WEBINAR

Hybridisation, electrification and the vital role of torsional vibration analysis

Thursday 7 November • 14:30-15:30 GMT

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PANELLISTS



Bob Lennon

Industry Manager for marine and CENTA
Regal Rexnord

Hybridisation, electrification and the vital role of torsional vibration analysis

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PANELLISTS



Dr Mahamudul Hasan

Director of Research and Development for couplings

Regal Rexnord

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Creating a Better Tomorrow

HYBRIDISATION, ELECTRIFICATION, & THE VITAL ROLE OF TORSIONAL VIBRATION ANALYSIS







RegalRexnord

SPEAKERS



Bob Lennon
Industry Manager, Expert
Marine & Power Generation



Dr. Mahamudul Hasan, Ph.D.
Director of Research and Development,
Couplings

CONNECT ON LinkedIn!

AGENDA

- THE REGAL REXNORD ADVANTAGE
- HYBRID DRIVELINE DESCRIPTIONS AND OPERATIONAL CONDITIONS
- TRANSIENT POWER LOSS & VIBRATORY TORQUE DIFFERENCES IN PROPULSION COUPLINGS
- CONCLUSIONS
- QUESTIONS



BUSINESS PURPOSE

WE CREATE A BETTER TOMORROW

with sustainable solutions that power, transmit, and control motion.™



THE REGAL REXNORD ADVANTAGE: UNMATCHED BRAND LEADERSHIP

Application

SHIP POWER

Engines & E-Motors

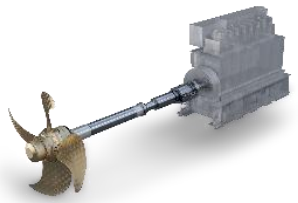




- Internal Combustion
- Electric Motors
- Hybrid Drives

PROPULSION

Propellers



- Fixed fitch (FPP)
- Controllable pitch (CPP)

Waterjets



- Axial flow pump
- Centrifugal pump
- Mixed flow pump

Thrusters & ASD Drives



- Tunnel
- Azimuth
- Retractable
- Azipull
- Rim drive

Products



Flexible & Torsional Couplings



Turning, Locking & Braking Systems



Hydraulic Couplings



Intermediate Driveshafts



Clutches & Brakes

Brands

CENTA

JAURE®

STROMAG™

Stearns®

SVENDBORG BRAKES™

TWIFLEX™

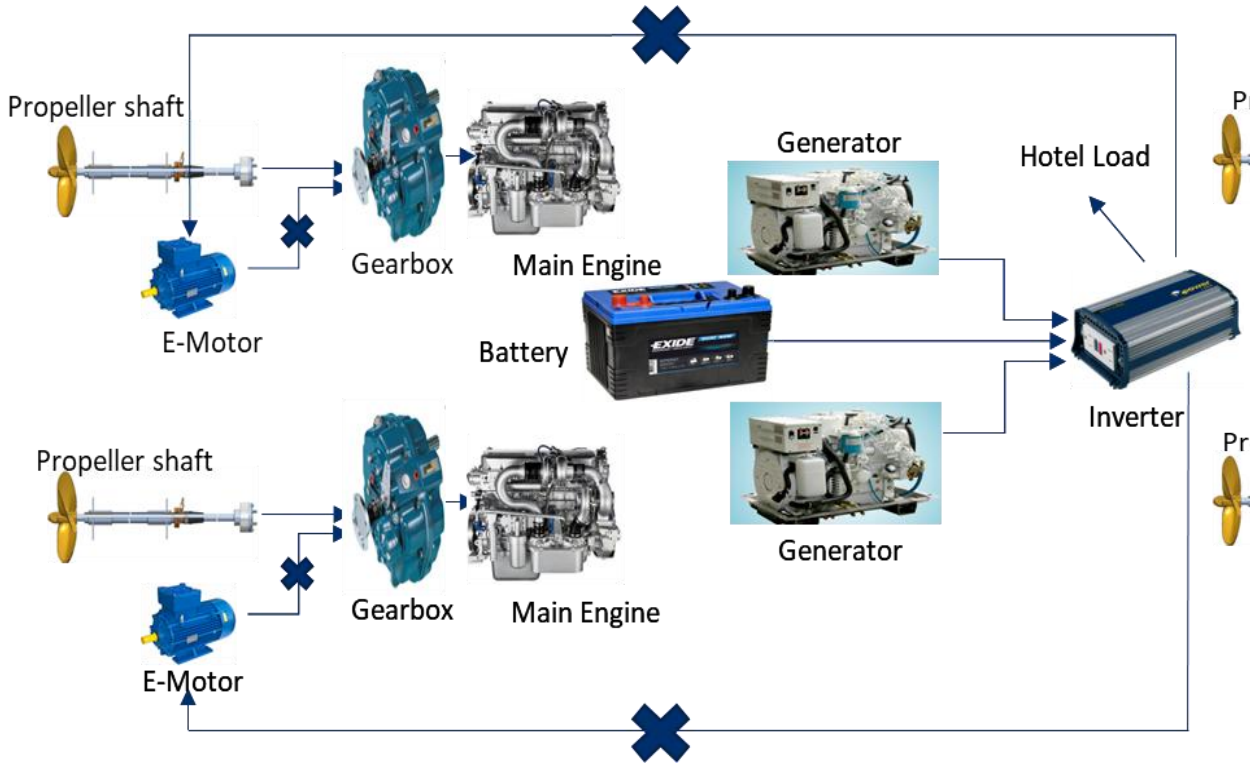
WICHITA CLUTCH™

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RegalRexnord™

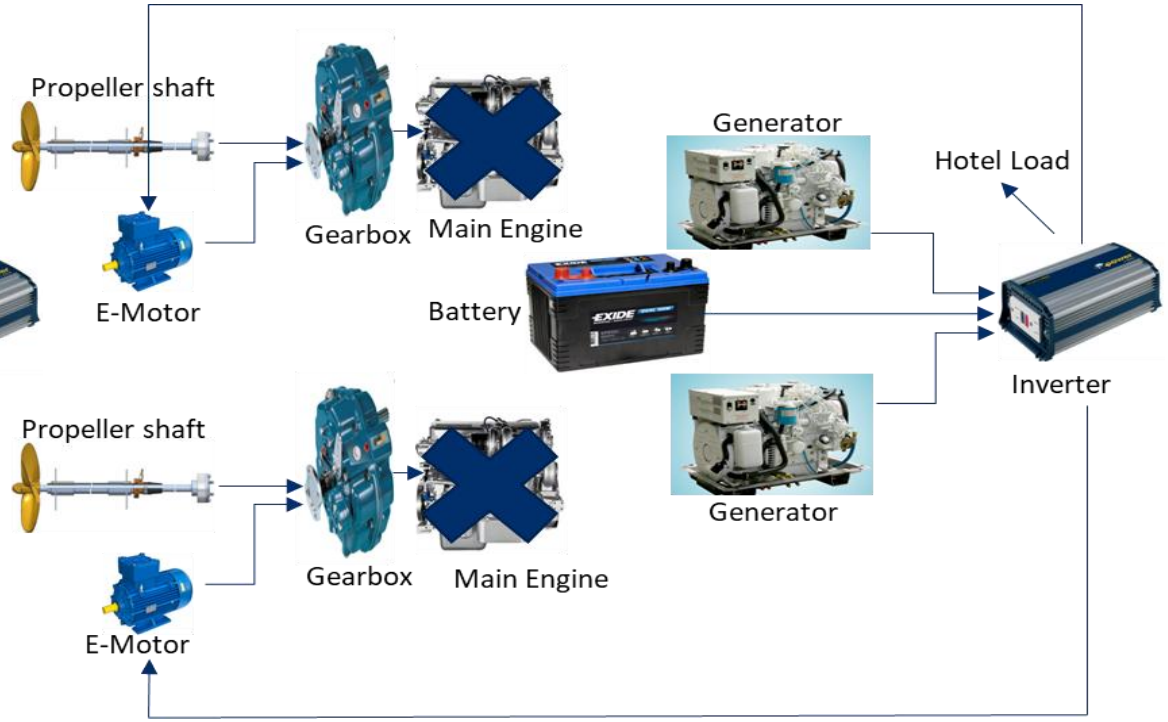
HYBRID DRIVELINE DESCRIPTION & OPERATIONAL CONDITIONS

Diesel Drive Mode



- E-Motor Off
- Propulsion by Main Engine (Diesel)
- Hotel Load by Main Generator or Battery

Electric Drive Mode

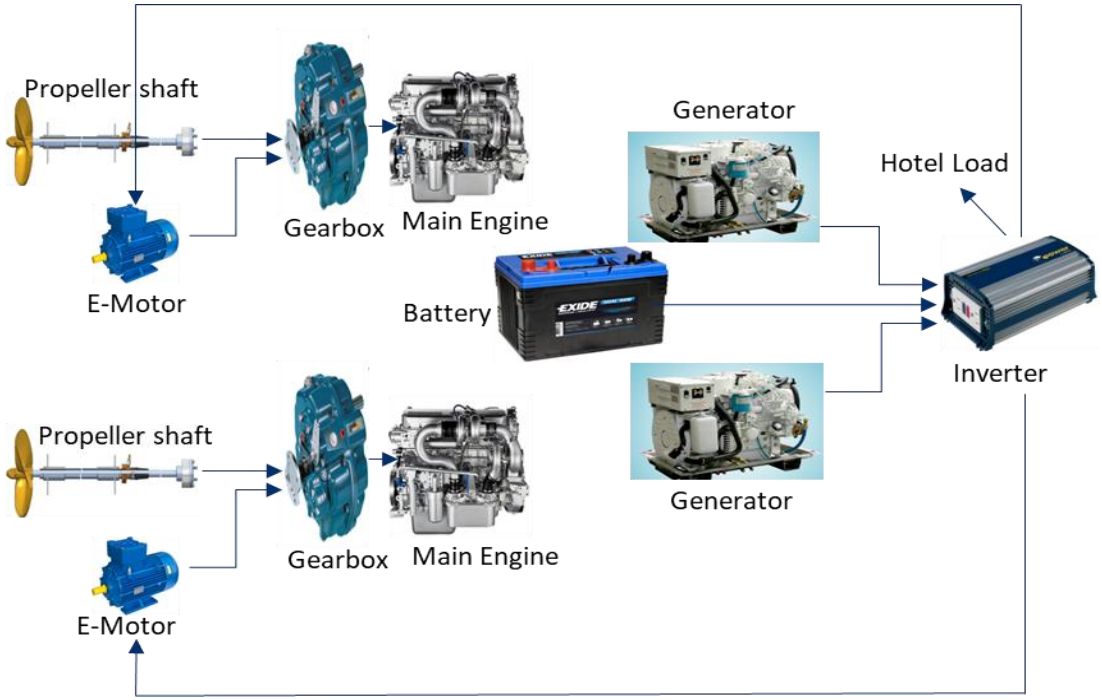


- Main Engine (Diesel) off
- Propulsion by E-Motor
- Powered by Main Generator or Battery
- Hotel Load by Main Generator or Battery

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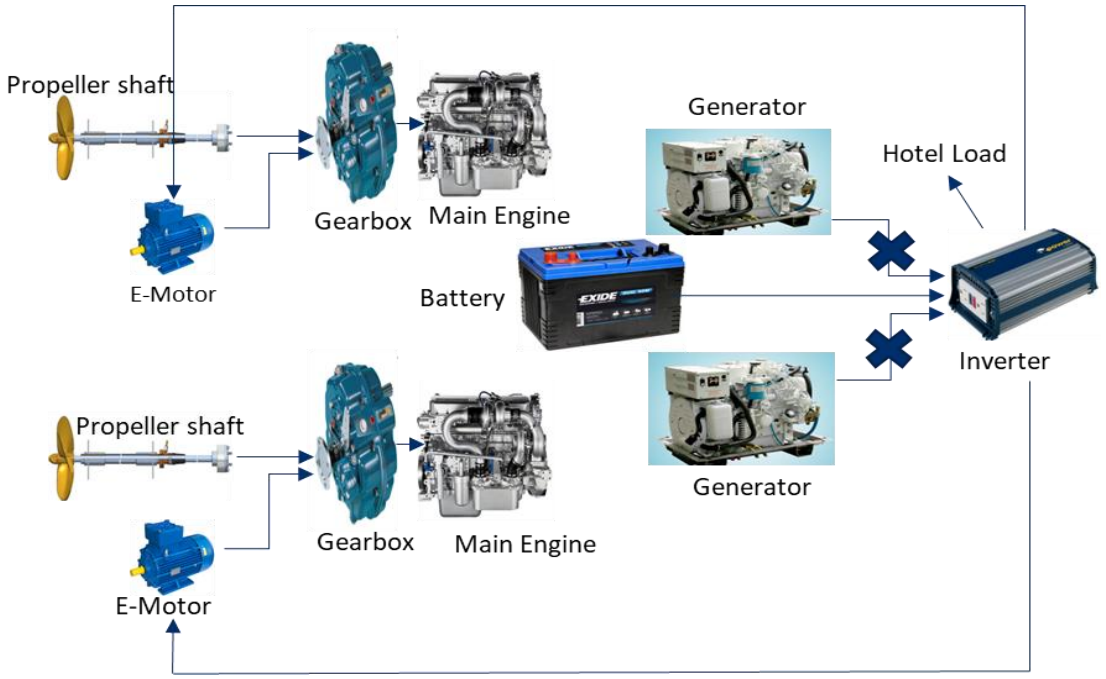
HYBRID DRIVELINE DESCRIPTION & OPERATIONAL CONDITIONS

Boost Mode



- Main Engine (Diesel) On
- Main Generator On
- Propulsion by E-Motor and Main Engine (Diesel)
- Powered by Main Generator or Battery
- Hotel Load by Main Generator or Battery

Generator Mode



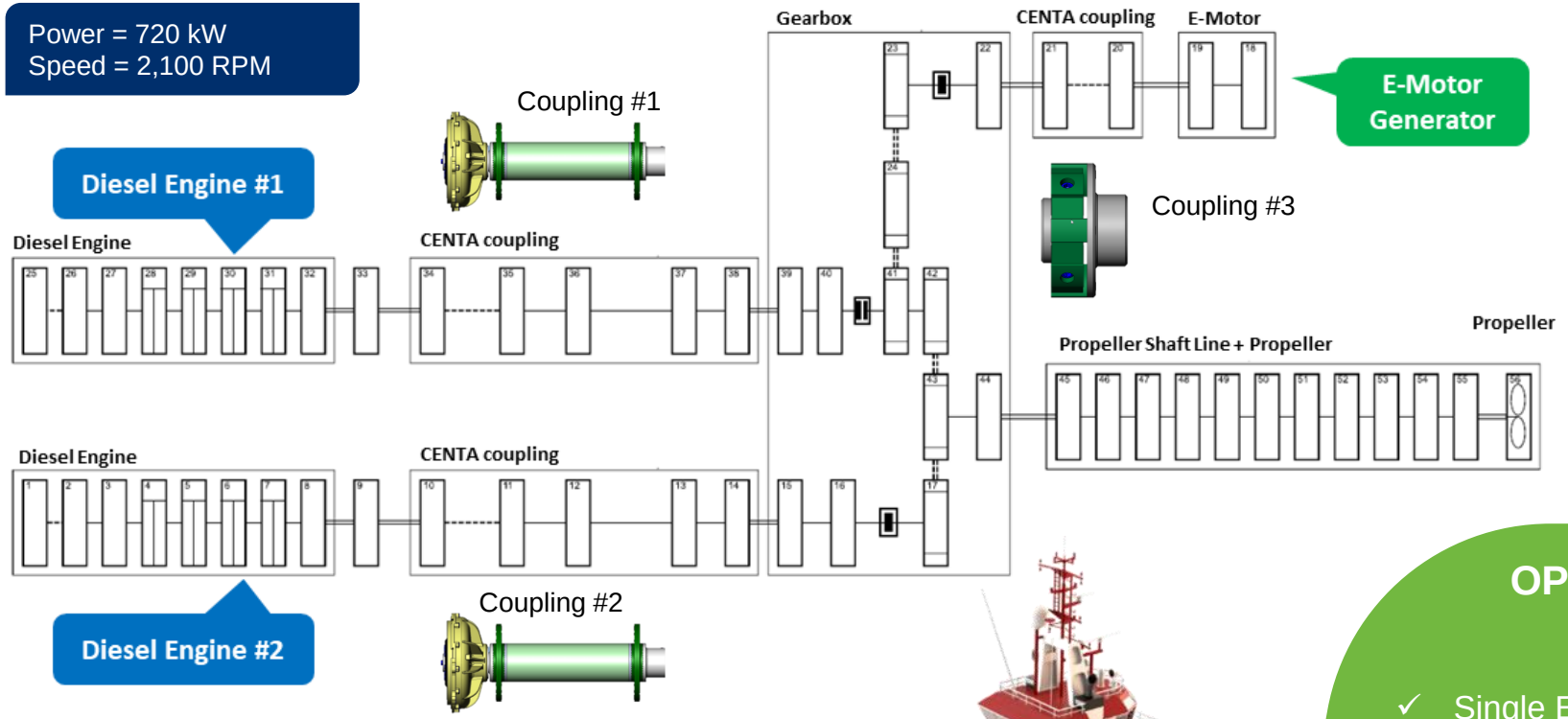
- Main Engine (Diesel) On
- Propulsion by Main Engine (Diesel)
- E-Motor as Generator Driven by Main Engine
- Main Generator only switched on if additional load of battery or hotel load is required

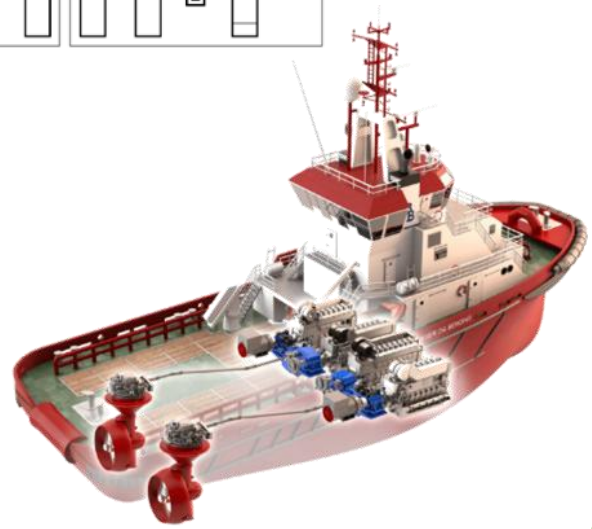
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HYBRID DRIVELINE DESCRIPTION AND OPERATIONAL CONDITIONS

Hybrid Driveline Example

Power = 720 kW
Speed = 2,100 RPM





REGAL REXNORD:

- Conducts the Torsional Vibration Analysis (TVA) in-house.
- Models engines with In-Line or Vee configuration for different fuels (diesel, gas, methanol, hydrogen, ammonia, others).
- Have conducted numerous TVA's for Methanol and Methane Slip Solution (MSS).

WHAT IS REQUIRED:

- Engine Excitation data and complete system Mass Elastic data along with Operating Conditions.

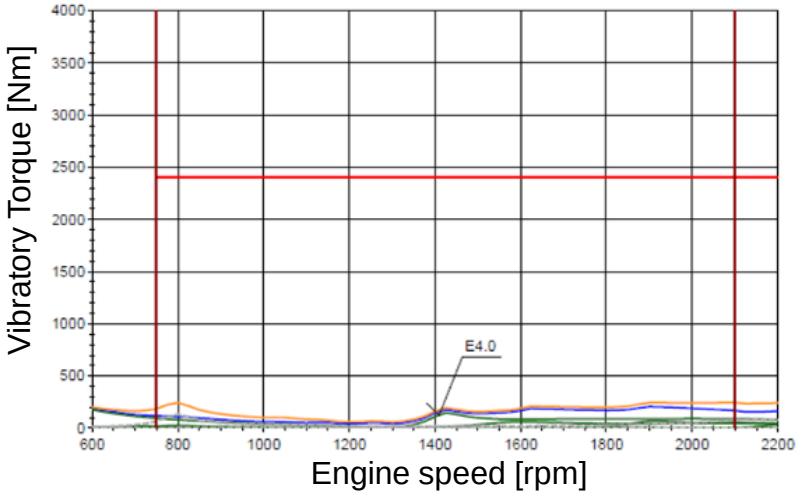
OPERATING CONDITIONS OF VESSEL

- ✓ PTI engaged; Full pitch
- ✓ Single Engine engaged; PTO Engaged; Propeller Full Pitch
- ✓ Single Engine engaged; PTO Engaged; Propeller Zero Pitch
- ✓ Single Engine engaged; PTO Dis-engaged; Propeller Full Pitch
- ✓ Single Engine engaged; PTO Dis-engaged; Propeller Zero Pitch
- ✓ Both Engines engaged; PTO Dis-engaged ; Propeller Full Pitch
- ✓ Both Engines engaged; PTO Dis-engaged ; Propeller Zero Pitch
- ✓ Both Engines engaged; PTO Engaged; Propeller Full Pitch
- ✓ Both Engines engaged; PTO Engaged; Propeller Zero Pitch

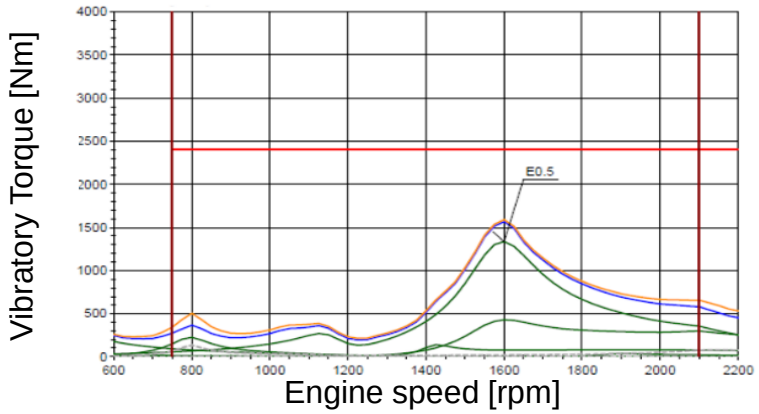
RegalRexnord

SINGLE ENGINE ENGAGED; PTO ENGAGED; FULL PITCH

Vibratory torque in coupling #1

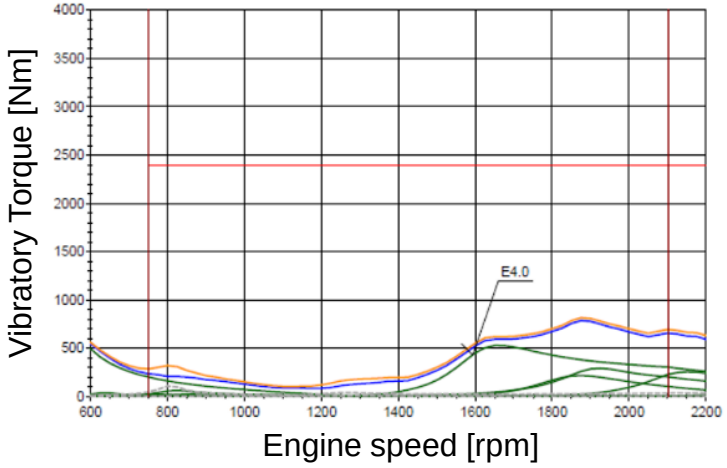


Vibratory torque in coupling #1

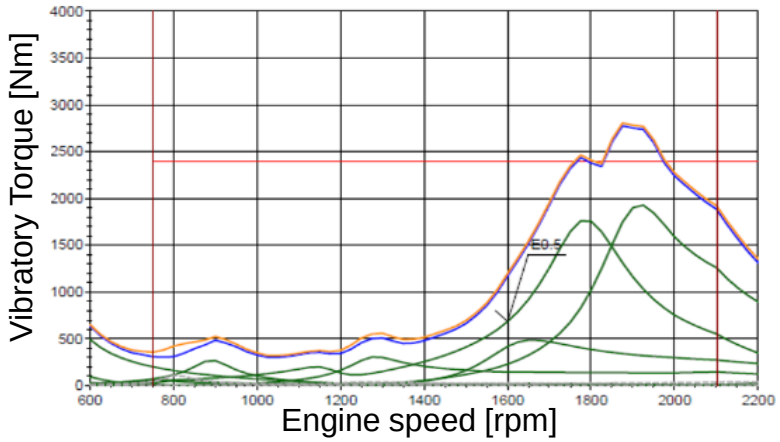


Tailored Solution

Vibratory torque in coupling #1



Vibratory torque in coupling #1



Original Solution

Vibratory torque in coupling #1

Normal Operating

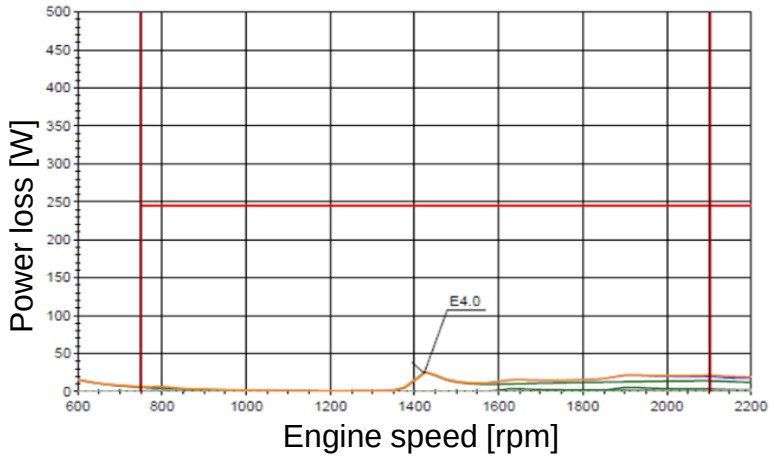
- Modified/tailored solution reduces vibration level

Misfiring

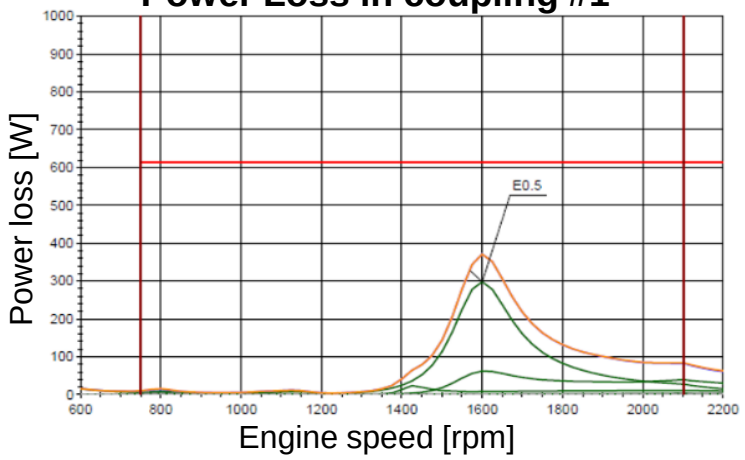
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SINGLE ENGINE ENGAGED; PTO ENGAGED; FULL PITCH

Power Loss in coupling #1

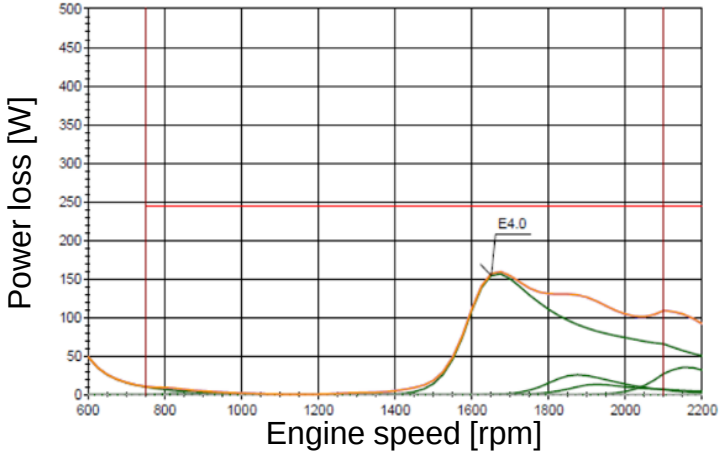


Power Loss in coupling #1

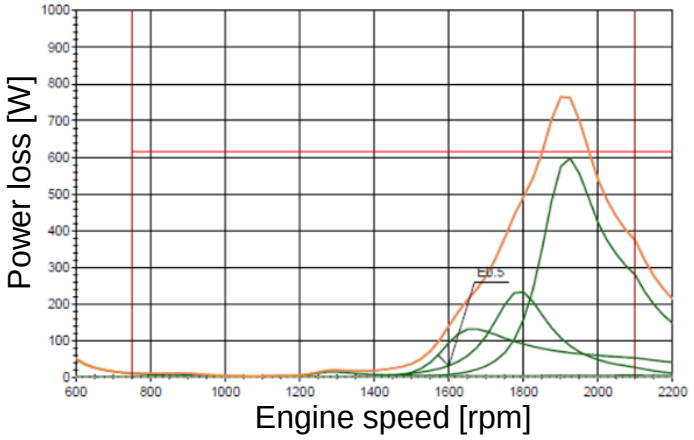


Tailored Solution

Power Loss in coupling #1



Power Loss in coupling #1



Original Solution

Power loss in coupling #1

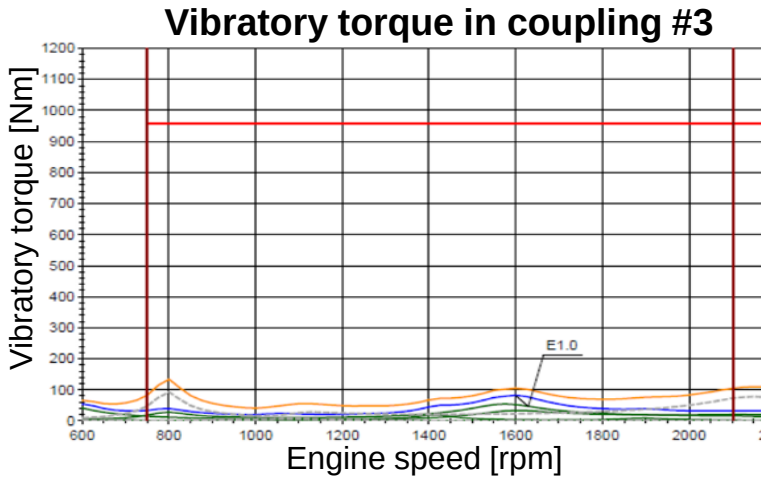
Normal Operating

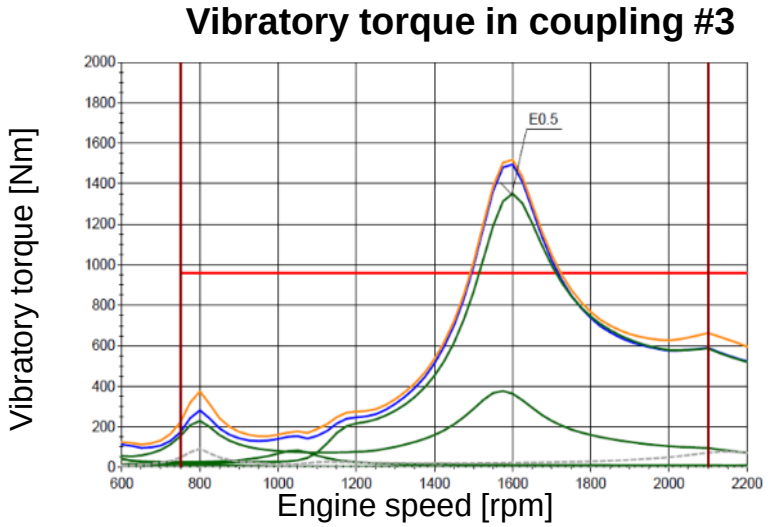
- Modified/tailored solution reduces vibration level

Misfiring

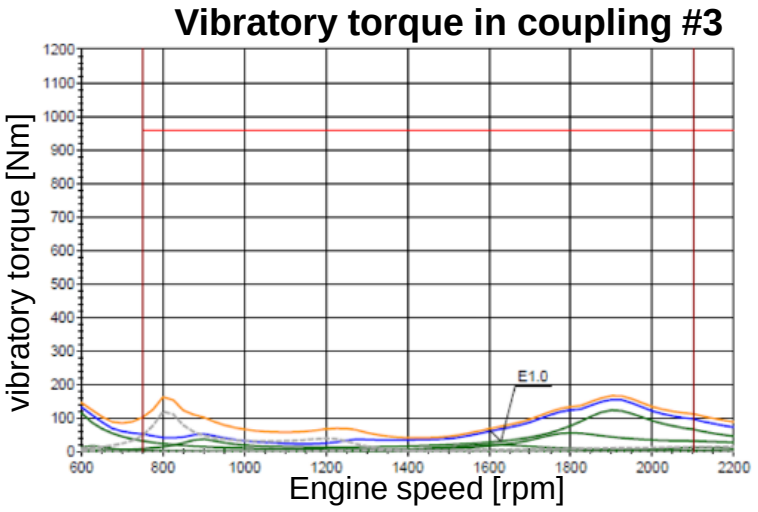
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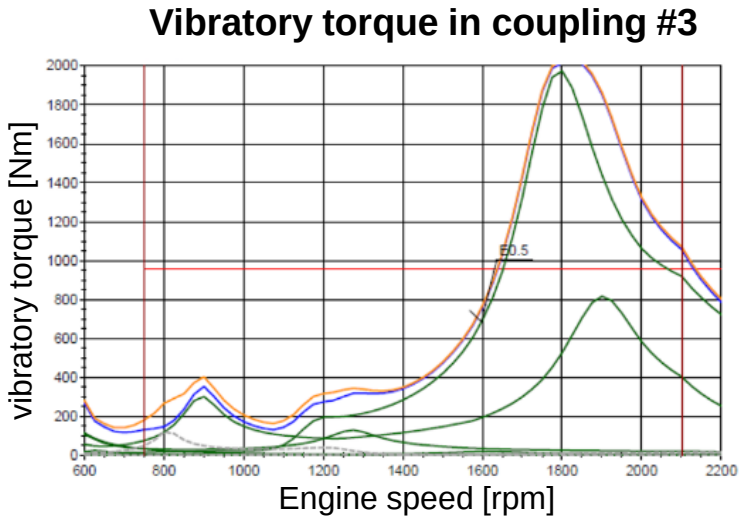
SINGLE ENGINE ENGAGED; PTO ENGAGED; FULL PITCH





Tailored Solution





Original Solution

Vibratory torque in coupling #3

Normal Operating

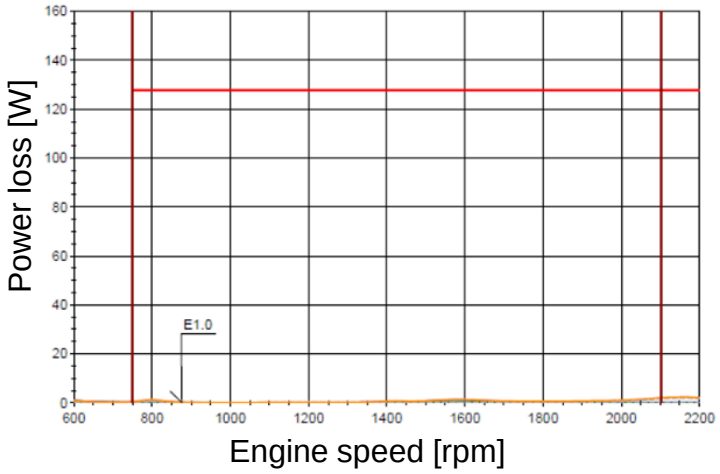
- The vibration magnitude of coupling #3 is different compared to coupling #1 & #2
- The duration of operational conditions and their repetitions play an important role for the coupling selection

Misfiring

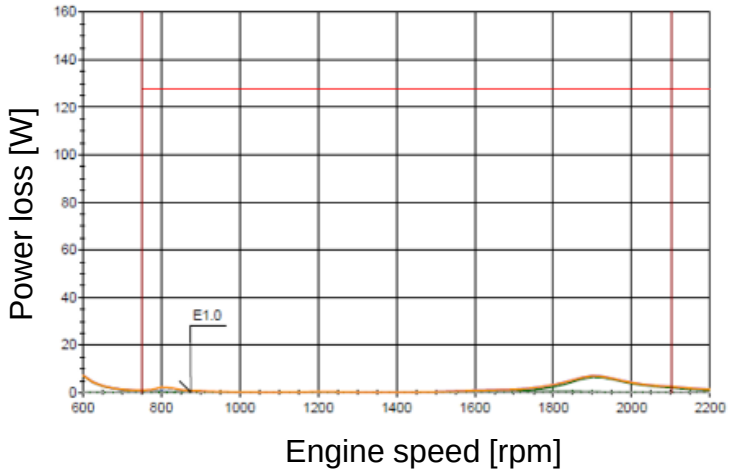
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SINGLE ENGINE ENGAGED; PTO ENGAGED; FULL PITCH

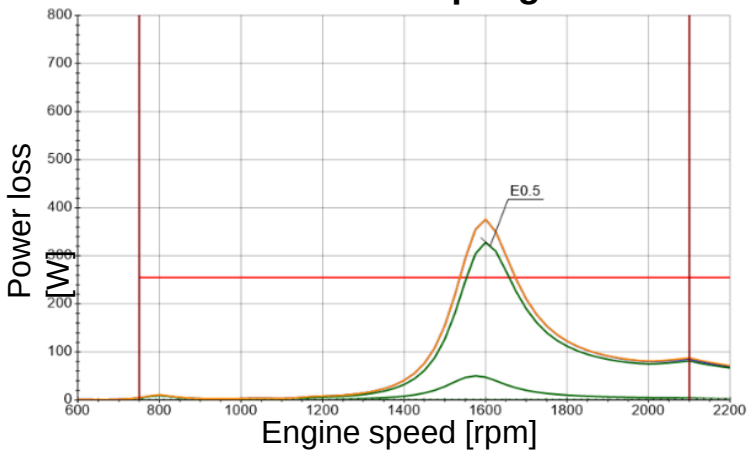
Power Loss in coupling #3



Power Loss in coupling #3

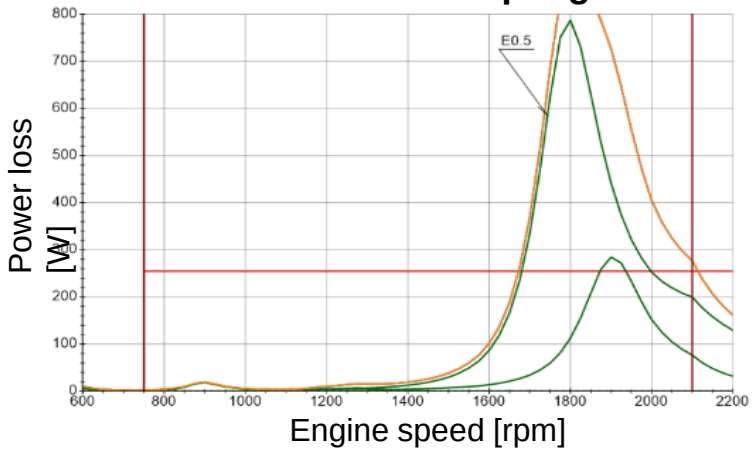


Power Loss in coupling #3



Tailored Solution

Power Loss in coupling #3



Original Solution

Power loss in coupling #3

Normal Operating

- The vibration magnitude of coupling #3 is different compared to coupling #1 & #2
- The duration of operational conditions and their repetitions play an important role for the coupling selection

Misfiring

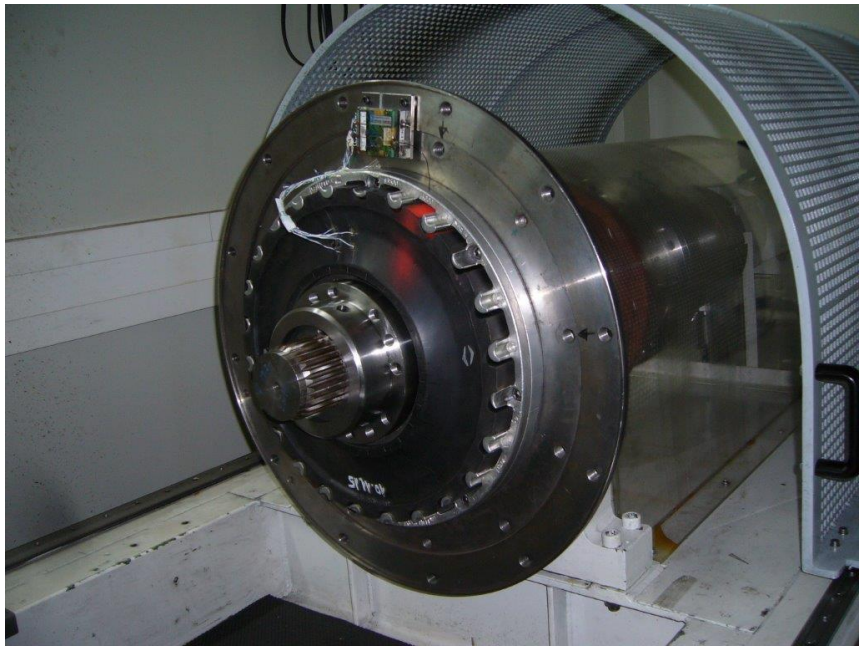
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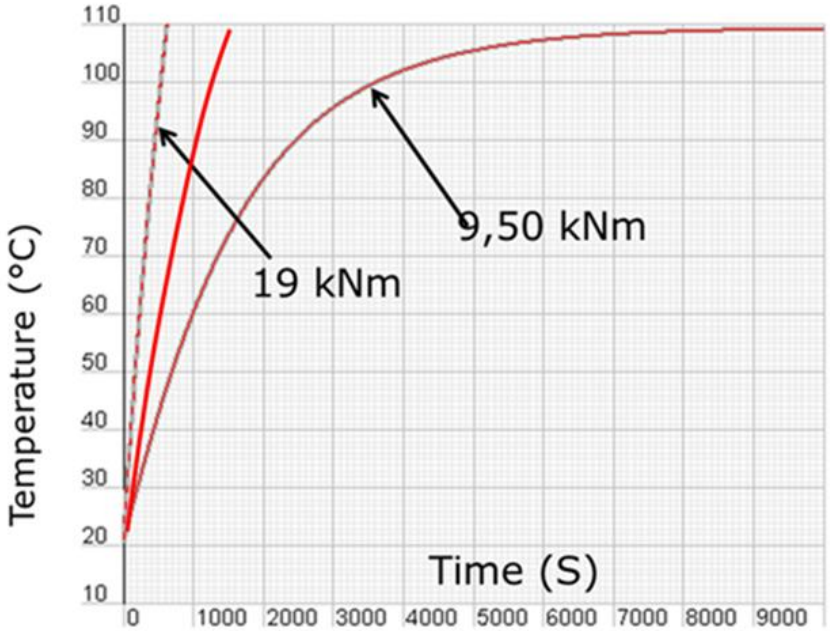
Development of transient power loss in rubber couplings to establish new time dependent limit.

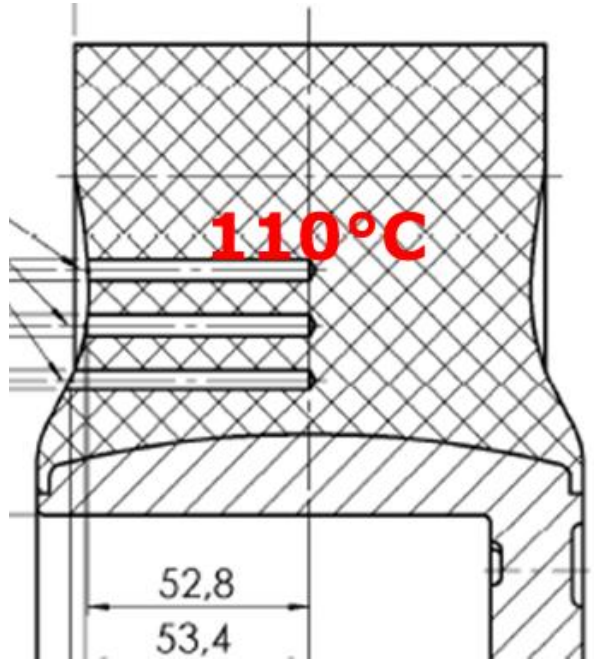
CURRENT INDUSTRY STANDARD PROCESS

Limitation:

Difficult to reach 110°C for larger couplings in short time periods due to required load levels.



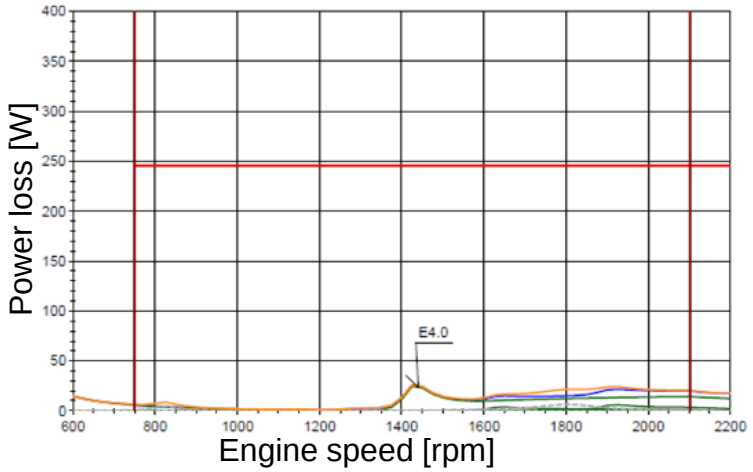




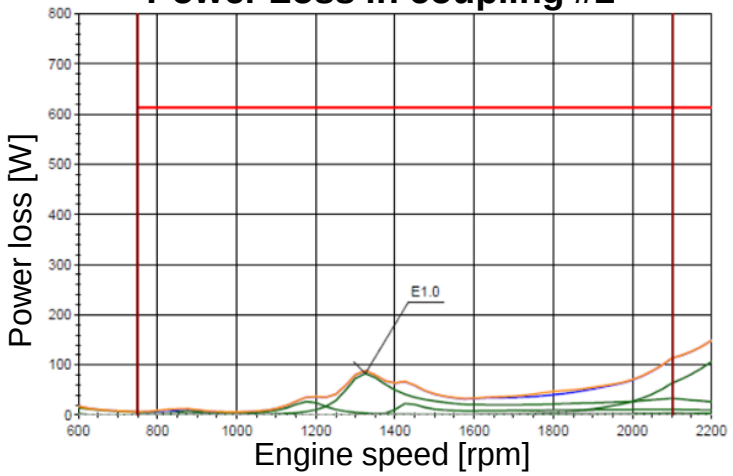
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SINGLE ENGINE ENGAGED; PTO DISENGAGED; FULL PITCH

Power Loss in coupling #2

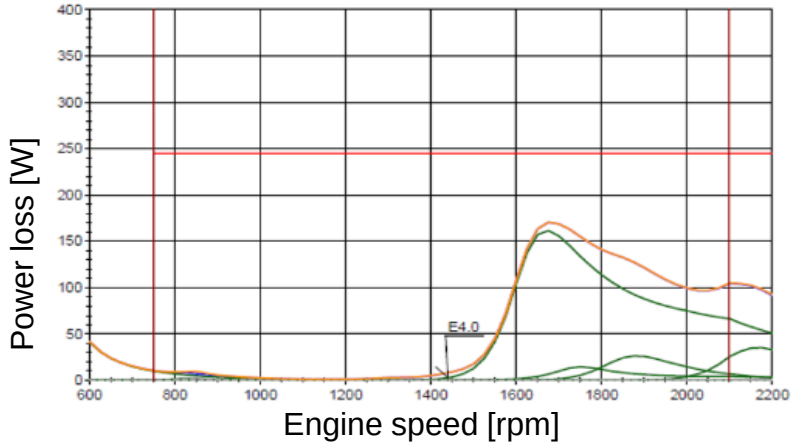


Power Loss in coupling #2

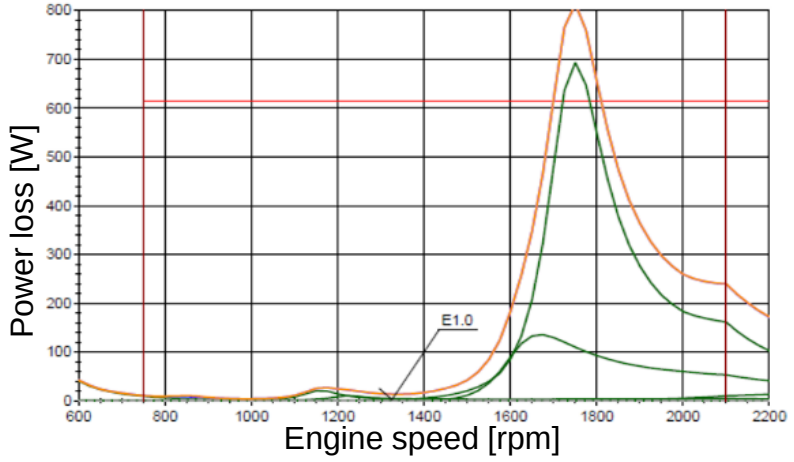


Tailored Solution

Power Loss in coupling #2



Power Loss in coupling #2



Original Solution

Power loss in coupling #2

Normal Operating

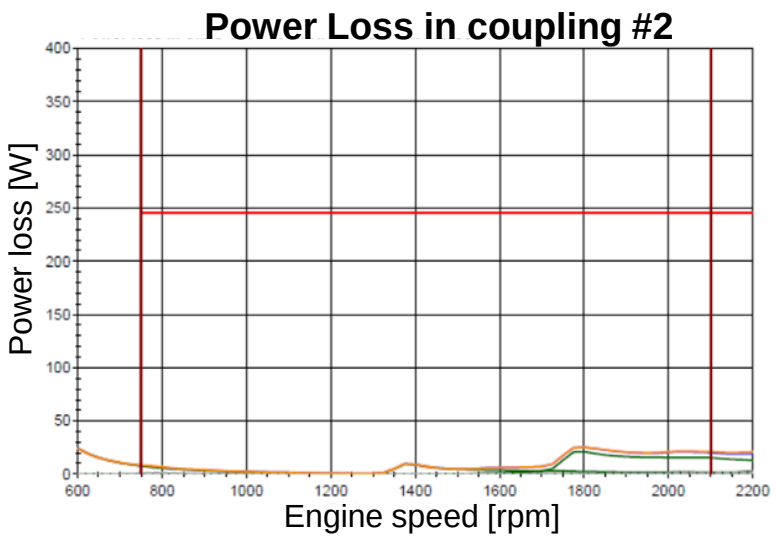
The operational conditions play an important role for a coupling selection

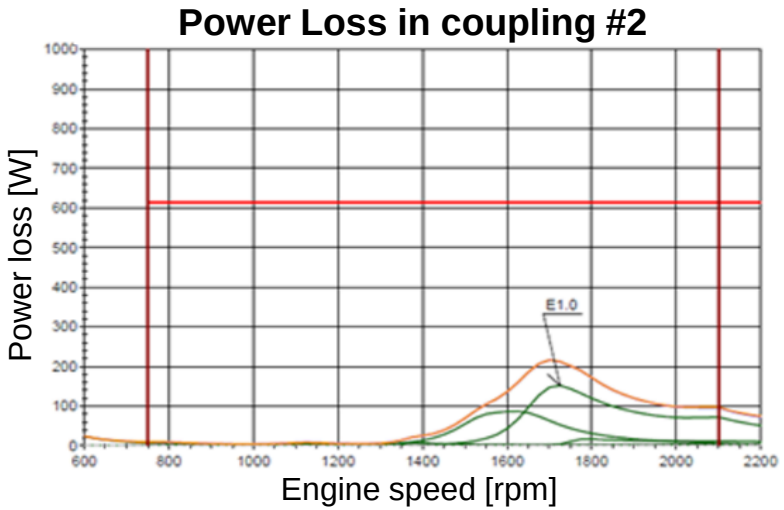
Misfiring

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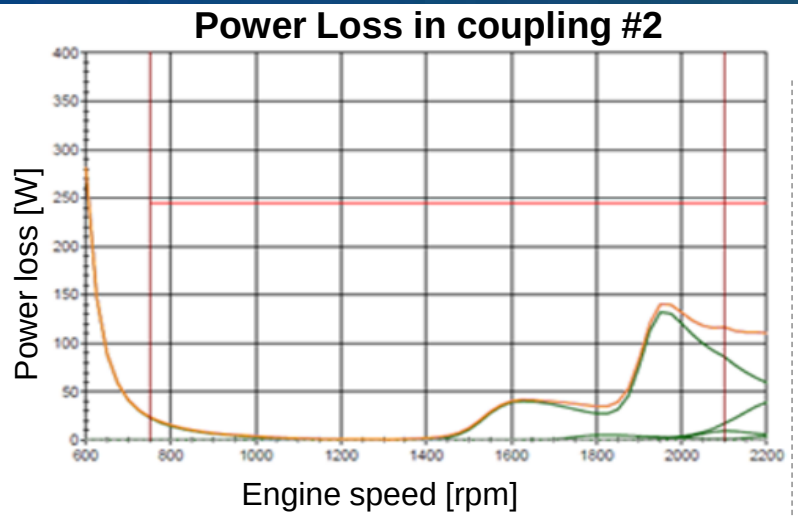
RegalRexnord

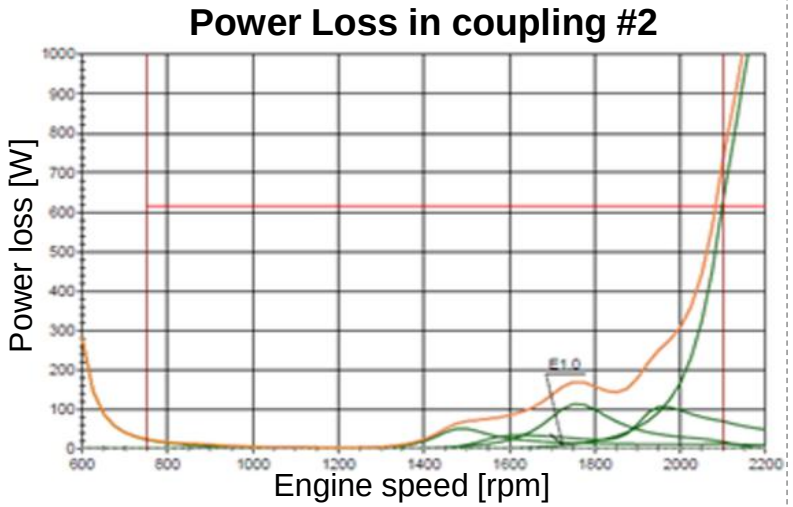
BOTH ENGINES ENGAGED; PTO ENGAGED; FULL PITCH





Tailored Solution





Original Solution

Power loss in coupling #2

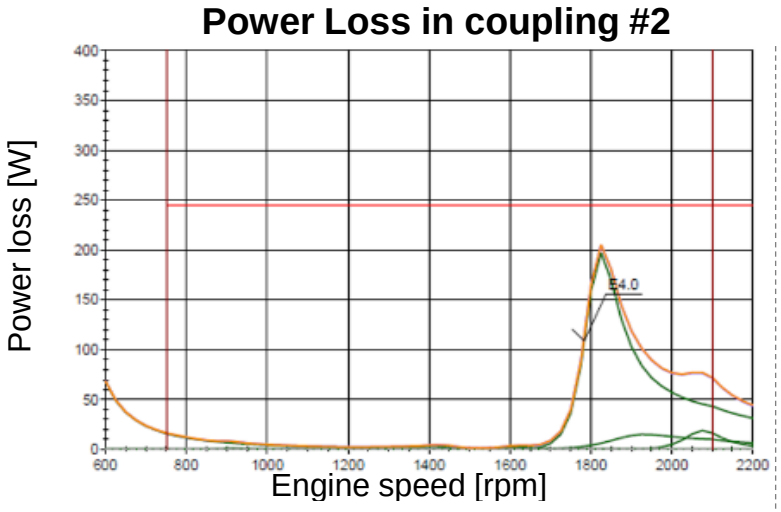
Normal Operating

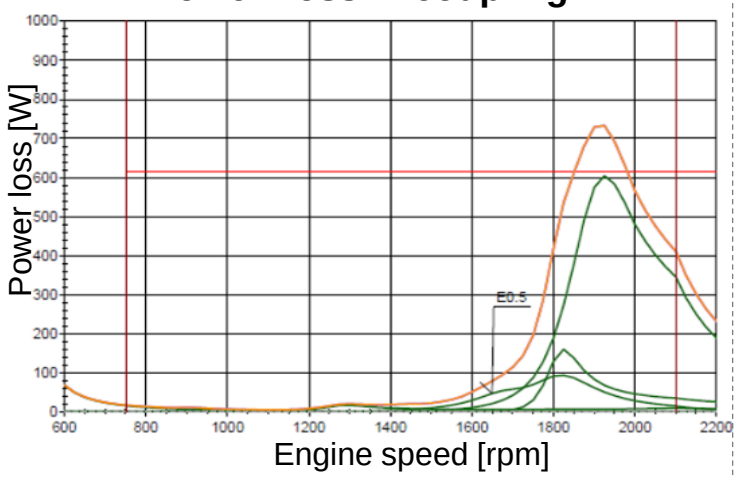
Operational conditions play an important role in coupling selection

Misfiring

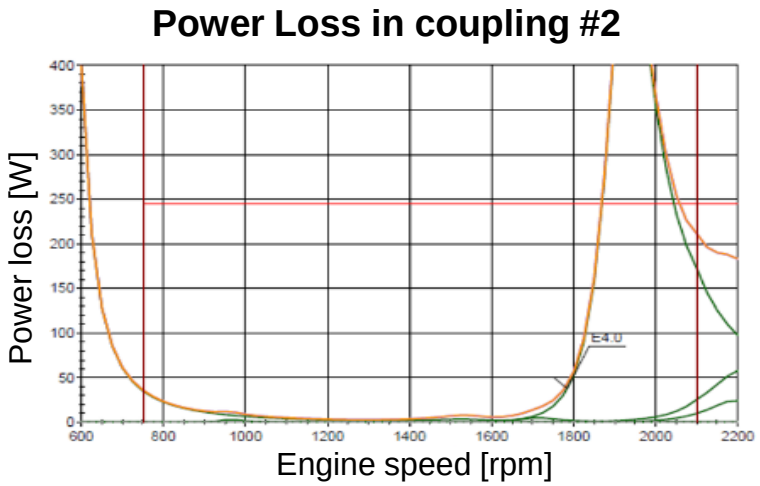
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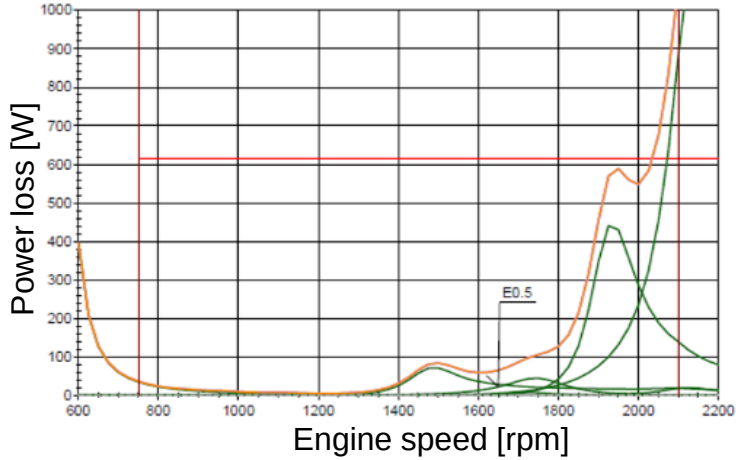
BOTH ENGINES ENGAGED; PTO ENGAGED; FULL PITCH





Tailored Solution





Original Solution

Power loss in coupling #2

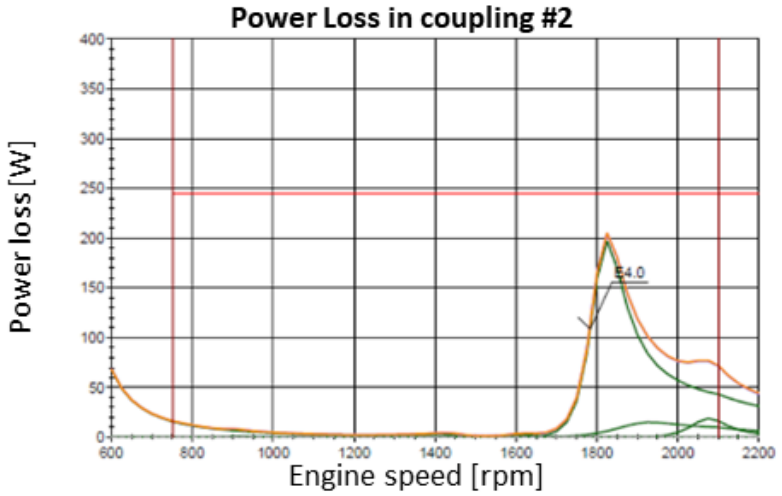
Normal Operating

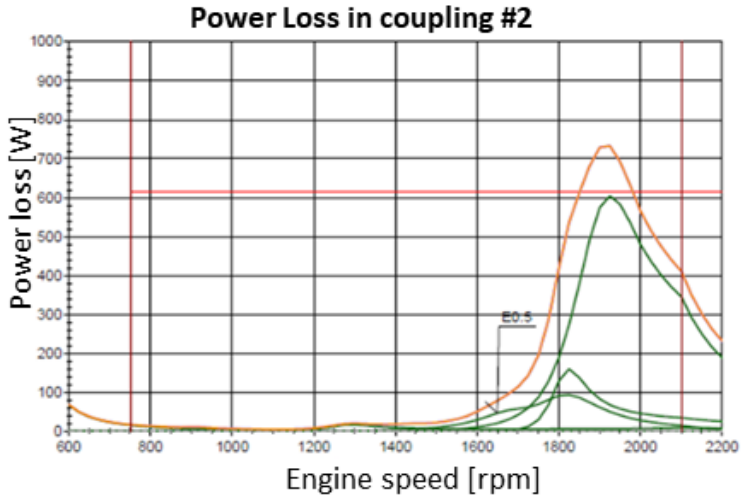
Both engines engaged conditions provide more excitation torque which leads to higher vibrations

Misfiring

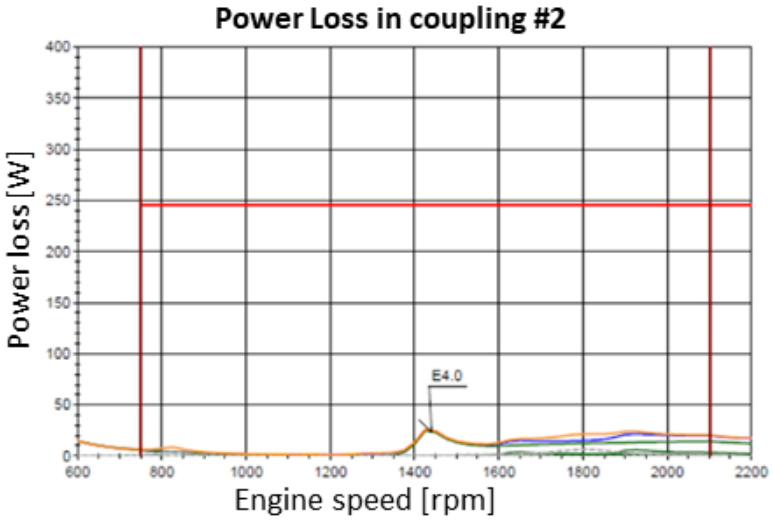
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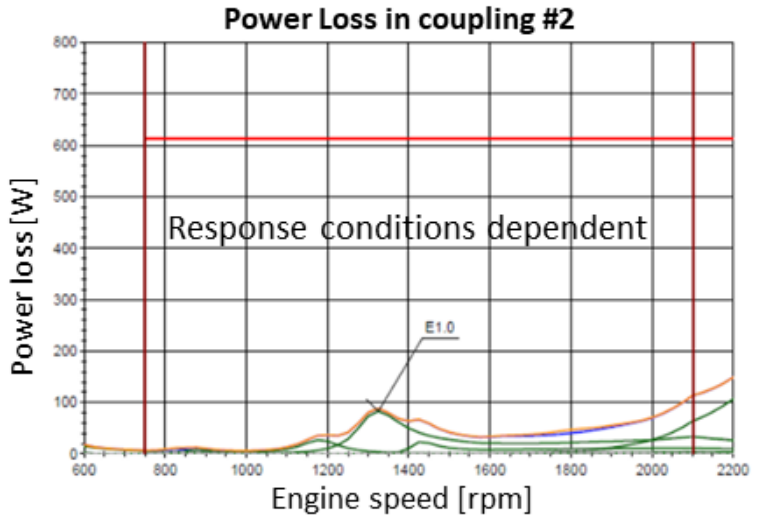
COMPARISONS BETWEEN SINGLE AND DOUBLE ENGINE ACTIVE COUPLING RESPONSE





Double Engines





Single Engine

Both engines engaged conditions provide more excitation torque which leads to higher vibrations.

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CONCLUSION – THE VALUE OF A DETAILED TVA

In this presentation, we have:

- Simulated the possible combinations of operating conditions in a parallel hybrid driveline.
  - Shown how understanding the vessel operating conditions plays a key role in confirming correct coupling specification as the vibration responses vary according to operating mode.
- Confirmed acceptable vibration levels in all hybrid drive modes.
  - Confirmed in this drivetrain by integrating a torsionally elastic coupling with a light-weight composite shaft and an optimized middle mass, which reduces the load on the driven components and thereby increases the expected lifetime of the marine transmission.



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To speak with an expert about how we can support your marine applications contact:

Americas - CentaAmericas@RegalRexnord.com

Europe & Asia - CentaMarine@RegalRexnord.com



THE REGAL REXNORD ADVANTAGE – UNMATCHED BRAND LEADERSHIP

Application

SHIP POWER

Engines & E-Motors

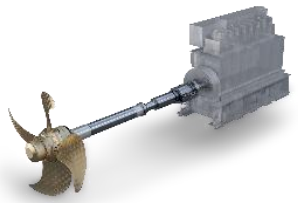




- Internal Combustion
- Electric Motors
- Hybrid Drives

PROPULSION

Propellers



- Fixed fitch (FPP)
- Controllable pitch (CPP)

Waterjets



- Axial flow pump
- Centrifugal pump
- Mixed flow pump

Thrusters & ASD Drives



- Tunnel
- Azimuth
- Retractable
- Azipull
- Rim drive

Products



Flexible & Torsional Couplings



Turning, Locking & Braking Systems



Hydraulic Couplings



Intermediate Driveshafts



Clutches & Brakes

Brands

CENTA

JAURE®

STROMAG™

Stearns®

SVENDBORG BRAKES™

TWIFLEX™

WICHITA CLUTCH™

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UPCOMING EVENTS

















SCAN HERE TO SEE THE FULL EVENTS SCHEDULE



"MEALTIMES WITH MY MARITIME FRIENDS" BOOK LAUNCH EVENT

Wine tasting, buffet dinner, art tour, book signing and live auction!

Wednesday 20 November
17:30-21:30, London

THE BRUN BEAR Foundation