



STANFORD LINEAR ACCELERATOR CENTER

# SPECIFICATION

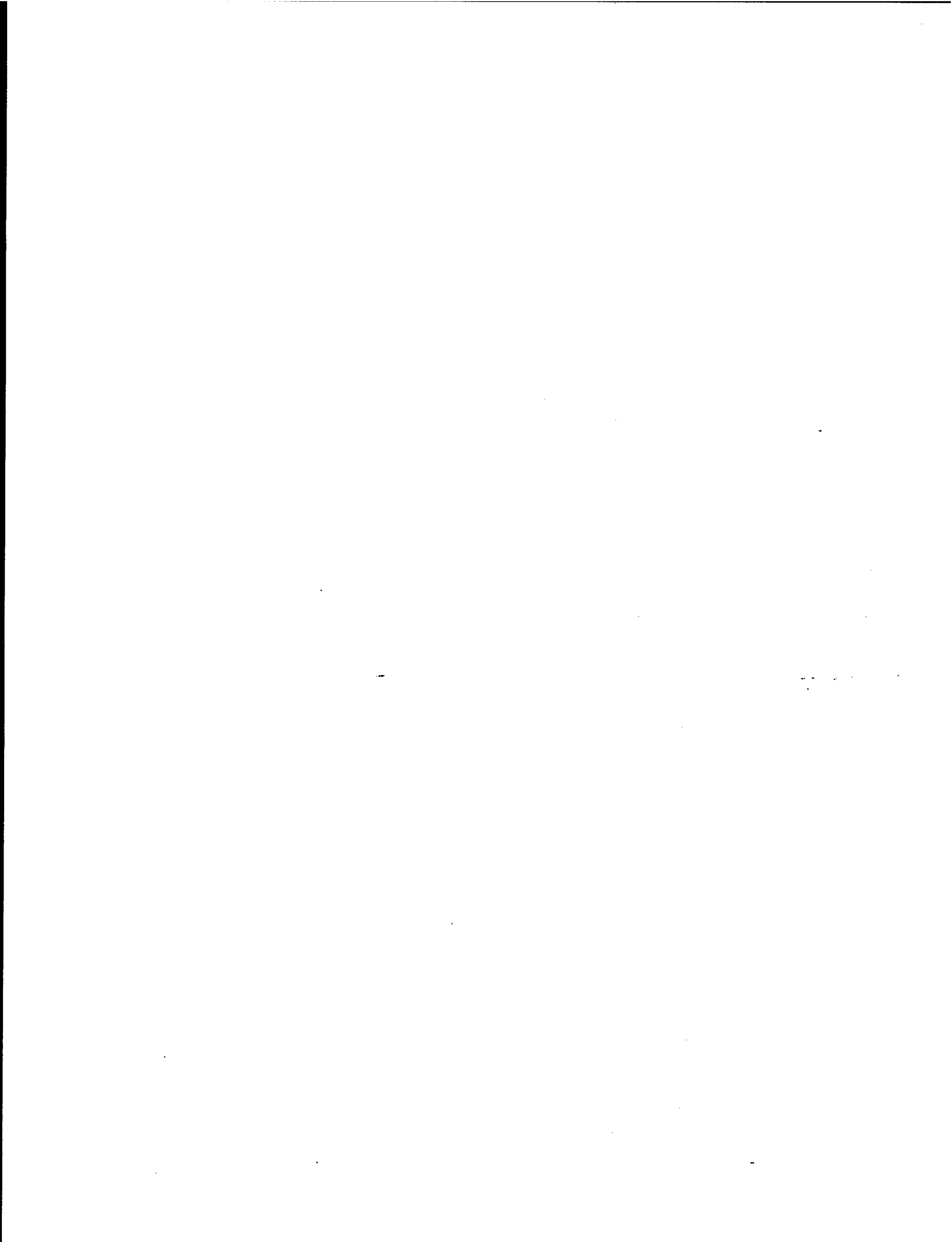
STANFORD SYNCHROTRON RADIATION LABORATORY

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Author(s): Jack Tanabe, Nanyang Li <i>MSJ</i>		Date: Jan. 16, 2001

First Line: SPEAR3
Second Line: Magnet System
Title: Horiz/Vert Corrector Magnet General Assembly

<p><b>H/V Corrector Magnet</b></p> <p><b>GENERAL ASSEMBLY</b></p> <p><b>Specification</b></p> <p><b>垂直 / 水平校正磁铁</b></p> <p><b>总装</b></p> <p><b>生产说明书</b></p>	<p>Approved: SLAC Project Engineer <b>Richard Boyce</b></p> <p><i>R Boyce</i></p> <p>Date: <i>1/17/01</i></p>
	<p>Approved: SPEAR3 Magnet Engineer <b>Domenico Dell'Orco</b></p> <p><i>Dom. Dell'Orco</i></p> <p>Date: <i>1/17/01</i></p>
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Update / 修改
<p>SP 3 SPEC H/V C MAG GEN ASSY</p>



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## 1. GENERAL / 概况

This document is presented in both English and Chinese text; in case of differences, the English version shall be used.

本文含中英文两种文字，如有不符之处，以英文为准。

### 1.1 Scope of the Specification / 说明书范围

This specification outlines the minimum requirements governing the assembly and testing of the SPEAR3 prototype, H/V corrector magnets. This specification further outlines the minimum requirements for packaging and shipping the completed and tested magnet from IHEP to SLAC.

本说明书概括了SPEAR3垂直/水平校正铁批量生产和样机总装和检测的基本要求，对完工后的磁铁从高能所运送到SLAC的包装和运输的基本要求也做了说明。

#### 1.1.1 Applicable Document / 使用文件

Drawing SA444-406-05 C1	Corrector Magnet Shield Assembly
Drawing SA444-406-06 C1	Corrector Magnet Support Bracket Assembly
Drawing SA444-406-07 C0	Corrector Magnet Coil & Core Assembly
Drawing SA444-406-08 C0	Corrector Magnet Core Assembly
Drawing SA444-406-10 C0	Corrector Magnet Coil Assembly

#### 1.1.2 Reference Document / 参考文件

Engineering Note M361 Horiz/Vert Corrector Magnet Engineering Design Summary/校正铁工程设计总括

### 1.2 Scope of Work / 工作范围

IHEP shall assemble the corrector including the parts listed in section 3. IHEP shall perform all hydraulic, electrical and thermal tests and inspect the assembled magnet to verify conformance to the mechanical dimensions outlined in the assembly drawing. IHEP shall develop quality assurance (QA) procedures and test documentation (travelers) and shall record all pertinent assembly information and test records.

高能所应用3款所列部件组装校正铁。高能所应实施总装后的水、电路和温控系统线路测试。并按照图纸要求对磁铁的机械尺寸进行检验。高能所应制定质量保证程序和质量检验文件（跟踪卡）并记录有关总装数据和检验数据。

### 1.3 Magnet Design Parameter / 磁铁设计参数

Maximum Horizontal and Vertical Steering Current (Amps) / 最大电流	30 Amps
Resistance of Horizontal Steering Corrector / 水平绕组电阻	0.51Ω
Resistance of Vertical Steering Corrector / 垂直绕组电阻	0.90Ω
Calculated Inductance (Horizontal Steering) / 水平电感计算值	41mH
Calculated Inductance (Vertical Steering) / 垂直电感计算值	43mH
Max. V 100% DC + 1%@200 Hz (Horizontal Steering) 100%DC+1%200Hz最大水平场电压	31V
Max. V 100% DC + 1%@200 Hz (Vertical Steering) 100%DC+1%200Hz最大垂直场电压	44V
Maximum Power V + H (kW) / 两个绕组总功率	1.273 kW

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Water  $\Delta p$  (psi) / 水压降

150 psi

Water Flow at Design  $\Delta p$  (gpm) @ 20°C / 设计水流量

0.76 gpm

## 2. MATERIAL AND PARTS / 材料和零件

### 2.1 Mechanical Fasteners / 机械紧固件

All fasteners shall adhere to US standards for size and strength.

所用紧固件应为符合美国尺寸、强度标准的产品。

### 2.2 Electrical Bussing / 母线

Electrical connections between coils and to terminal blocks for power lead connections shall be fabricated using OFHC copper and shall be designed with sufficient cross sectional area so that connections can be cooled convectively and can operate at safe handling temperatures. The maximum net current density for the design cross section shall be no more than 200 Amps/cm<sup>2</sup>. The terminal blocks for the power lead connections shall be attached to the core so that power lead weights are entirely carried by the core. The busses shall be electrically insulated from the core with US designation NEMA G-10 epoxy fiberglass block, or equivalent.

线圈和磁铁电源母板之接的连接板的材料应为无氧铜板，其截面尺寸要保证连接板在磁铁运行时不会过热，最大纯电流密度不可超过200安培/平方厘米。电源母板应通过铁芯固定，由铁芯承载其重量。母板应用美国NEMAG-10环氧玻璃纤维层压板或等同物与铁芯绝缘。

### 2.3 Electrical Bus Connection Fasteners / 电源母板连接紧固件

All fasteners required for mechanical connection between bus connections shall be steel and adhere to US dimensional and strength requirements. Split or conical (Belleville type) washers shall be used with the fasteners in order to ensure stored energy in all electrical joints carrying large currents (energy storage joints shall not be required for thermal interlock connections). All fasteners shall be appropriately torqued using the torque values listed in the travelers. A very thin silver film (0.005mm to 0.0075mm) shall be brushed on the bus lug surface using silver plating procedure to enhance the connection between bus connections.

所有电连接板之间的机械连接紧固件应为钢件，符合美国尺寸和强度要求。连接点需加弹簧或蝶形垫圈，以保证连接点的储能承载大电流（温控开关的连接不需采用储能连接方式）。紧固件的锁紧应严格按照跟踪卡所列扭矩操作。母线接线板的表面应经镀银处理，以进一步加强连接处的导电性。镀银层应非常薄，在0.075-0.1毫米之间。

### 2.4 Thermal Switch / 温控开关

Thermal switches will be supplied by SLAC. The Thermal switches for each corrector coil shall be wired in series on a terminal block. Two external terminals shall be provided on the terminal block for external wiring. After installation and wiring, the system shall be tested for continuity.

温控开关由SLAC提供。所有温控开关应在接线板上串接，最外的两个出头接电源引入和引出线。安装布线完毕后，应测量系统的电路连通性。

## 3. MAGNET ASSEMBLY / 磁铁总成

The magnet assembly shall consist of the following main components:

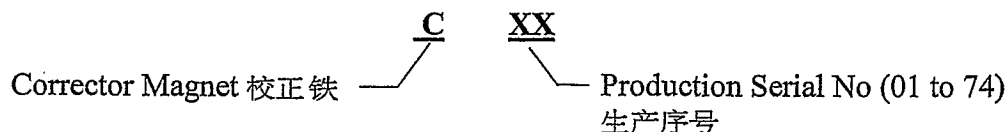
- One core,
- Two (2) identical coils and coil supports,
- Electrical power bussing, thermal interlocks and wiring,
- Magnetic Shield Assembly
- Support bracket.

磁铁总成包括以下主要元件：

- 一个铁芯，
- 两（2）完全一样的线圈和线圈支撑件，
- 电源母线板和连接板，温控开关和导线，
- 外屏蔽框架，
- 支撑框架。

### 3.1 Identification / 身份号

Each corrector magnet shall be identified with a unique number. The number shall be stamped on the magnet nameplate. The identification number shall consist of two (2) parts: Type of magnet and Production serial number.



每个磁铁都有自己独有的身份号。身份号应打印在每个磁铁的铭牌上。身份号由2部分组成：磁铁的类别和生产序号。

### 4. TESTS AND MEASUREMENTS / 检测和测量

The following tests and measurements shall be conducted on completed magnet in order to assure its adequate performance in the accelerator during operation.

总装后的磁铁应进行如下检测和测量，以保证磁铁的正常运行。

TEST ITEM 检测项目	TEST REQUIREMENT 检测要求
Water Flow 水流量	Pressure Drop 水压差: 150 psi @ Temperature 水温: 20°C-25°C Water flow 水流量: > 0.68 gpm
Hipot 高压检测	Voltage: 1.1 kV                      Time :1min                      Leakage Amp <2 μA 电压                                      加压时间                      漏电流
Magnet Resistances 电阻测量	Measure and record the total resistance of the assembled and wired coils for the horizontal and vertical corrector using a double bridge and the ambient temperature at the time of measurements. Correct resistance measurements to 40° C. 分别测量水平和垂直绕组的总电阻，记录环境温度。计算40摄氏度修正值。

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Magnet Inductances 电感测量	Measure and record the inductances of the horizontal and vertical correctors separately. 分别测量水平和垂直绕组的电感
Magnetic Measurements 磁测	See SLAC specification PS-444-400-28R0 见SLAC说明书 PS-444-400-28R0 见磁测说明书
Visual 外观检测	Core, coil, bussing, and water connections, all fasteners and the interlocks, and wiring. Water circuits shall be thoroughly drained and dried. Open end of water fittings shall be sealed. Unpainted core surfaces shall be coated with LPS-3 依次检查铁芯、线圈安装和出头位置，水连接件；所有紧固件是否拧紧，温控开关位置是否正确，连接导线有无损伤；水路内残留水分是否彻底空净，吹干，封口；不喷漆铁芯表面是否喷涂防锈剂LPS-3。

## 5. TRAVELER / 跟踪卡

The information included in general assembly traveler shall include at minimum the following data.

- Magnet identification number.
- Serial number of core.
- Serial number of coils.
- Test and Measurements Results
- Names of technicians installing coils and dates.
- Names of technicians assembling bus bars and interlocks and dates.
- Names of technician(s) performing the electrical tests and measurements (hipot, resistance and inductance) and dates.
- Names of technicians performing the magnetic measurements and dates.
- Name of supervising technician approving the magnet for delivery and date.

总装跟踪卡至少要含以下内容：

- 磁铁身份号，
- 铁芯号，
- 线圈号，
- 检测和测量结果，
- 安装线圈技工姓名和日期，
- 安装母线和温控开关技工姓名和日期，
- 电测人员姓名和日期，
- 磁测人员姓名和日期，
- 批准磁铁检验合格的负责人姓名和日期。

### 5.1 Documentation / 文件

The required documentation collected at the end of magnet assembly shall consist of the following travelers for each magnet (total of 6 documents). Copies of all these travelers shall be packaged with the magnet prior to shipment to SLAC or mailed to SLAC separate from the magnet shipment as required. Originals of all travelers shall be permanently filed at IHEP.

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- Two coil travelers
- One core traveler
- General assembly traveler.
- Magnetic field measurement data and floppy disk(s) containing the data.
- Quality certification signed by IHEP technical representative and other relative authority.

每块磁铁完工后汇总成册的文件应包括如下跟踪卡（共六份文件）。所有这些文件的复印件应随铁装箱或如需要，随磁铁发出同时寄往SLAC。文件的原件应由高能所存档。

- 两份线圈跟踪卡
- 一份铁芯跟踪卡
- 总装跟踪卡
- 磁测数据和数据磁盘
- 高能所技术代表和有关负责人签发的产品合格证书

## 6. PACKAGING AND SHIPPING / 包装和运输

### 6.1 Shipping Crate / 包装箱

More than one magnet may be packed in a shipping crate. If there are more than one magnet in a shipping crate, they shall be packaged rigidly so as to constitute a single unit in that crate. The shipping crate shall be attached to a pallet so that it can be moved using standard handling devices (forklift or pallet jack). All magnets in a crate shall be mounted on a metal frame that shall be attached to the pallet of the crate. IHEP design for the proposed shipping crate shall be reviewed and approved by SLAC.

每个包装内允许装多块磁铁，但是所有这些磁铁应用某种方式连接成一个整体。包装箱应坐在一个底托上，底托设计应该能用标准起货机械，如叉车或千斤顶之类移动箱体。包装箱内所装的所有磁铁应紧固在一个金属托架上，托架需与包装箱底托固定在一起。高能所建议采用的包装箱设计应交SLAC确认。

### 6.2 Environmental Protection / 包装保护

The magnet shall be covered or wrapped to protect it from moisture within the shipping crate.  
磁铁本身应有防潮包装。

### 6.3 Packing List / 装箱单

A packing list shall be installed in the crate. It should contain the following information:

- Identification of the crate which shall consist of serial number of crate and serial number of shipment.
- Identification numbers of the magnets contained in the shipping crate.
- Date of packing.
- Name of the inspector who conducts the final inspection and his/her signature.

每个包装箱内应有一份装箱单，其内容应包括：

- 包装箱号，该号应能指明该包装箱属于X次发货的XX号箱。

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- 该箱内所装所有磁铁身份号。
- 装箱日期。
- 终检员签字和日期。

#### 6.4 Marking / 包装箱外标记

Identification of the crate, identification number of the magnet contained in the crate and name of the receiver and final destination (SLAC) shall be clearly marked on at least two sides of the shipping crate. Arrows shall be conspicuously marked on the exterior surface of the crate to indicate its upright position.

包装箱至少要在两个外箱面清楚标明箱号，箱内所装磁铁身份号，收件人和发往地址（SLAC），并在显著位置标明箱体直立向上放置箭头。

#### 6.5 Installation in Shipping Container / 集装箱内放置

Several magnet crates will be installed in shipping containers for shipment to SLAC. These crates shall be braced in the container such that they will not shift during shipment. The crate orientation within the container shall be such that all crates can be accessed with a standard handling devices (forklift or pallet jack) without rotating or moving.

发往SLAC的集装箱内会放置多个包装箱。这些包装箱应在集装箱内妥善固定，使其不会在起运过程中窜动。包装箱在集装箱内的朝向，应能保证不做转、移动，就可使标准起运机械，如叉车或千斤顶进入其箱底。

#### 6.6 Spare Coils / 备用线圈

The same standards for shipment protection and handling described for the corrector magnet crates shall be applied for spare coils. The crate shall be conspicuously marked on the outside with a description of the contents.

校正铁的包装要求同样适用于这些备用线圈。包装箱外应在显著位置标明箱内所装物品。

#### 7. NAME PLATE / 铭牌

Each corrector magnet shall attach a name plate show as below. Its position shall not interfere with magnet operation.

每个校正铁都应钉如下图所示铭牌，其位置不应影响磁铁的运行性能造成影响。

<p>SPEAR3 H/V CORRECTOR MAGNET</p> <p>Magnet ID No.</p> <p>Net Weight:</p> <p>SPEAR3 Drawing #: SA444-406-General assembly drawing #</p> <p>Date:</p> <p>Made in IHEP, China</p>
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## 8. IHEP SUPPLIED DOCUMENTATION AND ITEMS / 高能所应提供文件和样品总括

Item	SLAC Duty	Delivery Date
3 lamination samples	Approval	After die trial
Lamination traveler	Review	When assembling the die
End chamfering procedure	Review	1 month before prototype fabrication
6 x 6 (cm) painting sample	Approval	1 month before prototype fabrication
Solid conductor purchase order	Review	1 week after sign attachment #5
Stacking fixture conceptual design	Review	1 month before prototype fabrication
Coil winding fixture layout drawing	Review	1 month before prototype fabrication
Coil potting mold layout drawing	Review	1 month before prototype fabrication
Rotating coil design engineering note	Review	2 weeks before prototype delivery
Travelers	Review	1 month before prototype fabrication
Crate Design	Review	When assembling the prototype

项目	SLAC责任	交付日期
三张样片	批准	试模合格后
冲片跟踪卡	审核	冲模总装时
端部削斜冲片加工方案	审核	样机生产前一月
6x6厘米喷漆样品	批准	样机生产前一月
实心导线订货合同	审核	协议5签字一星期后
叠装机设计结构示意图	审核	样机生产前一月
线圈绕线模总图	审核	样机生产前一月
线圈浇注模总图	审核	样机生产前一月
旋测线圈设计书	审核	样机发运前两周
跟踪卡	审核	样机生产前一月
包装箱设计	审核	样机开始生产时

