



*Vibration and Noise
Engineering Solutions*

Global Ship Solutions Inc.
Canada Corporation: 1117971-3
101, 5955 Yew Street
Vancouver, BC, V6M 3Y7, Canada

TSI Europe – Introduction to Canada

(Noise and Vibrations Engineering)

Respected,

Global Ship Solutions Inc. (GSS Inc.) is a proud Canadian company working in the shipbuilding industry and is the representative of **TSI** Europe in Canada.

TSI a company specialized in Vibration & Noise Measurement, Analysis and Control, Condition Base Maintenance (CBM), Failures Consultancy, Dynamic Analysis: Theoretical and Experimental and Condition Monitoring Systems: gather more than 2.800 references for these applications for national and foreign Civilian and Military Shipyards.

The Services of **TSI**, accredited by DNV, UKAS, RVA, and DMA, had permitted delivery of all types of Ships: Passengers, Luxury Yachts, LNG's, Fishing Research Vessels, Merchants and Fishing Vessels; in compliance with the most strictly Comfort, Radiated External Noise and Underwater Radiated Noise Requirements, Usually required by current Regulations: IMO, ILO Comfort Class Notations, and ICES 209.



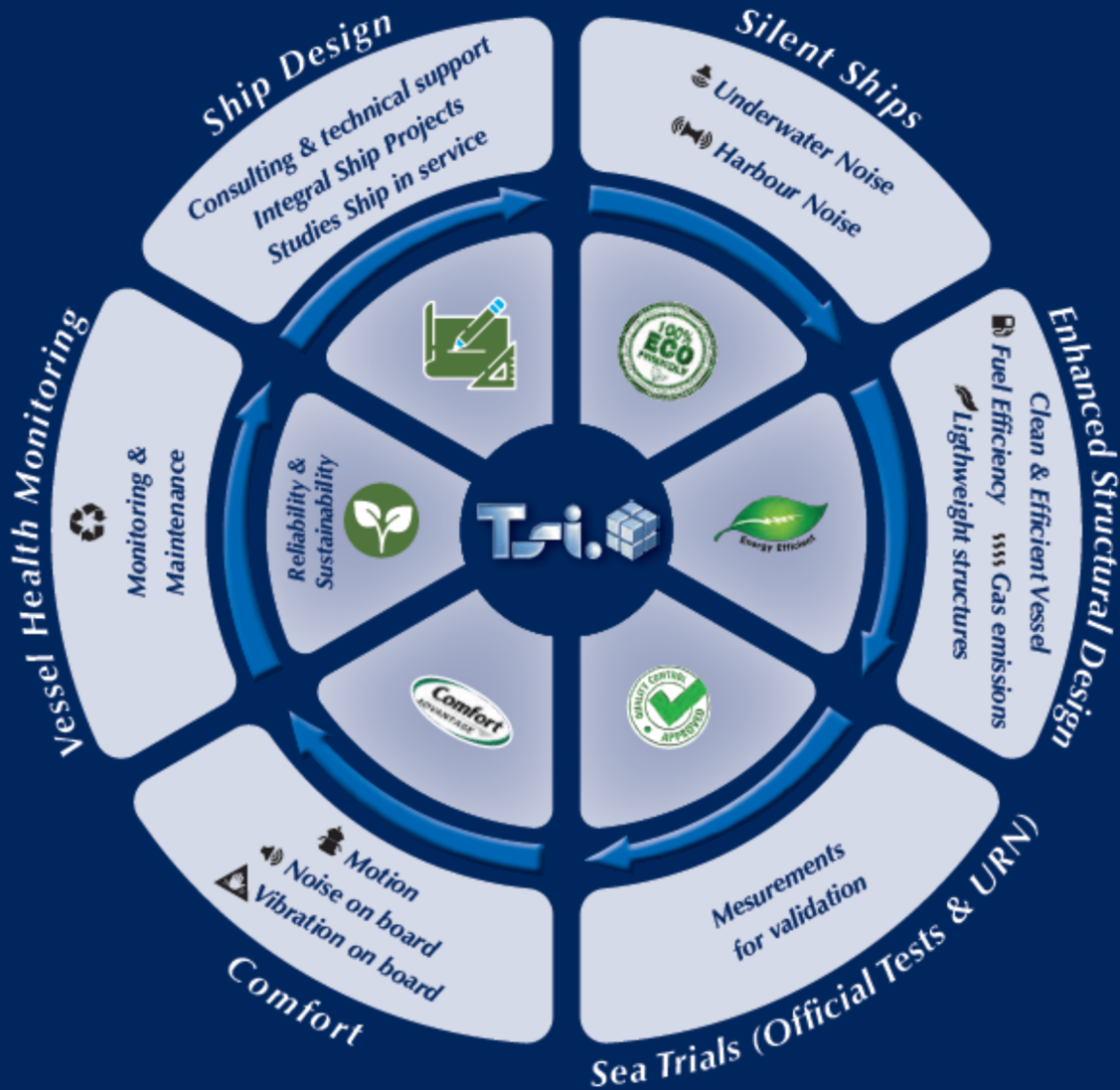
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Tsi. TÉCNICAS Y SERVICIOS DE INGENIERÍA, S.L.



Services oriented to obtain efficient ships with low environmental impact in compliance with the current Regulations and Directives.
From conceptual design to official validation tests!



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Noise & Vibration Comprehensive Management Silent Ship Design

Preliminary design analysis.

- Analysis for the Dynamic Design of the Structure & the Main Machinery.
- Analysis for the Acoustic Design of the Arrangement of Work Areas and Accommodation.
- Analysis for the Acoustic Design of the Main Machinery.

Sensibilization of suppliers purchase stage.

Development of Specific Acoustic & Dynamic Requirements for:

- Main noise and vibration sources: Main and auxiliary machinery, propellers, thrusters, pumps, compressors, HVAC system.
- Accommodation panels' acoustic characteristics and mounting.
- Damping and acoustics properties of the insulation materials.

Noise and vibration prediction calculation. Project stage.

- Vibration level prediction calculation.
- Noise level prediction calculation.
- Noise radiated to the harbour prediction calculation.
- Underwater radiated noise prediction calculation.

Factory acceptance tests building stage.

- Inertance Measurements.
- Airborne Sound Insulation Measurement.
- Impact Sound Insulation Measurement.
- URN Static Measurement.



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Special Tests

- Experimental Dynamic Tests: Modal Analysis and ODS for Equipment and Components.
- Dynamic Tests with Eccentric mass shaker (Full Scale).
- Non-Intrusive Cavitation Detection Tests.
- Measurement of Pressure pulses induced by the propeller (Full Scale).
- Shaft line reaction measurements.
- Thermography.
- Modal Analysis Test.
- Sound power measurements.





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Sea Trials

Comfort Noise and Vibration on board.

- Vibration and Noise Measurements according to Specification or Comfort Criteria.
- Sound Insulation Index ($R'w$) and Impact Sound Insulation ($L'n,w$) Tests, according to Standards and Comfort Class Notations.
- Indoor Climate.

Environmental Noise Impact.

- Measurement of Noise Radiated by the Ship to the Harbour.
- Underwater Radiated Noise by the ship measurements.

Ship Performance.

- Ship Performance: Power and Ship's Speed Measurements.
- Manoeuvring Qualities: Turning test, Zig-Zag test, Crash Stop test, etc.
- Bollard pull.

Machinery structural integrity.

- Torsional, Lateral and Axial Vibration Measurements in Shaft Lines.
- Shaft Lines Bearing Loads Measurement.

Base Line of Rotating and Alternating Machinery.

- Machinery Vibration Assessment. "Base Line"





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Structural & Machinery Monitoring

- Technical advice for the selection of instrumentation and monitoring systems (Online & Offline).
- Turnkey projects for asset monitoring:
 - Systems definition.
 - Systems supply.
 - Assembly & configuration.
 - Commissioning.
 - Staff training.
 - Technical support.
- On-Site verification of measurement chains & monitoring systems.
- Analysis and optimization of database configuration: Online & Offline systems.
- Platform 4.0 for fleet maintenance management.
- Portable Multi-Data Collector "IDAO".
- Online Non-Intrusive Cavitation System.
- Machinery & Structural Health Monitoring.

Consultancy

- Root cause analysis. Diagnosis and suggestions to be implemented. Failure report.
- Failure inspection: Study of the failure and material inspection.
- Specific techniques: Vibration measurement, Dynamic Tests, Extensometer, FEM calculations, etc.
- Expert witness Reports. Arbitration.
- Diagnosis Technical support and Troubleshooting.
- Technical assistance: Owners, Suppliers, Administration and Insurance Companies.



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Specialized & Dedicated Training

- Vibration and Noise on Board Ships Seminar.
- Underwater Radiated Noise Seminar.
- CBM and Vibration Protection Monitoring Systems Seminar.
- Vibration in Diesel Engines and Gas Turbines Seminar.
- Vibration Analyst Category I, II and III (ISO 18436-2) with Vibration Institute Certification.
- Tailored training programs.
- Maintenance, Operation and Instrumentation Staff training with the measuring equipment.



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Certifications

TSI is ISO certified (ISO 9001:2015) and has the recognition and accreditation of international entities, DNV-GL, UKAS, RvA, for the following issues: *“Specialized services of engineering and consultancy in Vibrations and Noises and related training. Carrying out of dynamic tests: Measurements, Analysis and Control. Sales of Vibrations Monitoring Systems and Technical Service. Building Technical Assistance”*.

TSI is authorized by BUREAU VERITAS to perform Noise and Vibration Measurements to obtain the corresponding “COMFORT CLASS Notation” in accordance with that established in their rule: *“Classification of Steel Ships, Part E, Chapter 6 Comfort on Board”*.

And it is also certified by BUREAU VERITAS to carry out and report on underwater radiated noise measurement on ships classed with BUREAU VERITAS within the scope of *Bureau Veritas Rule Note NR 614 – Underwater Radiated Noise*.

TSI is approved as service supplier to perform Comfort Class measurements for DNV GL. And It has authorization to carry out *Under Water Radiated Noise in accordance with its rule DNV GL Silent class notation*.

TSI has authorisation from DMA – DANISH MARITIME AUTHORITIES to carry out *Noise and Vibration measurements and studies on vessels*.

TSI is recognized by ABS as Service Provider to provide services which ABS may rely on to make decisions affecting classification or statutory surveys for: *Ambient Environmental Testing, Condition Monitoring Firm, Measurements of Noise Level on Board Ships, Sound pressure level measurements of public address and general alarm systems on board ships*.

TSI is approved as Firm engaged in *Noise Measurement of Ships under the relevant ClassNK regulations for approval of Service Suppliers*.





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Vibraciones
y Ruidos



Vibration & Noise

Engineering
Solutions

Soluciones
de Ingeniería

SILENT SHIPS



The solution for those Owners worried with
the Protection of the HEALTH & COMFORT
of Passengers, Crews and Environment!



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The Target: Compliance with the Current Regulatory Framework

The improvement of work conditions and health protection of passengers and seafarers of all type of ships, as well as the environmental protection of the residential areas closest to the harbours and the Marine Life, has been the reason and leitmotiv of **European Commission Regulatory Framework**. The corresponding Directives have been translated as Local Laws to all Member States.



-  **DIRECTIVE 2003/10/EC**
Improvement of work conditions and health protection of passengers and seafarers of all type of ships.
-  **DIRECTIVE 2006/56/EC**
Environmental protection of the residential areas close to the harbours.
-  **DIRECTIVE 2008/56/EC**
Marine Life Protection.

The Challenge: To Design and Build "SILENT SHIP"

Within this trend, the **REDUCTION OF THE UNDERWATER RADIATED NOISE** for all type of ships is the most remarkable novelty and the most difficult **CHALLENGE** that the Shipbuilding Industry has ever faced.

The Engineering Tool

The Proven Tool to achieve not only Noise & Vibration Comfort Class Notation but also the compliance with URN Requirements.



THE METHODOLOGY

APPLYING PREVENTIVE N&V CONTROL TECHNIQUES
FROM THE EARLIEST STAGES OF THE PROJECT UNTIL THE SEA TRIAL TEST!

PRELIMINARY ANALYSIS OF DESIGN

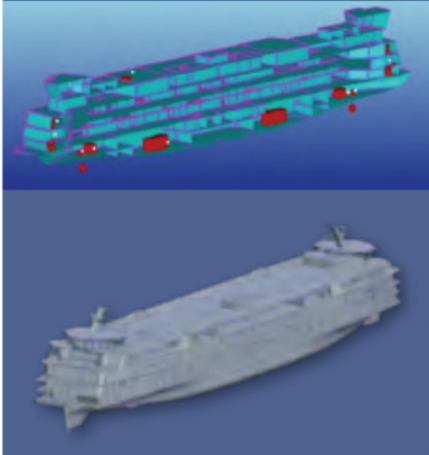
Assessment, from the Noise and Vibration point of view of:
Specification, Structural Design, Original Noise Insulation, Suitability of specified Machinery, etc.

SENSITIZATION OF SUPPLIERS

Specific Acoustical & Dynamic Requirements for:

Main Noise & Vibration Sources:
Main & Auxiliary Machinery, Propeller, Thrusters, HVAC and Ventilation Systems, etc.
Accommodation panels and certified damping properties of the noise insulation materials.
F.A.T and dedicated tests must be required for validations.

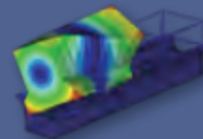
SIMULATION: N&V CALCULATIONS



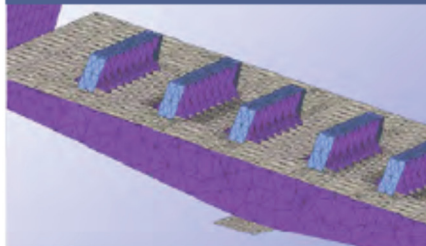
NOISE, VIBRATION & URN ACCEPTANCE



Double resilient bedframe Calculation



Ship foundation Mobility Calculation



Experimental ODS

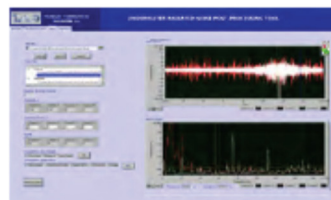


FAT FACTORY ACCEPTANCE TESTS

		NOISE & VIBRATION MEASUREMENTS ACCORDING TO SPECIFICATION OR COMFORT CRITERIA
		ON SITE MEASUREMENTS OF NOISE REDUCTION INDEX (Rw) BETWEEN LOCALS OF THE SHIP ACCORDING TO STANDARD AND COMFORT CLASS NOTATIONS
		IMPACT NOISE INSULATION TESTS
		MEASUREMENT OF NOISE RADIATED BY THE SHIP TO HARBOUR. IDENTIFICATION OF DEVIATIONS.
		MANEUVERING TESTS.
		SHIP PERFORMANCE: POWER AND SHIP'S SPEED MEASUREMENTS.
		URN - UNDERWATER RADIATED NOISE MEASUREMENTS

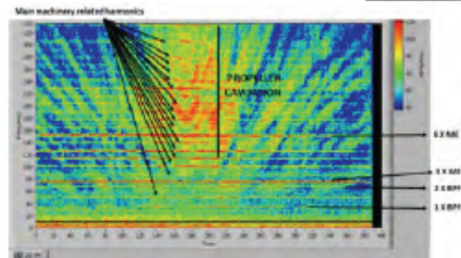
Everywhere and on Deep and Shallow water!

According to the most recent URN Measurement Procedure developed in the framework of AQUO Project (FP7-GA N° 314227) and implemented in the New voluntary URN Class Notation NR 614 of BUREAU VERITAS.



FUNCTIONALITIES:

- Adapted for BV NR614 Post-Processing
- Post-processing according to DNV and ANSVASA also available
- Any input of TL.
- Indicate what 1/3 octave band levels are background noise affected.
- Visualization of the results of all runs.
- Direct computation and visualization of the final URN signature.
- Directivity diagrams.
- Spectrograms to identify sources



Tsi- URN Database with over 48 "underwater footprints" of a wide variety of ships.



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Recent References of SILENT Ships

Applying the most innovative technologies to get the Compliance with the strictest Noise & Vibration and Underwater Radiated Noise Requirements.



Other References of SILENT Ships



When TSI takes care of the "Noise & Vibrations" of your Ship, these are the Experimental Results...

- Maximum Vibration Level at Passengers Areas: 0,6 mm/s-rms / Limit 2,5 mm/s-rms.
- Maximum Noise Levels at Passenger Areas: 52,8 dB (A) / Limit 58 dB (A)



- Noise & Vibration Levels in COMPLIANCE with Comfort Class Notation PCAC 2.2 Lloyd Register
- Mechanical Vibration of Human Exposure to Whole Body in COMPLIANCE with ISO 2631-1:1997 "
- Crew Noise & Vibration Exposure Levels in COMPLIANCE with ARBO Regulation (Dutch Labour HSE Regulation) and Directive 2002/44/EC and Directive 2003/10/EC.

- Maximum Vibration Level at Accommodation Areas: 1,3 mm/s-rms / Limit 4,0 mm/s-rms.
- Maximum Noise Levels at Accommodation Areas: 61,0 dB (A) / Limit 61dB (A)



- Noise & Vibration Levels in COMPLIANCE with Comfort Class Notation COMF-VIB3 and COMF-NOISE3- BV
- Crew Noise Exposure Levels in COMPLIANCE with REAL DECRETO DE RUIDO 286/2006 (Spanish Regulation) and Directive 2003/10/EC.

- Maximum Vibration Level: 0.7 mm/s-rms
- Noise: Cabin 37,6 dB (A) . Machinery Room: 87,0 dB (A)



- Noise Radiated to the Harbour: In COMPLIANCE with Directive 2002/49/EC.
- UNDERWATER RADIATED NOISE: In COMPLIANCE with ICES N°209, according to BV-NR 614

- Maximum Vibration Level at Accommodation Areas: 0,4 mm/s-rms / Limit 3,5 mm/s-rms.
- Maximum Noise Levels at Accommodation Areas: 48 dB (A) / Limit 55 dB (A)



- Noise & Vibration Levels in compliance with DNV CONF-(C2)V(2)
- Noise Radiated to the Harbour in compliance with 2006/56/EC



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"Acoustical Retrofitting for Ships in Service"

"The effective tool based on 40 years of experience solving noise and vibration problems on board ships".

"Who is acoustically designing
the most "Silent Ships" ...

SHIP IN SERVICE



...can help you to achieve the **COMPLIANCE** of your vessels with the Directive 2003/10/EC "on the minimum health safety requirements regarding the exposure of the workers to the risks arising from noise"



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Your right Partner to achieve
SILENT SHIPS
and so, **Quiet Oceans**



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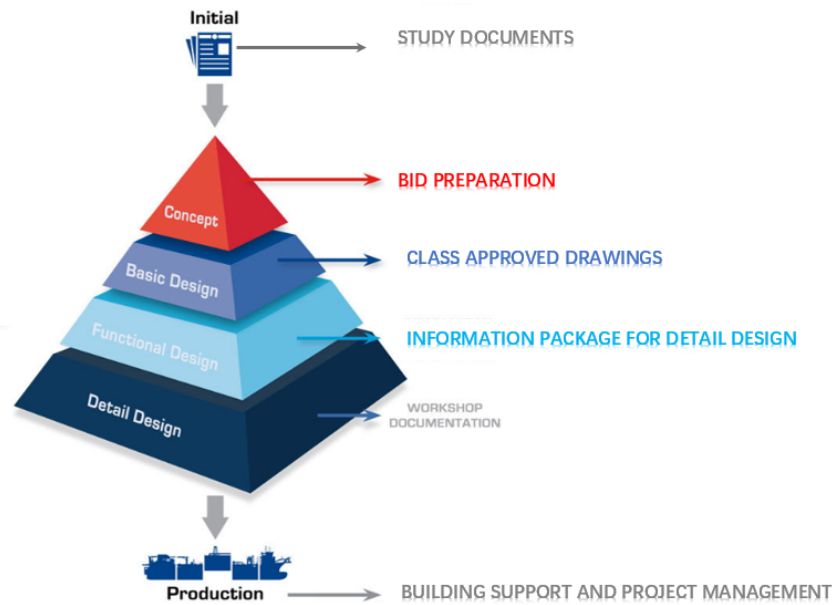
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Global Ship Solutions Inc. - Introduction:

Global Ship Solutions Inc. (GSS Inc.) is a Canadian shipbuilding and marine client representative company. GSS Inc. is well-equipped to act as a driving engine into the success of the construction and life-cycle support for Defence Shipbuilding projects in Canada.

GSS Inc. team of experts includes Naval Architects and shipbuilding consultants with many years of domestic and International Shipbuilding experience with industry gold standard credentials such as Professional Engineering (P.Eng.)-EGBC, Risk Management Professional, Chartered Professional Engineering (C.Peng.) and Master in Business Administration.

We act as Marine Sales representatives and Naval Architecture representative' consultants in all stages of shipbuilding projects with a GSS Inc. vision of the pyramid support process.



Using the Project Management Institute (PMI) methodology and bringing in current multi-dimensional industry best practices, such as agile and lean project management it is GSS beings in value preposition of 1:10. With every dollar business given to GSS, it will result in an average savings of \$10.



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GSS Inc. is a proud Canadian company established in BC, offers products and services for the marine industry through its associate shipyards and engineering companies, passing through the company's suppliers of equipment and supplies, joiner companies, outfitters, electrical installers, electrical motors and generators, and water treatment systems.

Please let us know if you would like to discuss further the potentials solutions we can provide to your shipbuilding enterprise.

Our team of Naval Architects shall be delighted to organize a Microsoft Teams Meeting to discuss with you in more detail, our intention to become your long-term supplier with our partners **TSI**.

Best Regards,

JP Moolan, Vice President | BEng MRINA | Naval Architect |Global Ship Solutions Inc.|Cell +1 (778) 512 7791

