



## Exhibit F - UTCRS

<b>UTC Project Information</b>	
Project Title	Development of Predictive Models for Spall Growth in Railroad Bearing Rolling Elements
University	The University of Texas Rio Grande Valley (UTRGV)
Principal Investigator	Robert Jones, Ph.D., Mechanical Engineering (PI) Arturo Fuentes, Ph.D., Mechanical Engineering (Co-PI) Constantine Tarawneh, Ph.D., Mechanical Engineering (Co-PI)
PI Contact Information	Mechanical Engineering ENGR 3.246 Dept. (956) 665-2394 Office (956) 665-5019 <a href="mailto:robert.jones@utrgv.edu">robert.jones@utrgv.edu</a>
Funding Source(s) and Amounts Provided (by each agency or organization)	Federal Funds (US DOT UTC Program): \$52,424 Cost Share Funds (UTPA): \$26,756
Total Project Cost	\$79,180
Agency ID or Contract Number	DTRT13-G-UTC59
Start and End Dates	January 2015 – May 2017
Brief Description of Research Project	The mechanics of spall growth in a railroad rolling element bearing will be studied using a number of bearings with spalls of various sizes. Bearings undergoing simulated service life testing will be monitored and the developing spalls will be periodically measured. From this data, a model for spall growth as a function of bearing loading, speed, and mileage will be developed. The thermal signature and vibration response of bearings with the spalls will also be obtained during testing. This signal information will permit the eventual coupling of a model of spall growth to spall detection technology to permit economical scheduling of bearing replacement after spall detection without a reduction of safety margin. Given advancements in monitoring technologies which are likely to emerge in the near future, operators will be able to identify the initiation of a spall on a bearing in

	<p>service. However, a bearing with a spall is not necessarily in danger of imminent failure. To minimize disruption to operations while providing the same level of accident prevention that early detection provides, it will be necessary to understand the growth process and the associated signals generated by various size spalls to permit timely and economical replacement of failing components.</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"> <li>• Report</li> <li>• Project Website</li> </ul>	<p><a href="http://www.utrgv.edu/railwaysafety/research/mechanical/2015/predictive-models-for-spall-growth-in-railroad-bearings/index.htm">http://www.utrgv.edu/railwaysafety/research/mechanical/2015/predictive-models-for-spall-growth-in-railroad-bearings/index.htm</a></p>