Lowest cost printer chassis design that would pass a series of transportation drop tests, utilizing design of experiments in conjunction with Abaqcus/ Explicit analysis.

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A printer chassis provides an important function of locating and securing the relative position of all the sub-systems that makeup a printer. The customer location could be thousands of miles away from the factory and many modes of transportation are required from ship, train, trucks, forklift, to pushing across corridors, stairs and elevators. The transportation loads are the most sever the printer would see in its life time. These include impacts on all sides at 3 MPH to an 8 inch vertical drop. In today's competitive market cost is as critical a function as performance to succeed in the market. To design the lowest cost chassis, 3 large highly stressed parts in the chassis were optimized for cost. Two parameters; sheet metal thickness, and material strength were used to minimize the chassis cost provided the combination passed each one of the six unique transportation tests. A six factor, two levels, Taguchi L12 matrix was utilized for the design of experiment (DOE). Abaqus/ Explicit analysis were used for virtual transportation testing to compute the output responses of the DOE. The design optimization exercise resulted in an addition 6% cost savings.

Keywords: Abaqus/Explicit, Abaqus/CAE, Chassis, Cost, Design of Experiments, Drop Test, Finite Element Analysis, Impact, Mild Steel, Noryl, Optimization, Plastic Strain, Printer, SECC, Structure, Simulation, Taguchi L12, Transportation Test, Welding, Wood

1. Introduction

A printer chassis is the backbone of the printer. Its function is to provide support and location to all of its subsystems, customer user interfaces like screens and keyboard but it also has to protect its content from abuse and damage during the life of the printer. The propensity and severity of damage is the largest during its transit from the factory to customer locations thousands of miles away. All modes of transportation are realized by the chassis during its life from fork lifting, truck ride, train haul, freight container across the oceans and pushing across the hallways to its final destination at the customer site. For the chassis to be robust against failures from vertical drops to accidental bumps on all of its sides and edges, a series of transportation tests have been defined for new design qualification.

2. Transportation Test

The transportation testing specifications is an internal Xerox document that defines a suite of tests both packaged and unpackaged. The testing is comprised of handling tests that require the product or package be dropped from different heights depending on product weight. The product or package has to be dropped on its bottom and also roll dropped on its four edges and four corners. Three miles per hour impact on all of its four sides and a random vibration test to a predefined power spectral density is also required. Table 1.0 summarizes the entire tests that were required for the particular chassis design.

Abaqus/Explicit was used to simulate the entire test suites defined in Table 1. Most of the chassis members were sized based on stress feedback from the simulations.