standard components for the Synchrotron Radiation Instrumentation (SRI) CAT beamlines will be manufactured in 1994.

References

[1] G.K. Shenoy et al., Status of Advanced Photon Source Project, Int. Symp. on X-Ray Synchrotron Radiation and Advanced Science and Technology, RIKEN, JAERI, Japan (1990).

[2] D.M. Mills, The Advanced Photon Source: A Status Report, Nucl. Inst. and Meth. A319 (1992) 33-39.

[3] AutoCAD is registered in the U.S. Patent and Trademark Office by Autodesk, Inc..

[4] B. Lai et al., Undulator A Characteristics and Specifications, ANL/APS/TB-3, (1993).

[5] J. Barraza et al., SRI 93, NIST, (1993).

[6] J. Chang et al., Design of a New Coaxial Water-Cooled Photon Shutter, SPIE,

Vol.1977, pp.451-458 (1993).

[7] C. Brite et al., Beamline Filters Design, SRI 94, Stony Brook (1994)

[8] J. Chang et al., Design of Integral Shutters for the Beamlines at the Advanced Photon Source, SRI 94, Stony Brook (1994)

[9] D. Shu et al., Precision White-Beam Slit Design for High Power Density X-ray Undulator Beamlines at the Advanced Photon Source, SRI 94, Stony Brook (1994).

[10] U. Hahn et al., APS Beamline Standard Components Handbook V.1.3, ANL/APS/LS-187 (1993).

[11] J. Barraza et al., Experimental Station Support Systems for the Advanced Photon Source, SRI 94, Stony Brook (1994).

[12] S.M. Heald, Private communication with D. Shu, (1994)

Figure Captions

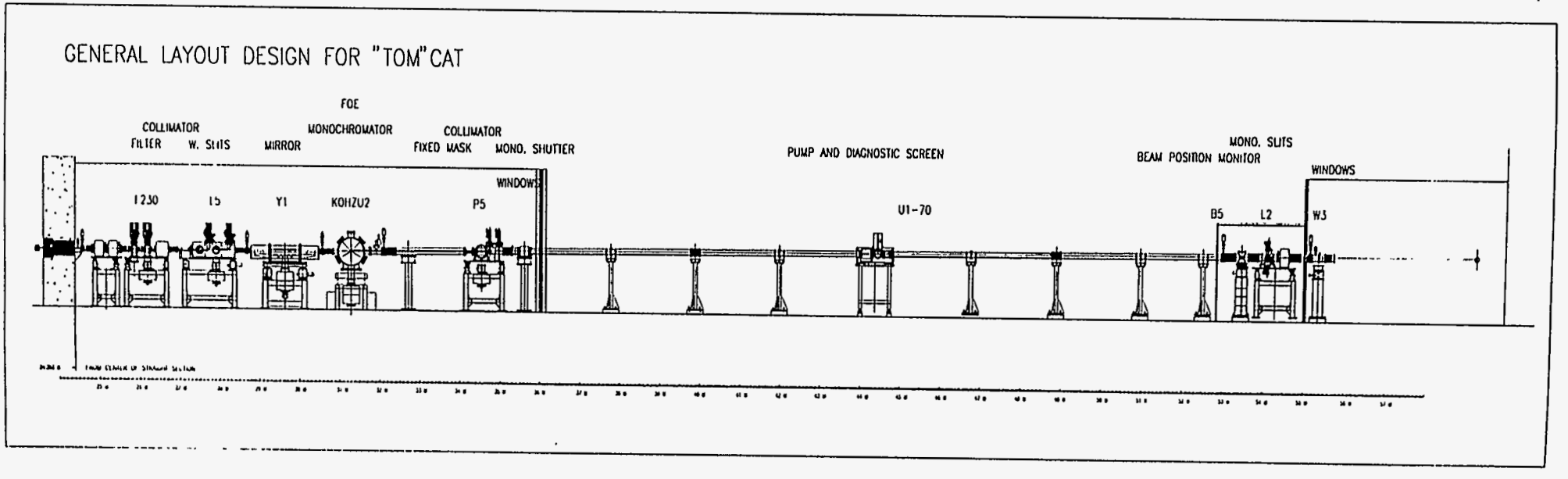
Fig. 1, A typical APS beamline: "TOM-CAT" ID beamline general layout.

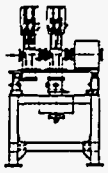
Fig. 2, APS Standard Components Library Part 1 - Main Components.

Fig. 3, APS Standard Components Library Part 2 - Subcomponents.

Fig. 4, APS Standard Components Library Part 3 - Experimental Stations.

Fig. 1


GENERAL LAYOUT DESIGN FOR "TOM" CAT
FOE
COLLIMATOR
FILTER
W. SLITS
MIRROR
MONOCHROMATOR
COLLIMATOR
FIXED MASK
MONO. SHUTTER
WINDOWS
PUMP AND DIAGNOSTIC SCREEN
MONO. SLITS
BEAM POSITION MONITOR
WINDOWS
I230
I5
Y1
KOHZU2
P5
U1-70
B5
L2
W3

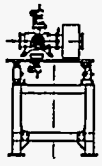


F230 ID BEAMLINE FILTERS
WITH COLLIMATOR K1 AND BELLOWS

F-F 575 mm + 452 mm
O.A. 13 mm (V) X 76 mm (H)

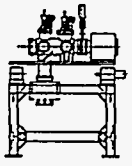
L1 ID U/W WHITE BEAM H&V SLITS

F-F 1750 mm
O.A. (IN) 8.5 mm (V) X 70 mm (H)
O.A. (OUT) 0-8.5 mm (V) X 0-60 mm (H)



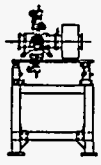
L2 ID MONO. BEAM H&V SLITS
WITH ION PUMP

F-F 465 mm + 320 mm
O.A. 0-30 mm (V) X 0-30 mm (H)



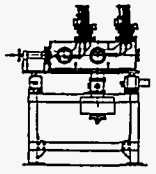
L3 BM WHITE BEAM H&V SLITS
WITH COLLIMATOR K1 AND VALVE

F-F 600 mm + 475 mm
O.A. 0-30 mm (V) X 0-120 mm (H)



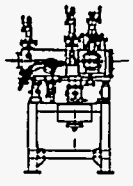
L4 BM MONO. BEAM H&V SLITS

F-F 465 mm + 320 mm
O.A. 0-30 mm (V) X 0-120 mm (H)



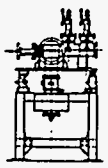
L5 UNDULATOR WHITE BEAM H&V SLITS

F-F 1490 mm
O.A. (IN) 20 mm (V) X 35 mm (H)
O.A. (OUT) 0-7 mm (V) X 0-7 mm (H)



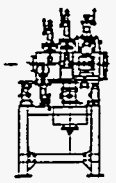
P4 ID INTEGRAL SHUTTERS/STOPS
WHITE BEAM MOVEABLE STOP WITH KIRK KEY
BREMSSTRAHLUNG MOVEABLE STOP WITH KIRK KEY
DOUBLE MONO. BEAM SHUTTERS

F-F 1158.8 mm
O.A. 13.3 mm (V) X 80 mm (H)
B.A. 18 mm (V) X 80 mm (H)



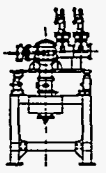
P5 ID INTEGRAL SHUTTERS/STOPS
WHITE BEAM FIXED MASK
BREMSSTRAHLUNG FIXED STOP
DOUBLE MONO. BEAM SHUTTERS

F-F 981.3 mm
O.A. 10 mm (V) X 80 mm (H)
B.A. 10 mm (V) X 80 mm (H)



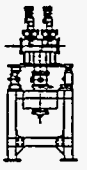
P6 BM INTEGRAL SHUTTERS/STOPS
WHITE BEAM MOVEABLE STOP WITH KIRK KEY
BREMSSTRAHLUNG MOVEABLE STOP WITH KIRK KEY
DOUBLE MONO. BEAM SHUTTERS

F-F 917.5 mm
O.A. 13.3 mm (V) X 120 mm (H)
B.A. 18 mm (V) X 120 mm (H)



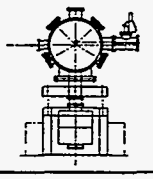
P7 BM INTEGRAL SHUTTERS/STOPS
WHITE BEAM FIXED MASK
BREMSSTRAHLUNG FIXED STOP
DOUBLE MONO. BEAM SHUTTERS

F-F 928.1 mm
O.A. 13.3 mm (V) X 120 mm (H)
B.A. 18 mm (V) X 120 mm (H)



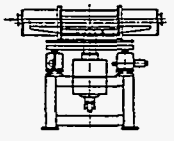
P8 DOUBLE MONO. BEAM SHUTTERS

F-F 482.6 mm
O.A. 13.3 mm (V) X 120 mm (H)



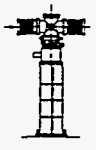
KOHZU2 ID MONOCHROMATOR
WITH DIAGNOSTIC SCREEN

F-F 939 mm + 310 mm



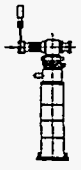
Y1 UNDULATOR VERTICAL REFLECTION

F-F 1800 mm



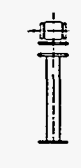
B5 PHOTON BEAM POSITION MONITOR

F-F 835 mm
O.A. 27 mm (V) X 72 mm (H)



B5W3
MONO. BEAM POSITION MONITOR
WITH VALVE AND WINDOWS

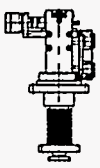
F-F 640 mm
O.A. 8.8 mm (V) X 72 mm (H)



60PMP
60 L/S IN LINE ION PUMP

F-F 317 mm

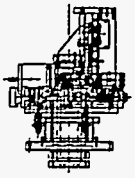
Fig. 3



A1-82

STEPPING MOTOR DRIVEN
LINEAR ACTUATOR

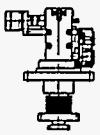
Flange O.D. 171 mm Travel Range 30 mm



A1-85

STEPPING MOTOR DRIVEN
X-Z LINEAR ACTUATOR

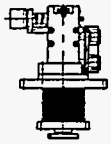
Flange O.D. 253 mm Travel Range 25 mm



A1-86

STEPPING MOTOR DRIVEN
LINEAR ACTUATOR

Flange O.D. 202 mm Travel Range 30 mm



A2-82

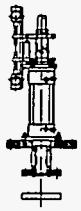
HEAVY LOAD STEPPING MOTOR DRIVEN
LINEAR ACTUATOR

Flange O.D. 253 mm Travel Range 70 mm

A3-81

PNEUMATIC DRIVEN
LINEAR ACTUATOR

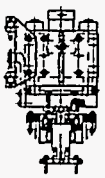
Flange O.D. 202 mm Travel Range 31 mm



A3-83

PNEUMATIC DRIVEN
LINEAR ACTUATOR

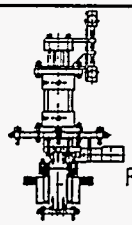
Flange O.D. 202 mm Travel Range 70 mm



A4-81

HEAVY LOAD PNEUMATIC DRIVEN
LINEAR ACTUATOR

Flange O.D. 202 mm Travel Range 33 mm

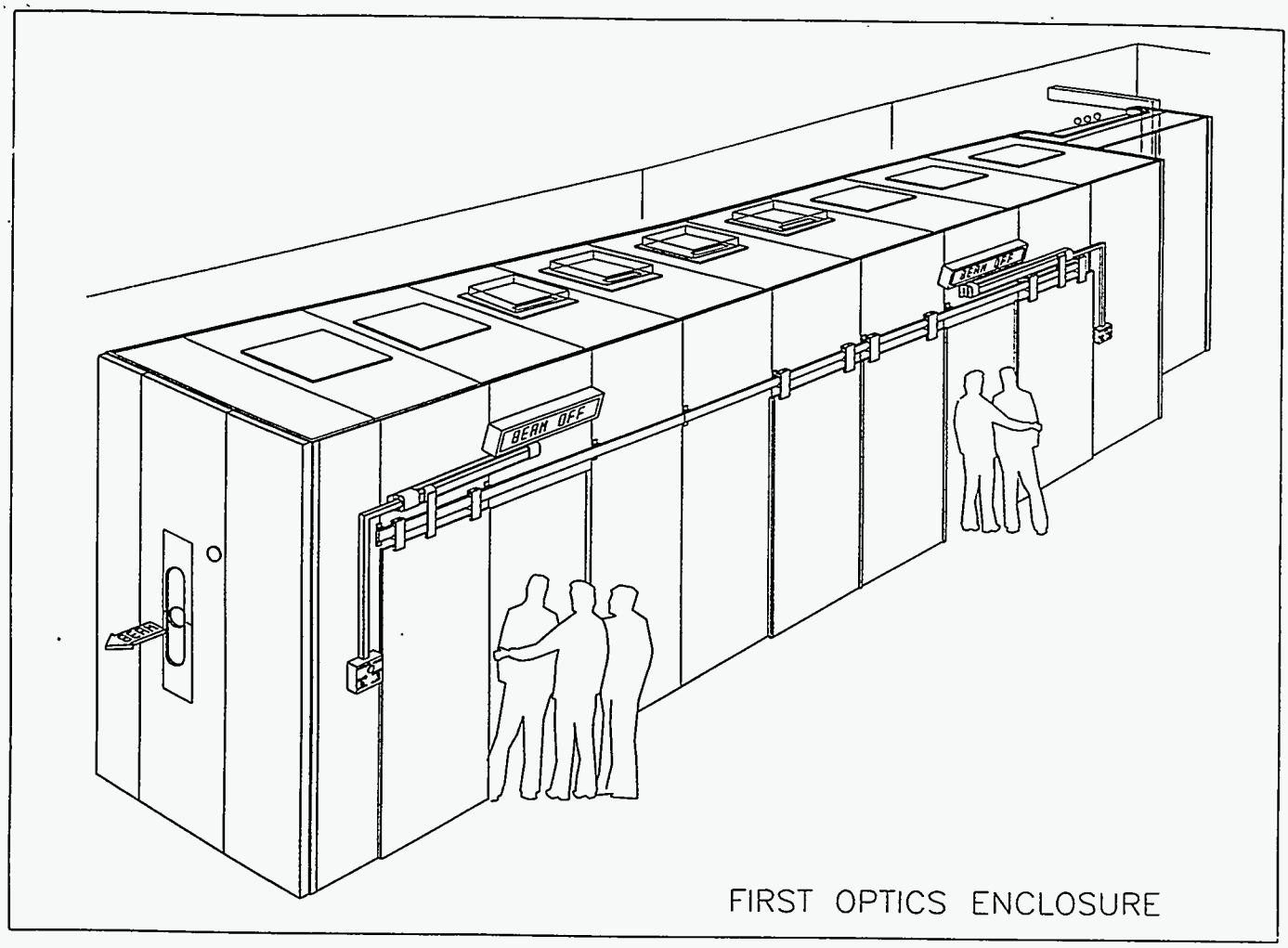


A4-82

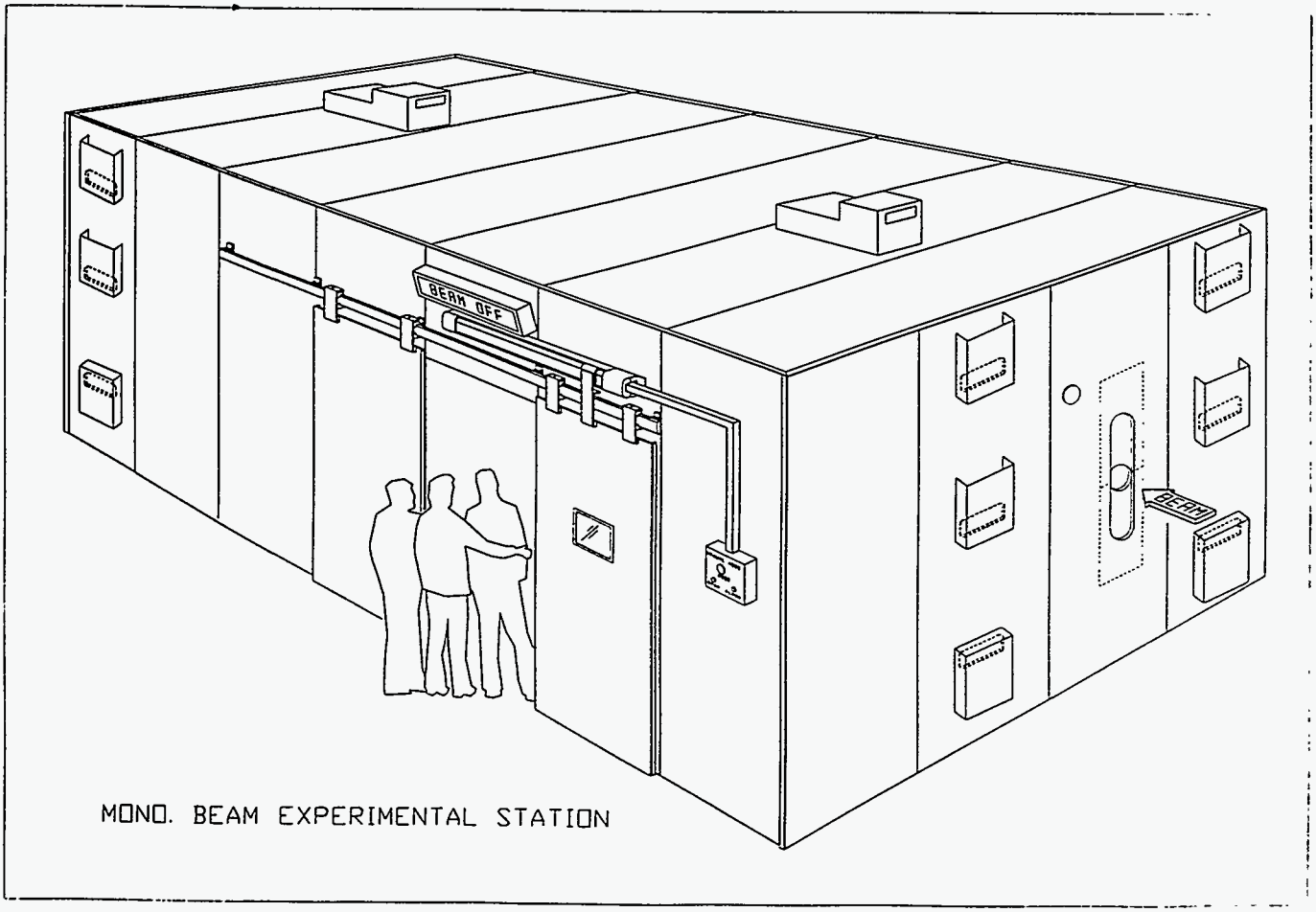
HEAVY LOAD PNEUMATIC DRIVEN
LINEAR ACTUATOR

Flange O.D. 202 mm Travel Range 35 mm

Fig.4



FIRST OPTICS ENCLOSURE



MONO. BEAM EXPERIMENTAL STATION