Quality Assurance Definition

EQUIPMENT NAMING CONVENTIONS

Abstract
This document defines the general conventions for naming LHC components and locating them in the collider. It also gives the naming relationship with the drawing codes related to these components. This document supersedes the LHC Project Report 92 on Naming Conventions for the Large Hadron Collider Project.

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### History of Changes

<table>
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<tr>
<th>Rev. No.</th>
<th>Date</th>
<th>Pages</th>
<th>Description of Changes</th>
</tr>
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<tr>
<td>1.0</td>
<td>1999-09-17</td>
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<td>First release. This document replaces the LHC Project Report 92 on Naming Conventions.</td>
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</table>
| 1.1      | 2003-04-03|       | Updated responsibilities for updating the documents (chapter 4).  
|          |           |       | Included machine prefix in equipment position code (chapter 5.2) |
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1. PURPOSE

This document defines the general conventions for naming LHC components and locating them in the collider. It also gives the naming relationship with the drawing codes related to these components. This document supersedes the LHC Project Report 92 on Naming Conventions for the Large Hadron Collider Project [1].

2. POLICY

The increasing size and complexity of the machines has led to the naming of their components and their location using abbreviated names. These are constructed using a predefined number of alphanumeric characters. Rules are defined for the choice and the meaning of each character and its position in the name. The abbreviated names are chosen so that they reflect the nature of the equipment. These names are used as roots to generate a drawing number related to the equipment, to build LHC Project Document numbers for the EDMS and as identifiers in the Hardware Baseline.

Once the abbreviated name, also called equipment code, is defined, a string of alphanumeric characters can be appended to it which gives the physical location of the component in the collider.

3. SCOPE

The naming conventions described in the present document apply to equipment and assemblies installed in
- the collider tunnel,
- its injection lines from TT60, TCC6 and TI2 and from TT40 and TI8, as well as
- the external beam dumps.

Schematic and installation layouts also follow the naming conventions described in the present document.

Naming of buildings and civil engineering works are the object of another document [2].

4. RESPONSIBILITIES

Any change or revision of the naming conventions must be endorsed first by the Technical Coordination Committee. The revised version must then be approved by the Project Leader or by his Deputy for Quality Assurance.

4.1 PROCEDURE FOR THE CREATION OF NEW CODES

Each Project Engineer has the right and the duty to propose the new equipment codes related to his equipment. Newly created codes must then be checked within the group to ensure consistency with rules internal to the system to which the equipment belongs. The proposal for these new codes is then submitted to the Coordinator for Equipment Codes¹ who verifies the compliance with the rules at the project level and ensures the creation of the code in the equipment code database.

¹ This function is presently fulfilled by R.Saban.
5. NAMING OF COLLIDER COMPONENTS

A collider component is identified by a string of characters composed of three fields. The definition of these fields is given in the sections below.

5.1 EQUIPMENT CODE

The abbreviated name denoting a type of collider component is called an equipment code and is made of up to five letters.

- **S** the first letter indicates the system to which the equipment belongs and must be chosen from the list of systems given in Annex 1.
- **F** the second letter defines the family of the equipment within a given system.
- **TTT** the last three letters defines the type within a family, the model for a given type and lastly the variant.

The equipment code is also a part of the identifier used for manufactured physical components [3].

5.1.1 GENERAL RULES

The following general rules apply:

1. An equipment code must start with a letter and contain at least two letters which define the system to which the equipment belongs and its family.
2. Numbers must be avoided in equipment codes. When used, they refer to either the interaction point or the octant around it. Also, they must always be followed by a letter.
3. Equipment codes must be unique within a given accelerator.
4. The meaning of each letter is a function of its position in the equipment code and of the preceding letter(s). It may change from one system to another.
5. Identical equipment must have the same equipment code, and similar but different equipment must have different equipment codes.
6. Identical components assembled on different composite collider elements must retain the same equipment code.
7. The letter used to differentiate between variants must be attributed in alphabetical order, i.e. A for the first variant, B for the second, etc. Differentiating variants of an equipment with letters like N for new or for normal, S for standard, F for final must be avoided.

5.1.2 SPECIAL CASES

5.1.2.1 THE MAIN DIPOLE

The magnet system is denoted by the letter M. The main dipole magnets have been assigned the letter B. The third character in the equipment code for the main dipoles, MB is reserved to denote the variant:

- S or L for short (1 m) or long (10 m) magnet models,
- P for magnet full length prototypes,
- _ an underscore for the series dipoles manufactured in industry. This character will be used to distinguish dipoles of different type.

The fourth character will be used to identify the manufacturer of the coil. The fifth character is used to identify sub-components of the dipole such as the active part (coil, cable, collars), the electrical connections or the yoke and outer skin.
5.1.2.2 THE SEXTUPOLES AND THE SEPTA

The letter S has been traditionally used to denote septum magnets. The injection and dump septa, which are elements of the LHC ring and not of the injection and dump lines, are called MSI and MSD respectively.

The letter S in the second position is also been used to for the sextupoles. The sextupoles for correcting the machine chromaticity are combined with orbit correction dipoles. The latter apply a correction to horizontal plane on one beam and a vertical correction on the other. The equipment code for such a combined corrector will then be MSCBA (B, C or D). The four letters differentiate the type of combined corrector depending on the plane of correction and the presence of a skew or a normal sextupole. The small sextupole correctors in the dipole cold-mass, also called spool pieces or multipole correctors, are called MCS.

5.1.2.3 NESTED COILS

For magnets assembled using nested coils, the order of the letters identifying each coil polarity reflects the order with which the coils have been assembled when moving from the beam outwards.

5.1.3 ASSEMBLIES

Those components of the collider which are made of sub-components originating in different groups and the assembly of which constitutes a task in itself, are named assemblies. There are two types of assemblies: the cold mass assemblies and the cryomagnet assemblies. The former are helium vessels – commonly called cold mass containing several magnets, their busbars, etc while the latter are the cold mass assembled in its cryostat, fully equipped with diodes, super-insulation, vacuum beam pipes and beam screens ready for installation in the tunnel.

The assemblies are denoted with equipment codes starting with the letter L. The second letter indicates the main component included in the assembly.

e.g. LB will be used for an assembly of a dipole in its cryostat, equipped with diodes, super-insulation, vacuum beam pipes and beam screens, as it will be installed in the machine ring. LQ will be used for a short straight section assembly, whose main element is the lattice quadrupole MQ.

5.2 POSITION

5.2.1 CERN WIDE COORDINATION OF CODING SCHEMES

The coding scheme defined for part identification includes a two-character prefix defining a CERN machine or installation, e.g. an accelerator, an experiment, a transfer line [3]. The same scheme is applicable to position coding schemes. It ensures that codes are unique throughout CERN while providing flexibility in adapting schemes to machine and installation characteristics.

The machine prefix used for LHC position codes is HC.

5.2.2 DEFINITION OF COLLIDER PARTS

An LHC sector is defined as the part of the machine between two insertion points. There are four even sectors, labelled S12, S34, S56, S78, and four odd sectors S23, S45, S67, S81. The naming is always clockwise.

An octant starts from the middle of an arc and ends in the middle of the following arc. Octants are numbered following the number of the point which they include.
The **arc** is the part of the ring occupied by 23 identical FODO cells. A cell is in turn subdivided into two half-cells each composed of three dipoles and one quadrupole (Q12 to Q34). The half-cells are numbered following the number of the lattice quadrupole they contain: there are 34 half-cells per half-octant. The **dispersion suppressor** is made of four special half-cells with two dipoles and one quadrupole (Q8 to Q11) which are situated on either side of an arc but do not belong to the arc.

An **insertion** is the part of the ring between two arcs. It consists of one dispersion suppressor, one **long straight section** and a second dispersion suppressor. The exact layout of the long straight section depends on the specific use of the insertion: physics, injection, beam dumping, beam cleaning. The long straight section always starts and ends with a **matching section** (Q4 to Q7). Q6 and Q7 however, are missing in Point 6.

In addition, the long straight section around the experimental insertions at Points 1, 2, 5 and 8 include the **inner triplet** (Q1 to Q3) on either side of the interaction points. In the other long straight sections, Q1 to Q3 are missing and the numbering starts with Q4 so that the mid-arc quadrupole is always numbered 34.

5.2.3 **NAMING OF POSITIONS IN THE COLLIDER TUNNEL**

The position of a half-cell along the circumference of the collider is uniquely described by three parameters:

- **i** the octant number where it belongs \((i = 1..8)\)
- **L or R** whether it is situated in the left or in the right half-octant with respect to the IP when looking outwards from the centre of the collider and,
- **j** its sequence number along the line starting from the insertion point and ending in the mid-arc. For the octants 1, 2 and 5, with experimental insertions, \(j=1..34\). While for octants 3, 4, 6 and 7, \(j=4..34\).

In the layouts (see Section 6.1) the convention **CjLi** or **CjRi** is used to identify the half-cells.

Every collider component is always situated inside a half-cell. Therefore, the position of a collider component is first identified by the position of the half-cell. If more than one element of the same type exist in a given half-cell, a letter is used to discern between them. The letters are placed before the index \(j\).

Typically the letters A, B and C are used to differentiate the three locations occupied by the three dipole assemblies of a half-cell in the arc.
Q2 is always made of two identical quadrupoles powered in series.
Half cells 34R i and 34L i+1 are special as they share the same lattice quadrupole.

5.2.4 NAMING OF POSITIONS IN THE INJECTION LINES

The injection lines also use a FODO structure with a half cell length of 30.3 m. The installations names are composed of up to five letters given by the device type (e.g. MBI), and five numbers, where the first identifies the line (i.e. 2 or 8 for TI 2 or TI 8). The following two digits give the number of the preceding quadrupole or, in case of a quadrupole, the number of that quadrupole. These numbers run from 01 to 95 for TI 2 and 01 to 81 for TI 8. The last two digits give the number of the slot, counted from the beginning of the preceding quadrupole, in which the device starts. Slots are 0.5 m long and counting starts with 01. Quadrupoles themselves carry the slot number 00 except in case of a quadrupole multiplet where the consecutive quadrupoles of a series carry slot numbers different from 00 except other devices.

Typically the position of the 65th quadrupole in TI 8 is given as 86500, while the position of the bending magnets is 86506, 86520, 86534 and 86547. The position of the beam position monitor between the quadrupole and the first dipole is defined as 86504. It indicates that the equipment is located in the fourth 0.5 m segment after the beginning of the quadrupole.

5.2.5 NAMING OF COMPONENTS IN THEIR POSITION

A component of the collider is identified as follows:

< machine prefix> • <equipment code> • <position>

Typically, a main quadrupole will be identified by HC • MQ • j Li, if situated in half-cell j left of insertion point I and by HC • MQ • j Ri, if situated in half-cell j right of insertion point i. The separator •, which is mandatory, allows the identification of the equipment code and the position.

All the half cells in the left half-octant have their quadrupole to the left of the dipoles (when looking from the centre of the collider) and all the half cells in the right half-
octant have their quadrupole to the right of the dipoles. Therefore, the three dipoles of a half-cell in the left half-octant will be identified as \textit{HC MB CjLi}, \textit{HC MB BjLi}, \textit{HC MB A Li}, rotating clockwise. While, the three dipoles of a half-cell in the right half-octant will be identified as \textit{HC MB AjRi}, \textit{HC MB BjRi}, \textit{HC MB CjRi}, rotating clockwise. Figures 2 and 3 above illustrate this convention.

5.3 FAMILY

When the position along the machine is not sufficient to uniquely identify a component or when equipment are grouped following a position independent scheme, a further level of qualification is given using this field.

\textendash; the equipment which is installed on one of the beam tubes such as beam position monitors or,

\textendash; equipment performing the same optical function and connected to the same power converter such as a family of lattice correctors.

6. IDENTIFICATION OF DRAWINGS

A general drawing numbering system [5], [6], already in use since 1990, has been defined for all mechanical and installation engineering drawings. A drawing number, which uniquely identifies the drawing, incorporates the machine code and the equipment code, followed by a sequentially attributed drawing number.

\begin{center}
\begin{tabular}{l}
\textbf{LHC VSSB 0014} \\
Machine & Equipment Code & Sequential Number
\end{tabular}
\end{center}

This label identifies the 14\textsuperscript{th} drawing for the screen part of a dipole beam-screen for LHC. Because the equipment code VSSB, contained less than five characters, one underscore was added. The drawing code is therefore the equipment code padded to five characters with underscores followed by an ordinal number and preceded by the project name. The number is sequentially attributed as the requests are made to CDD.

6.1 LAYOUTS

Layouts are drawings showing how the collider components are installed in the machine on its actual site. This either follows the structural properties of the system (e.g. vacuum, magnet, electrical distribution) which it illustrates (schematic layouts) or, show the real shape and physical sizes of the equipment belonging to a particular system (installation or equipment specific layouts).

6.1.1 SCHEMATIC LAYOUTS

The schematic layouts define the positions and the lengths of the elements of the collider (magnetic or physical). Drawing codes for schematic layouts always start with \textbf{LS}. The following letter indicates which part of the machine or which system the layout in question is concerned with. The fourth digit may be a number which indicates the octant of the machine. In this case, the last digit is either an underscore or a letter.
Examples:
LSAO_ denotes the drawings showing the schematic layout of an odd cell in an arc.
LSD denotes the drawings showing the electrical distribution.

6.1.2 INSTALLATION LAYOUTS

These layouts show the installation of equipment in the actual tunnel shape and are identified with a drawing code starting with LJ. The third digit gives the LHC octant number and the fourth indicates which part or system of the machine is concerned.

Examples:

LJ___ denotes the drawings showing the general installation layout in the tunnel,
LJ1UQ denotes the drawings associated to the layout of the cryogenics in the underground around Point 1.

7. ACCESSING THE EQUIPMENT CODE DATABASE

The equipment code database is accessible via the LHC Project Web Pages in the LHC Design section under Naming & Conventions.

8. RELATED DOCUMENTATION

## Annex 1: LIST OF SYSTEMS

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<thead>
<tr>
<th>Letter</th>
<th>System Definition</th>
<th>Comments</th>
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<tbody>
<tr>
<td>A</td>
<td>Acceleration</td>
<td>All RF equipment, incl. Dampers</td>
</tr>
<tr>
<td>B</td>
<td>Beam Instrumentation</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Controls, Communications</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>Electrical Distribution</td>
<td>Busbars, quench protection</td>
</tr>
<tr>
<td>E</td>
<td>Electricity</td>
<td>Electrical equipment</td>
</tr>
<tr>
<td>F</td>
<td>Fluids</td>
<td>De-mineralized water excluded</td>
</tr>
<tr>
<td>G</td>
<td>Survey and Geodesy</td>
<td>Girders for the SPS</td>
</tr>
<tr>
<td>H</td>
<td>Mechanics, Supports</td>
<td>Including handling</td>
</tr>
<tr>
<td>I</td>
<td>Injection</td>
<td>All transfer lines</td>
</tr>
<tr>
<td>J</td>
<td>Infrastructure</td>
<td>Including in the machine pits</td>
</tr>
<tr>
<td>K</td>
<td>Civil Engineering</td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>Layouts</td>
<td>Lenses in SPS codes</td>
</tr>
<tr>
<td>M</td>
<td>Magnetic Elements</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>Particle Sources</td>
<td></td>
</tr>
<tr>
<td>O</td>
<td>NOT TO BE USED</td>
<td>(Confusion with zero)</td>
</tr>
<tr>
<td>P</td>
<td>Personnel safety</td>
<td>Including radiation protection</td>
</tr>
<tr>
<td>Q</td>
<td>Cryogenic equipment</td>
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<tr>
<td>R</td>
<td>Power converters</td>
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<tr>
<td>S</td>
<td>General Safety</td>
<td>Supply for SPS</td>
</tr>
<tr>
<td>T</td>
<td>Targets and Dumps</td>
<td>Including collimators</td>
</tr>
<tr>
<td>U</td>
<td>Ventilation</td>
<td>Including. air conditioning</td>
</tr>
<tr>
<td>V</td>
<td>Vacuum</td>
<td></td>
</tr>
<tr>
<td>W</td>
<td>NO LONGER USED</td>
<td>(De-mineralized water for LEP)</td>
</tr>
<tr>
<td>X</td>
<td>Experimental and test areas</td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>Access system</td>
<td></td>
</tr>
<tr>
<td>Z</td>
<td>Electrostatic systems</td>
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