Summary

The vehicle design automation (VDA) software (General Packaging) is a suite of tools within NX™ to aid in the design of vehicles, enabling engineers to validate automotive designs against safety, occupant ergonomics and visibility standards.

These tools check preliminary concept designs and final detailed geometry designs of cars and trucks against national and international standards. The tools use product geometry and key “base data” dimensions to check design compliance to United Nations Economic Commission for Europe (ECE) and Global Technical Regulations (GTRs), European Economic Community (EEC) and specific country government regulations including Guobiao (GB) standards in China; Society of Automotive Engineers (SAE), Federal Motor Vehicle Safety Standards (FMVSS) and University of Michigan Transportation Research Institute (UMTRI) standards in the U.S., and Ministry of Land, Infrastructure, Transport and Tourism (MLIT) and TRIAS in Japan for topics such as Pedestrian Protection and Close Range Visibility. The embedded knowledge base of more than 60 standards from at least 15 standards bodies provides a reliable and repeatable assessment of vehicle layouts, both for car (Class A) and truck (Class B) regulations, eliminating the need to re-read thousands of technical pages. Associativity of the output geometry automatically updates analysis results as the design of the vehicle evolves from art to final product.

Benefits

• Permits early occupancy and mechanical packaging studies
• Helps establish key vehicle reference points for configuring and measuring aspects of the interior automobile compartment and external components
• Includes international vehicle industry standards and process knowledge database for repeatability and standardization
• Full integration with the NX™ CAD system, ready-to-go and out-of-the-box for minimal customization costs
• Frees up highly skilled packaging engineers to concentrate on complex packaging problems
• Enables rapid evaluation of alternative designs in a unified design environment
• Leverages integrated analysis to provide fast feedback on designs’ compliance with established standards
Automotive packaging

Features
- Incorporates more than 60 standards from more than 15 standards organizations
- Associative update of checks to base dimensions and geometry
- Supports multiple vehicle loadings and human ergonomic profile percentiles
- Works with surface or facet models
- Automatic geometry creation and integrated compliance checks with visual reporting

NX Vehicle Design Automation addresses a broad range of packaging tasks, including:

Base data
Base data dimensions (based on SAE J1100) such as wheelbase, vehicle length, tire sizes and driver side and seat reference point are used as the starting point for other functions. Different loadings can also be defined such as empty weight or with co-driver or fully loaded with occupant, luggage and fuel, which will be used to adjust the results to reflect the actual position of the driver relative to the ground. These key base values can be referenced by multiple validation functions across an assembly of the product, allowing an easy single point of update if dimensions and positions change. The base data can be updated by the function’s own user interface (UI) or by importing from a spreadsheet of values. Base data component template files can also be easily swapped.
Occupant packaging and vehicle architecture analysis

The Hip Point Design (HPD) tool helps establish key vehicle reference points for configuring and measuring aspects of the interior automobile compartment. These points include seating reference points for each occupant position and heel points (accelerator heel point for the driver and floor reference points for passengers). The tool creates the reference points according to the Driver Designated Seating Position Design Procedures and Design Procedures for second- or third-row outboard seating positions in the SAE J4002 standards and creates a simplified CAD version of the H-Point Machine (HPM).

The Seat Lines assistant is used during early stages of vehicle development to create seat position lines and to determine the length and position of horizontal seat travel. As a design tool, the assistant makes it easy to determine the level of accommodation provided by proposed seat tracks. As a checking tool, it implements the SAE J1516 standard describing where drivers position their adjustable seats.

The Seat Belt Anchorage tool provides design recommendations for determining the anchorage location for vehicle seat belt restraint systems. The option is useful when performing occupant packaging studies to determine anchorage locations for restraint systems that conform to the guidelines of SAE, ISOFIX and ECE R14. Output includes the acceptable anchorage zone for the pelvic restraint system, the upper torso restraint system and the top tether for child restraint devices. The anchorage point for the pelvic restraint can be located on the vehicle structure or on the seat assembly. For SAE J383, it creates a closed curve representing the acceptable zone for the anchorage point of the pelvic restraint system. A closed curve is also created for the acceptable zone of the upper torso restraint system. For SAE J1369, it creates a sheet body representing the enclosed volume in which to locate the anchorage point for the top tether strap of a child restraint system.

The Hand Reach tool can be used to estimate the extent of a driver’s hand control reach. Hand control reach is the maximum reach of drivers in a simulated driving situation, with the non-reaching hand on the steering wheel and the right foot on the accelerator pedal. The software creates 3D surfaces forming envelopes representing the hand reach capability for a specified proportion of the driver population and torso restraint system. The function follows the recommendations of SAE J287 and creates data for three-finger, extend finger and full hand reach.

Head Impact defines upper roof zone and head impact data target points and angles to FMVSS 201U on the upper interior components of a vehicle to analyze the impact of a vehicle collision to the heads of occupants.

The Architecture Cover and Clearance functions evaluate the vehicle geometry to international and company standards creating geometry and check measurements for slope angle, static curb, dynamic curb, oil pan, wheel fixing, ground clearance, inner angle, wheel covering, bumper and crash barrier.

Visibility analysis and pedestrian safety

The Eyellipse tool helps certify vehicles for compliance with various regulatory standards. The tool graphically depicts the location of the driver’s eyes for specified population percentiles, creating an elliptical model representing driver eye locations in the vehicle, and also creates features representing head contours and EEC vision points. These are used in other NX Vehicle Design Automation tools, including Instrument Panel Visibility Assistant, Windshield Vision Zones Assistant and Mirror Certification Assistant. The Eyellipse tool creates features that comply with a selection of standards, including SAE J941 and UMTRI for eyellipses, SAE J1052 for head position contours and the EEC ECE R125 Vision Points 77/649 standard as well as user-defined head gear profiles.

The Instrument Panel Visibility tool lets you calculate the visible and nonvisible areas of an automotive instrument.
whether the vision angles are within an acceptable range to meet SAE J1050. The user can limit the vision region by either defining the eye/head rotation or by specifying a window boundary. The regions are dependent on the eye points or an eyellipse (the eyellipse takes into account the vehicle type and the driver population percentile). The software creates a geometric feature representing the direct field of view and can also perform quick checks on the up, down, left and right angle values of that field of view.

Vision Planes and Windshield Datum Points create geometry representing the no-obstruction area based on ECE 77/649 and GB 11562 standards. All-round Vision generates surface or line geometry at the driver’s eye-level to represent blocked or visible areas around the vehicle from the driver’s position. This aids in the design of the vehicle for safe driving by evaluating the driver’s view angles.

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Hood Visibility Line provides a line representing the foremost points on the hood that the driver is able to see within a given view range. This assists in the evaluation of EEC 90/630.
Pedestrian Protection creates head impact and leg impact zone geometry to comply with NCAP (Euro, North America, Japan, China, Korea) and UN GTR 9 regulations. The tool performs extensive interference checks and area calculations and supports passive and active hood systems, different loading configurations and marginal as well as standard head offset values. The tool uses the vehicle geometry (front upper surfaces, windshield, A-pillar, bumper beam) to associatively create wrap-around distance (WAD) lines and calculate bonnet reference lines (BLE, BRRL, BRTL, BSRL), corner reference points (CRP), bumper reference lines (UBRL, LBRL), internal bumper reference line and bumper corner points.

NX vehicle design automation provides a rapid method of checking vehicle designs against numerous international standards throughout the product development cycle.