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Design for Assembly: Integration of Ergonomics into Harley-Davidson's M9 Product Development Methodology

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Abstract: Harley-Davidson Motor Company's (HDMC) focus on ergonomics began over 15 years ago with an emphasis on identifying and controlling hazards within the manufacturing processes. Using a hazard identification tool called the Ergonomic Job Measurement System (EJMS), all workstations are assessed then ranked according to risk level. Resources are provided to focus on correcting high risk work tasks; thereby, lowering the overall risk exposure for a workstation. Since 2012, high risk EJMS jobs have been reduced by 98% across the company. It's not enough, however, to correct ergonomic risk within manufacturing, as two times per year new motorcycle models are introduced with the potential of new risks to employees.

In 2014, emphasis was placed on moving upstream into product development to influence the design for assembly of the motorcycles. Designing out ergonomic hazards such as pinch and grip forces; hand and finger access can significantly improve the overall safety for employees and is a benefit to customers. HDMC's Ergonomic Design Guidelines are a resource for design engineers to understand the targets for various assembly tasks and training them on understand the impact of their role in providing a safety work environment and influencing productivity and quality. Ergonomic design reviews are performed as part of the M9 Product Design process; during the Pre-development phase through product launch. At the Implementation phase, the ergonomic specialist participates in build-events and quantifies risks; then, works with design engineers to correct identified issues. Tools used to measure risk include an ergo glove, vibration meters and force gauge.

Armed with the EJMS and Ergonomic Design guidelines; the chief engineers make business decisions regarding choice of suppliers, parts, tooling and assembly processes in order to balance safety, productivity and quality.

1. EJMS- Ergonomic Job Measurement System- an ergonomic risk assessment tool originally published 2001, David Ridyard, American Society of Safety Engineers. Over the past few years, HDMC has modified this tool to meet design objectives. Process engineers are responsible for evaluating all work stations to understand current risks and prioritize corrective actions. Information in this assessment is kept current with the introduction of new model year or other modifications to tooling or process. The EJMS is reviewed as part of any work-related injury investigation.

2. Harley-Davidson Ergonomic Design Guidelines- Approved by Leadership in 2009 and intended to assist in driving manufacturing and product design to be best in class in ergonomics. References are from research and industry best practices. Contents include; hand postures, clearance and accessibility, arm/hand/finger forces, pinch points and general workstation design.

3. M9 Product Development Methodology- HDMC's product design process integrates ergonomics from Pre-Development through the Implementation phases. A key milestone is at the time of (EK), transitioning from Pre-Development to Definition/Contracting. During this transition proportions and profiles are known and the design is 80% complete. Key decisions regarding wiring, grommets, connectors, brackets and plugs are being made by engineers and its important design for assembly/ergonomics as part of the decision-making process. Product development is a dynamic environment and challenges exist with resource availability and general ergonomic awareness.

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4. Ergonomic Assessment Tools- HDMC uses various tools to objectively measure risk. An ergonomic glove with load cells on the finger and hand is used to obtain pinch and grip forces and ascertain specific areas of contact stress. A digital force gauge is used to obtain push/pull requirements for wire harnesses, plugs and grommets. Vibration meters assist in understanding the hand tool vibration and to determine tooling changes or preventative maintenance for vibratory tools in order to prevent injury.

Keywords: Ergonomic Measurement, Ergonomic Design, Product Design, Ergonomic Assessment