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(57) Abstract :

A modular bumper impact absorption apparatus (100) is disclosed, comprising a primary frame (102) fitted with multiple removable energy absorption cartridges (101). Each cartridge includes an elastic outer shell (103) and viscoelastic core (104) for staged impact energy dissipation. Quick-release mechanisms (106) and force sensors (107) enable selective replacement and diagnostics post-collision. The system offers enhanced low-speed impact protection, modular maintainability, and reduced repair costs, making it ideal for modern vehicles in urban driving environments.

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