Department of the Navy SBIR/STTR Transition Program

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NAVAIR 2016-835

Topic # N102-142
Creation of New Robust Liquid Induction Carburization Technology LINCARBOHEAT for Deep Internal Splines with High Aspect Ratios
SANOVA LLC

WHO

SYSCOM: NAVAIR

Sponsoring Program: PMA-261

Transition Target: CH-53K King Stallion Heavy Lift Replacement (HLR) Helicopter

TPOC:
(301)342-8036

Other transition opportunities: This process is applicable to similar gear alloys, sizes and high aspect ratios. Target applications are gears from 4 to 44" OD, including Herringbone Pinions with internal aspect ratio of approximately 5:1.

LINCARBOHEAT-53 Treatment Equipment,
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Notes: SANOVA's unique proprietary LINCARBOHEAT-53 treatment is based on its patented thermo-chemical processing technologies LINTERPROCESS™ and LINHEAT™ and is energy and time efficient and conducive to mass production. The applications for such powerful technology are too many to list here, as any existing metal treatment process can be enhanced by this innovation. LINCATBOHEAT-53 is a revolutionary carburizing technology for use in many applications in various industries. It represents a new integrated metals treatment class where all major stages (carburizing, heat-treatment and final tempering) are performed in same treatment chamber of one machine resulting in highly efficient cost-effective component processing.

WHAT

Operational Need and Improvement: Current aerospace gearing carburizing processes are conventional gas and vacuum. Both methods rely on carburizing gas circulation to achieve uniform surface carburization, but high gear aspect ratios can cause restriction of gas circulation inside the part, limiting carburized quality of internal features, i.e., splines. SANOVA has responded to the DoN's need for effective carburizing processes for internal high aspect ratio surfaces providing uniform coverage and case hardening depth devoid of carbon formation or sooting.

Specifications Required: PW 53 Steel K-1 double-helical output pinion gear having: i) Surface finish to be 90 Rz or better all around; ii) Carburizing case depth on the finished part 0.040-0.060" (1.00-1.50 mm); iii) Heat treatment to HRC 60-64 case hardness and HRC 33-45 core hardness; iv) Top lands and end faces of gear teeth to be masked to prevent carburization (10% leakage allowed); v) Prior to superfinish, tooth flanks and roots to be shotpeened with steel shot to intensity of .005-.007A with 200% minimum coverage. Overspray allowed except on bearing spline and thread areas; vi) Superfinish gear teeth after shotpeening. Surface finish of the load side gear tooth flanks is not to exceed 20 Ra and 150 Rz before superfinish, 4 Ra and 30 Rz after superfinish; vii) Carburizing inside areas (splines) 0.010-0.020" (0.25-o.5o mm) in case depth on the finished parts; and viii) Heat treatment to HRC 58-64 case hardness and HRC 33-45 core hardness.

Technology Developed: SANOVA has developed an effective simultaneous carburizing (internal and external surfaces) process for Pyrowear® 53 steel gears having deep internal features (i.e., splines) and high aspect ratios (> 5:1). Individual carburizing requirements (carburized case hardness and depth) can be programmed into the fully-automated LINCARBOHEAT-53 treatment protocol. Additionally developed post-carburization hardening and final tempering steps can also be performed in the same treatment chamber without the need to remove and relocate the component.

Warfighter Value: Better Warfighter performance due to significantly enhanced gear performance. Less frequent maintenance due to gear failure. Significant increase in reliability and up-time of the aircraft. Considerable reduction in manufacturing, operational and service costs.

WHEN

Contract Number: N68335-14-C-0070 **Ending on:** June 15, 2016

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Creation of new LINCARBOHEAT-53 carburizing technology prototype	Low		1	May 2012
Creation of new liquid N2 heat-treatment technology and integration into LINCARBOHEAT-53	Med		2	October 2014
Completion of LINCARBOHEAT-53 prototype technology development	Med		4	May 2016
Transition of prototype LINCARBOHEAT-53 technology to treatment of live gears	Med		6	December 2017
Creation and validation of production LINCARBOHEAT-53 technology and equipment for commercialization	Med		8	September 2018

HOW

Projected Business Model: Generally, SANOVA does not manufacture. We are a metallurgical research company and develop innovative technologies and equipment for customers to implement into their manufacturing processes, e.g., LINCARBOHEAT-53. Once the technology prototype is fully developed, SANOVA will design and build manufacturing equipment for commercialization and implementation of this technology for various required components. Production versions of treatment technologies and equipment (primary and auxiliary) will undergo testing and verification at SANOVA, after which they will be transferred to a customer-designated facility. SANOVA will sell or license this technology to the OEM customer. If the customer prefers to keep the production equipment at SANOVA and for SANOVA to process supplied gears, we are open for discussion.

Company Objectives: LINCARBOHEAT-53 carburizing technology was created from our patented seed technologies LINTERPROCESS and LINHEAT. SANOVA strives to become a leader in this area and offer the DoD and commercial customers best-of-breed innovative thermo-chemical and heat-treatment solutions. SANOVA is looking to transition our technology and complete full automation of the LINCARBOHEAT-53 process for commercialization. When fully completed, this technology can be customized for for such applications as processing of air, land and marine vehicle components and engine components for improved performance and longevity.

Potential Commercial Applications: SANOVA is already working with the Ch-53K Prime but would like to introduce this technology to other aircraft, sea and ground vehicle Primes, where integrated efficient carburizing is in highest demand. It is also important to note, that SANOVA has developed similar treatment technologies for other steels and also for refractory metals, such as Ti, Zr, Ta, Nb.

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