PURDUE UNIVERSITY

CAPSTONE/DESIGN EXPERIENCE 2017

GKN Universal Joint Temperature Sensor

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Agricultural & Biological ENGINEERING

Background & Problem Statement:

The project was proposed by GKN Shafts and Services to develop a temperature sensor application to accurately detect the temperature of universal joint components during operation on machines. When the temperature of these universal joint components rises to a predetermined level, a warning would need to be sent to the machine operator. The goal of this project was to be able to detect and prevent impending failure of these components, prior to an actual breakdown.

Sensor Technology & Alternative Solutions:

Requirements:

- Able to withstand harsh environmental conditions & high rotational speeds up to 1520 rpm
- 350°F peak temperature
- Wireless Capabilities
- Warning Notification

Parker — ENGINEERING YOUR SUCCESS.

SENSEOR all sense

SAW components

RFMICRON Smart Passive Sensing

Economic Analysis:

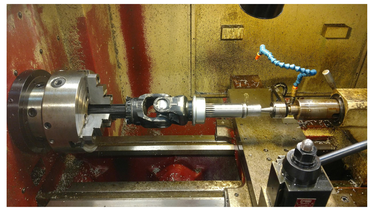
GKN PLC

RFMICRON Smart Passive Sensing

Description	Unit Price	Quantity	Total Price
Eval System w/ Handheld FCC Reader	$ 1,995.00	1	$ 1,995.00
Rugged Wireless Temperature Sensor	$ 19.45	10	$ 194.50
Shipping & Handling	$ 45.00	1	$ 45.00
		Total	$ 2,234.50

Testing Preparations:

- GKN Power Take-Off (PTO) shaft, stub shaft & universal joint components manufactured
- Ensure dynamometer was operating sufficiently
- Determine placement, location & number of sensors
- Confirm precision of RFMicron reader and sensors
  - Tested against infrared thermometer and thermal camera
- Ensure New Holland T8050 was operating sufficiently
- Draft testing procedures
- Set up testing stations at ADM
- Sensor adhesive application
- Swap universal joints



Timeline, Testing & Results:

Sensor Speed Test

- Determine if sensors would remain intact with universal joint at maximum speed (1520 rpm)
- Test was performed on a lathe
- Tachometer showed that the sensors remained intact at 1550 rpm. Adhesive was sufficient.

1000 rpm Universal Joint Tests

- PTO shaft placed at a 20° driveline angle
- Initial static component temperature measurements
- Temperature measurements were taken after 5 minutes of rotation at a constant torque load
- Torque load was increased by 100 lbf.ft. at each 5 minute interval
- Measurements were repeated until maximum temperature was reached on the dynamometer (140°F)

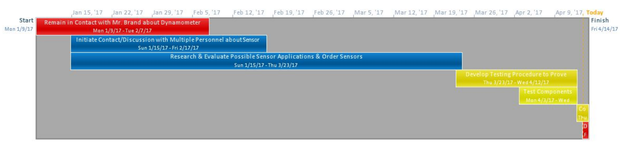


Figure 1: Project Timeline

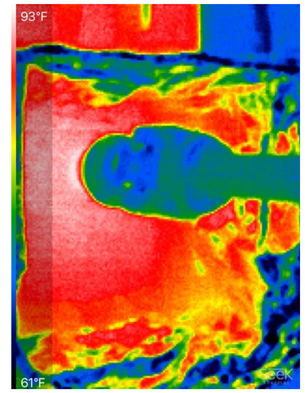


Figure 2: No Torque Loading

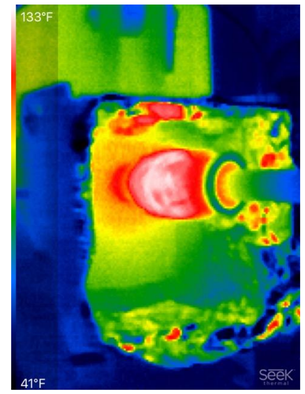
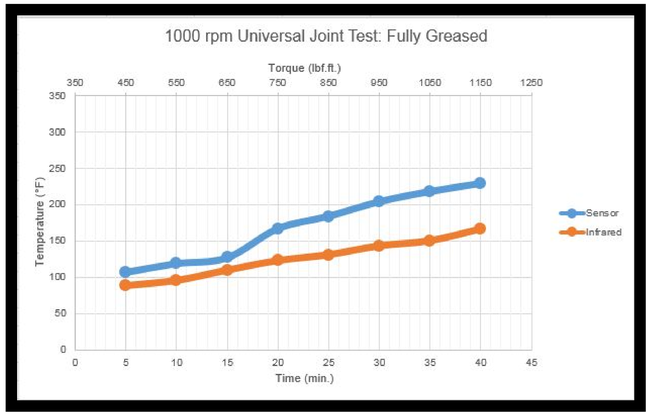
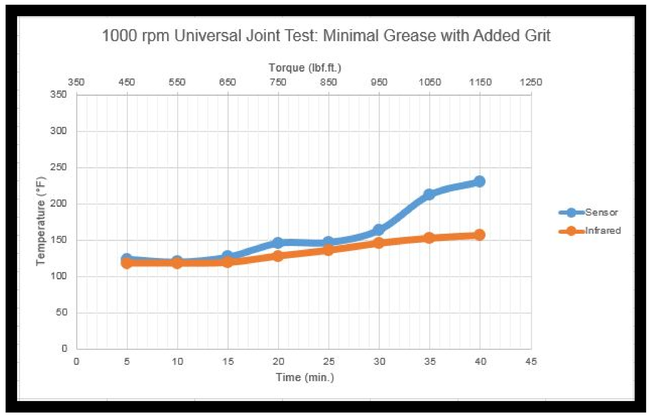


Figure 3: Applied Torque Loading





Changes During Project:

- Reduced number of sensors on u-joint
  - Allowed for greater precision during temperature measurements of bearing caps
- Addition of a 360° signal encasing around sensor area
  - Allowed sensors to retrieve and transmit signal more quickly during high speed rotation

Impact, Sustainability & Conclusion:

The testing results proved that the concept of attaching temperature sensors to universal joint components and accurately measuring temperature was possible. Not only could the sensors remain in contact with the universal joint during operation, but accurate, real time data of bearing cap temperatures could be recorded. This would ultimately make for more productive machines and a safer working environment for the machine operator. Not only could this technology be a practical safety precaution, but could also prove to be a beneficial preventative maintenance tool with little modification to the existing prototype.

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