



Exhibit F - UTCRS

UTC Project Information	
Project Title	The Effect of Heat Generation in the Railroad Bearing Thermoplastic Elastomer Suspension Element on the Thermal Behavior of Railroad Bearing Assembly
University	The University of Texas-Pan American (UTPA)
Principal Investigator	Arturo Fuentes, Ph.D., Mechanical Engineering (PI) Robert Jones, Ph.D., Mechanical Engineering (Co-PI) Constantine Tarawneh, Ph.D., Mechanical Engineering (Co-PI)
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Funding Source(s) and Amounts Provided (by each agency or organization)	Federal Funds (US DOT UTC Program): \$59,324 Cost Share Funds (UTPA): \$12,352
Total Project Cost	\$71,676
Agency ID or Contract Number	DTRT13-G-UTC59
Start and End Dates	January 1, 2015 – December 31, 2016
Brief Description of Research Project	The main purpose of the proposed study is to investigate the effect of heat generation in the railroad thermoplastic elastomer suspension element to develop an experimentally informed and validated finite element thermal model which can be used to attain temperature distribution maps of railroad bearing assemblies under a variety of normal and abnormal service conditions. Among other things, these maps will be useful for sensor data interpretation and identifying ideal locations for sensor placement for continuous temperature tracking of railroad bearings (e.g. IONX motes). Specifically, the main objectives of this project are: 1) to explore and quantify the heat generation in the railroad bearing elastomer suspension element with different material systems and under different loads, frequencies, and temperature



	<p>scenarios; and 2) to determine the effect of this heat generation on the thermal behavior of railroad bearing assembly under different operating conditions. To that end, the contribution of the elastomer pad to the system energy balance will be modeled using data from dynamic mechanical analysis (DMA) of common materials in use for that part. DMA will provide a full characterization of the elastic deformation (energy storage) and viscous dissipation (energy dissipation) behavior of the material as a function of load, frequency, and temperature. In parallel, CAD models of the railroad bearing assembly will be developed using Solidworks commercial software to be used in constructing finite element models utilizing the ALGOR commercial software. The finite element (FE) model will be used to conduct thermal finite element analyses using some of the expected operational boundary conditions and loads including the heat generation in the elastomer suspension system. The FE models will then be validated with some physical laboratory experiments. Finally, based on the simulations and experimental results, bearing assembly recommendations will be suggested to further ensure the safe operation of railroad bearings.</p>
<p>Describe Implementation of Research Outcomes (or why not implemented)</p> <p>Place Any Photos Here</p>	<p>Pending Project Completion.</p>
<p>Impacts/Benefits of Implementation (actual, not anticipated)</p>	<p>Pending Project Completion.</p>
<p>Web Links</p> <ul style="list-style-type: none"> • Reports • Project website 	<p>http://portal.utpa.edu/railwaysafety/research/mechanical/projects/2015/pad-heat-generation</p>