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Material characterisation and preliminary mechanical design for the HL-LHC shielded beam screens operating at cryogenic temperatures.

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The High Luminosity LHC (HL-LHC) project aims at increasing the luminosity (rate of collisions) in the Large Hadron Collider (LHC) experiments by a factor of 10 beyond the original design value (from 300 to 3000 fb⁻¹). It relies on new superconducting magnets, installed close to the interaction points, equipped with new beam screen. This component has to ensure the vacuum performance together with shielding the cold mass from physics debris and screening the cold bore cryogenic system from beam induced heating. The beam screen operates in the range 40-60 K whereas the magnet cold bore temperature is 1.9 K. A tungsten alloy is used to absorb the energy of particles. In this paper, the measurements, at room and cryogenic temperatures, of the mechanical and some physical properties of this tungsten alloy are shown. The strength of soldering with copper is also assessed at cryogenic temperatures. Then, the design and the thermal mechanical behaviour of the beam screen assembly are presented. It includes the heat transfer from the tungsten absorbers to the cooling pipes and through the supporting system that has to minimise the heat inleak to the cold mass. The behaviour during a quench is also presented.

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