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WEKA01: Selection of materials and processes for vacuum, cryogenic and non-magnetic applications in particle accelerators

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Stringent requirements are placed on materials of modern accelerators. Their physical and mechanical properties, machinability, weldability or brazeability are key parameters. Adequate strength, ductility, magnetic properties at room as well as low temperatures are important factors for materials of accelerators working at cryogenic temperatures. In addition, components undergoing baking or activation of Non-Evaporable Getters (NEG) or directly submitted to the impact of the beam impose specific choices of material grades of suitable outgassing and mechanical properties in a large temperature range.

Magnetic properties are of paramount importance. In order to minimize the magnetic permeability of the final components, precise specifications in terms of composition and microstructure have to be applied while also imposing adapted steelmaking and manufacturing processes. Specific measurement techniques targeted for feebly magnetic materials have to be applied for the cross-check of the magnetic behaviour.

Today, stainless steels are the dominant materials for accelerator construction. Their metallurgy is extensively treated. It will be shown that a stainless steel does not only consist of a chemical composition or a designation, but is the result of a whole metallurgy and metalworking process, in view of obtaining adequate purity, weldability, inclusion cleanliness and fineness of the microstructure. In many cases these requirements are crucial to guarantee the final properties and leak tightness of the components.

Innovative manufacturing and non-destructive examination technologies will also be covered.

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