PART 6 CHAPTER 12

NOISE AND VIBRATIONS
JANUARY 2011

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CHANGES IN THE RULES

General
As of October 2010 all DNV service documents are primarily published electronically.
In order to ensure a practical transition from the “print” scheme to the “electronic” scheme, all rule chapters having incorporated amendments and corrections more recent than the date of the latest printed issue, have been given the date January 2011.
An overview of DNV service documents, their update status and historical “amendments and corrections” may be found through http://www.dnv.com/resources/rules_standards/.

Main changes
Since the previous edition (July 2000), this chapter has been amended, most recently in July 2008. All changes previously found in Pt.0 Ch.1 Sec.3 have been incorporated and a new date (January 2011) has been given as explained under “General”.
In addition, the layout has been changed to one column in order to improve electronic readability.
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SECTION 1
NOISE AND VIBRATION

A. General

A 100 Scope

101 The rules in this chapter state requirements for the design and operation of craft with acceptable noise and vibration levels.

102 The rules are divided in three different groups, with different additional class notations:

N noise requirements
SV structural vibration requirements
MV machinery vibration requirements.

The additional class notations may be given for each group separately or for all three groups. If all the three groups are satisfied, the additional class notation NV may be used.

103 Noise requirements related to the N notation are covered in B. Structural vibration requirements related to the SV notation are covered in C. Machinery vibration requirements related to the MV notation are covered in D.

104 The selected requirements should be incorporated in the design of the craft and verified through measurements on each completed craft. It may be necessary to carry out calculations at an early design stage in order to ensure that control measures necessary to satisfy the requirements are included in the craft design.

A 200 Definitions

201 Airborne noise. Audible air pressure fluctuations generated by craft machinery, systems or structure in the frequency range 16 to 20 000 Hz.

202 Airborne noise levels. The specified airborne noise levels should be measured as overall A-weighted continuous equivalent noise levels in dB(A) re. 20 μPa.

203 Airborne sound insulation. Characteristics of a partition's ability to insulate against airborne sound transmission.

204 Weighted apparent sound insulation index. The specified sound insulation should be measured in accordance with ISO 140-4 and presented as the one number quantity: R’w, the “Weighted Apparent Sound Insulation Index” in accordance with ISO 717-1.

205 Reverberation time. The time for the sound pressure level to decrease by 60 dB after the sound source has stopped. The quantity is denoted by T, and is expressed in s. The specified limit is related to space averaged reverberation times in each of the octave bands 500, 1000 and 2000 Hz.

206 Vibration. Structural oscillation in the frequency range 1 to 100 Hz.

207 Vibration level. The specified vibration levels should be measured as vibration velocity in mm/s (peak), unless vibration displacement in mm (peak) or vibration acceleration in mm/s² (peak) is specified.

208 Structural vibration. Vibration level measured on craft structure.

209 Machinery vibration. Vibration level measured on machinery or machinery foundation when the machinery is operating.

A 300 References

301 International standards and resolutions have been used as foundation for the rules, but have not necessarily been adhered to. Due consideration has been given to technical and practical limitations inherent in the design and construction of craft. If the requirements in the standards referred to deviate from the text in the rules, the rule text should take precedence.

302 The standards shown below contain provisions which are referred to in this text or have been used as basis when developing the rules. Unless a particular edition is stated explicitly, the latest edition of each standard applies.

303 Abbreviations

ISO : International Organisation for Standardisation
IMO : International Maritime Organization
304  **Airborne noise standards**  
IMO Resolution A.468(XII), “Code on noise levels onboard ships”.  
ISO 2923 “Acoustics – Measurement of noise on board vessels”.  
ISO 31/VII, “Quantities and units of acoustics”.  
IEC Publication 651, “Sound level meters”.  
IEC Publication 225, “Octave, half octave and third-octave band filters intended for the analysis of sound and vibration”.  
IEC Publication 942, “Sound calibrators”.  

305  **Vibration standards**  
ISO 6954, “Mechanical vibration and shock – Guidelines for the overall evaluation of vibration in merchant ships”.  
ISO 2041, “Vibration and Shock – Vocabulary”.  
ISO 4867, “Code for the measurement and reporting of shipboard vibration data”.  
ISO 4868, “Code for the measurement and reporting of local vibration data of ship structures and equipment”.  
ISO 2631, “Guide for the evaluation of human exposure to whole-body vibration”.  

**B. Noise**  

**B 100  Scope**  
101  Airborne noise levels shall be minimised in order to:  
— avoid hearing damage  
— ensure intelligible communication and ability to hear alarms  
— ensure easy communication and intense levels of concentration  
— ensure that necessary recreation through sleep is possible.  

Due to practical constrains inherent in craft design all these aims will not be satisfied in all areas. Hence, a division of noise limits for specific areas based on the intended use of the area has to be performed.  

**B 200  Criteria**  
201  Reference is made to Pt.3 Ch.7. In addition the maximum allowable noise levels for different types of localities as given in the Table B1 apply. For the maximum speed condition only a limited number of locations of importance for the operation of the craft have been assigned noise limits. For the normal service and harbour conditions noise limits apply in all accessible locations.
For special locations not covered by the area designations given in Table B1, limits should be specified using the guidelines given in Table B2. For locations where it can be proved practically impossible to reduce the noise level below 85 dB(A), warning signs should be posted and hearing protectors required for all personnel entering the location. Noise levels should preferably be restricted to a maximum of 110 dB(A), but under no circumstances should noise levels exceeding 120 dB(A) be allowed.

Table B1 Maximum allowable noise levels

<table>
<thead>
<tr>
<th>Area designation</th>
<th>Noise limits in dB(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Harbour and normal service</td>
</tr>
<tr>
<td>Machinery spaces (continuously manned) 1)</td>
<td>90</td>
</tr>
<tr>
<td>Machinery spaces (not continuously manned) 1), 2)</td>
<td>110/120</td>
</tr>
<tr>
<td>Machinery control rooms</td>
<td>75</td>
</tr>
<tr>
<td>Workshops</td>
<td>85</td>
</tr>
<tr>
<td>Stores 1)</td>
<td>90</td>
</tr>
<tr>
<td>Navigation bridge and chart rooms</td>
<td>65</td>
</tr>
<tr>
<td>Listening posts, including navigation bridge wings and windows</td>
<td>70</td>
</tr>
<tr>
<td>Radio rooms (radio equipment in operation but not producing audio signals)</td>
<td>60</td>
</tr>
<tr>
<td>Radar rooms</td>
<td>65</td>
</tr>
<tr>
<td>Cabins and hospitals 3)</td>
<td>60</td>
</tr>
<tr>
<td>Mess rooms 3)</td>
<td>65</td>
</tr>
<tr>
<td>Recreation rooms 3)</td>
<td>65</td>
</tr>
<tr>
<td>Offices 3)</td>
<td>65</td>
</tr>
<tr>
<td>Open recreation areas</td>
<td>75</td>
</tr>
<tr>
<td>Gymnasiums and laundries</td>
<td>80</td>
</tr>
<tr>
<td>Galleys (without food processing equipment in operation)</td>
<td>75</td>
</tr>
<tr>
<td>Serveries and pantries</td>
<td>75</td>
</tr>
<tr>
<td>Ammunition rooms</td>
<td>75</td>
</tr>
<tr>
<td>Signal distribution offices</td>
<td>70</td>
</tr>
<tr>
<td>Fire control rooms, combat information centres, damage control rooms</td>
<td>65</td>
</tr>
<tr>
<td>Sonar control rooms, electronic countermeasure rooms</td>
<td>60</td>
</tr>
</tbody>
</table>

1) Warning signs should be posted at all entrances and ear protectors should be worn when the noise exceeds 85 dB(A).
2) It is recommended that the noise levels in unmanned machinery spaces are kept below or as close to 110 dB(A) as practically possible. The maximum level of 120 dB(A) should not be exceeded. Warning signs should be posted at all entrances and earmuffs should be used in combination with earplugs when the noise level exceeds 110 dB(A).
3) For “high speed craft” see definition in Pt.0 Ch.6 Sec.1 and “light craft” see definition in Pt.1 Ch.1 Sec.2, these limits only apply for harbour conditions without propulsion machinery in operation, but with auxiliary machinery, ventilation and all systems that normally are running in harbour, in operation. However, the limits mentioned in Pt.3 Ch.7 Sec.1 E100 apply for all operating conditions.

Table B2 Noise limits

<table>
<thead>
<tr>
<th>Type of location</th>
<th>Noise limits dB(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locations for sleeping</td>
<td>60</td>
</tr>
<tr>
<td>Locations for intense levels of concentration</td>
<td>65</td>
</tr>
<tr>
<td>Locations for easy speech communication</td>
<td>70</td>
</tr>
<tr>
<td>Locations where hearing damage should not be at risk and where hearing protectors should not be required, verbal communication should be possible with raised voice</td>
<td>85</td>
</tr>
</tbody>
</table>

Table B3 Minimum requirements for sound insulation

<table>
<thead>
<tr>
<th>Between</th>
<th>$R'_W$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cabins</td>
<td>30</td>
</tr>
<tr>
<td>Cabins and corridors or stairways</td>
<td>25</td>
</tr>
<tr>
<td>Cabins and mess or dayroom</td>
<td>45</td>
</tr>
<tr>
<td>Cabins and galley</td>
<td>45</td>
</tr>
<tr>
<td>Cabins and open decks</td>
<td>35</td>
</tr>
</tbody>
</table>

The highest value of the measured reverberation time, as defined in A205 should not exceed 0.8 s.
B 300 Measurements

301 The measurements of airborne noise levels are to be carried out according to the procedures described in ISO 2923. The measuring equipment should conform to the requirements stated in ISO 2923. When the procedures in ISO 2923 deviates from any requirements or procedure mentioned in these rules, the procedures and requirements in these rules should be adhered to.

302 When a craft is completed, the building yard is responsible for execution of noise measurements. If a craft is modified or rebuilt, the owner is responsible for documenting any changes in the noise levels. Measurement of noise levels should in any case be carried out at least once every ten years for craft in operation. The measurements are to be carried out by a competent body approved by the Society.

303 The measurements are to be carried out for at least a full speed transit condition, a defined normal service condition and optionally for a harbour condition. The defined normal service condition should be a steady operating condition at which the power absorbed by the propellers is not less than 85 % of the maximum continuous rating. Alternatively, a different operating condition with less power may be accepted if it can be demonstrated by the owner that this would correspond to a more representative normal service condition for the craft in question.

304 A test program shall be approved by the Society prior to execution of the measurements. The test program shall at least contain:

- a description of the intended measuring locations
- required loading conditions
- required operating conditions for machinery and systems
- instrumentation to be used.

305 For the full speed condition measurements are to be taken in the operational rooms for which noise limits have been specified. For the service condition measurements are to follow the guidance given in paragraph 307, 308 and 309. For the harbour condition measurements are optional provided that power is generated by the same machinery as for the service condition and that the same auxiliary machinery and ventilation systems are used as for the service condition.

306 If the specified criterion is exceeded, octave band analysis of the noise is to be performed.

307 Measurements are to be taken in all public spaces, all working locations, all operational locations, all machinery spaces, on open decks and in cabins as specified in 308 to 310.

308 Measurements are to be taken on open decks at listening positions, bridge wings, muster stations, working locations, recreation areas and battle stations.

309 The number of cabins to be tested shall at least comply with the following requirements:

a) For ships with less than 50 cabins, measurements are to be taken in all cabins.
b) For ships with 50 to 100 cabins, measurements are to be taken in not less than 50 cabins and at least in every other cabin.
c) For ships with more than 100 cabins, measurements are to be taken in not less than 75 cabins and at least in every forth cabin.
d) For all ships, measurements are always to be performed in all cabins being at the end of a corridor or adjacent to a room containing machinery.

310 In large rooms, e.g. mess rooms, machinery rooms, wheelhouses, etc. several measuring positions may be necessary to get a representative description of the noise situation. No distance between measuring positions or measuring positions and walls is to exceed 7 m.

311 Noise levels greater than those specified in these rules may be accepted on a case by case basis. Up to 20 % of the locations may be allowed to exceed the criteria by not more than 3 dB(A).

312 The report is to comply with the requirements in ISO 2923. The positions of the noise measurements are to be plotted on general arrangement drawings of the craft. The airborne noise levels are to be listed in tables and preferably plotted on general arrangement drawings of the craft. If the specified noise criterion is exceeded, octave band readings are to be reported.

313 The sound insulation is to be measured for selected representative partitions to be specified by the Society. Measurements are to be carried out as described in ISO 140-4 and the results shall be evaluated and reported in accordance with the procedure in ISO 717-1.

314 The reverberation times may be tested if required by the Society. The tests shall be carried out in accordance with ISO 140-4.
C. Structural Vibration

C 100 Scope

101 Structural vibration should be limited in order to ensure personnel comfort and proficiency as well as structural integrity and trouble free operation of machinery and components.

C 200 Criteria

201 Larger craft, with length overall exceeding 35 m, should be divided in three different regions, aft region, main region and masthead region, as shown in Fig. 1. Aft region is restricted to aft 1/5 of the craft length. Masthead region comprises all masts and the decks they are mounted on.

![Division of a craft with length larger than 35 m](image)

202 The structural vibration levels should not exceed the following values in the frequency range between 5 and 100 Hz:

<table>
<thead>
<tr>
<th>Region</th>
<th>Limit (mm/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main region, decks normally accessible to personnel and structure for mounting of equipment</td>
<td>5 mm/s</td>
</tr>
<tr>
<td>Aft region, decks normally accessible to personnel and structure for mounting of equipment</td>
<td>7 mm/s</td>
</tr>
</tbody>
</table>

For frequencies between 1 Hz and 5 Hz the vibration should be restricted to the acceleration level at 5 Hz corresponding to the relevant velocity level at 5 Hz.

<table>
<thead>
<tr>
<th>Region</th>
<th>Limit (mm/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Masthead region</td>
<td>15 mm/s</td>
</tr>
</tbody>
</table>

Other structure where personnel comfort or proficiency is not affected and critical equipment is not to be mounted, e.g. tanks and void spaces:

<table>
<thead>
<tr>
<th>Material</th>
<th>Limit (mm/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel craft</td>
<td>30 mm/s</td>
</tr>
<tr>
<td>Aluminium craft</td>
<td>10 mm/s</td>
</tr>
</tbody>
</table>

For frequencies between 1 Hz and 5 Hz the vibration should be restricted to the displacement level at 5 Hz corresponding to the relevant velocity level at 5 Hz.

All vibration levels refer to single frequency components.

For weapon and sensor platforms, equipment supplier may have equipment dependent criteria. If stricter than the general criteria given above for human proficiency or structural integrity, the supplier specified criteria should be applied.

203 For smaller craft, length overall less than 35 m, the requirements for the masthead region do not apply. The requirements for the main region may be relaxed to 6 mm/s.

204 For naval combat craft it is of particular importance to avoid resonance due to excitation from damaged machinery. Hence, the critical structure, of combat craft, should be verified not to have fundamental natural frequencies corresponding to the rotational frequency or the first harmonic of this frequency in a realistic operational speed range of the propulsion machinery. Critical structure is all structure in the direct vicinity of the propulsion machinery, the structure on the two decks immediately above the propulsion machinery and platforms for weapon and sensors. The owner should define a realistic operational speed range of the propulsion machinery for the investigation.

C 300 Measurements

301 Measurements of vibration should be carried out in accordance with the procedures described in ISO 4868. When the procedures described in ISO 4868 deviates from any requirements or procedures given in these rules, the requirements or procedures of the rules are to take precedence.

302 When a craft is completed, the building yard is responsible for execution of the necessary measurements. If a craft is modified or rebuilt, the owner is responsible for documenting any changes in the vibration levels. Measurement of vibration levels should in any case be carried out at least once every ten years for craft in
The measurements are to be carried out by a competent body approved by the Society.

303 The structural vibration measurements are to be carried out for a defined normal service condition and at any other relevant operating conditions found appropriate by the Society, or as specified by the owner.

The defined normal service condition should be a steady operating condition at which the power absorbed by the propellers is not less than 85% of the maximum continuous rating. Alternatively, a different normal service condition may be accepted if the owner can demonstrate that this would correspond to a more representative normal service condition for the craft in question.

304 A test program shall be approved by the Society prior to execution of the measurements. The test program shall at least contain:

— a description of the intended measuring locations
— required loading conditions
— required operating conditions for machinery and systems
— instrumentation to be used.

305 The measuring locations are to be selected as such as to give a representative description of the vibration situation all over the craft. The minimum distribution of measuring locations is to be approved prior to the measurements. New measuring positions may, however, be added during the testing based on actual findings on board the craft.

306 Measurements are to be taken in all public spaces, all working locations, all operational locations, all machinery spaces, on open decks and in cabins as specified in 307 to 309.

307 The number of cabins to be tested shall at least comply with the following requirements:

a) For ships with less than 50 cabins, measurements are to be taken in all cabins.
b) For ships with 50 to 100 cabins, measurements are to be taken in not less than 50 cabins and at least in every other cabin.
c) For ships with more than 100 cabins, measurements are to be taken in not less than 75 cabins and at least in every forth cabin.
d) For all ships, measurements are always to be performed in all cabins being at the end of a corridor or adjacent to a room containing machinery.

308 Vibration measurements in cabins are normally to be taken at the floor in the centre of the room, unless higher vibration levels are sensed in other positions.

309 In large rooms and on open deck areas, e.g. mess rooms, machinery rooms, wheelhouses, etc., several measuring positions may be necessary to get a representative description of the vibration situation. No distance between measuring positions or measuring positions and walls is to exceed 7 m.

310 Structural vibration levels are to be measured in vertical, longitudinal and transverse directions. Vertical vibration should be recorded in all measuring locations, transverse vibration should be recorded in at least 25% of the locations evenly distributed over the craft and longitudinal vibration should be measured in at least one location on each deck level.

311 The instrumentation to be used for the measurements is to be of an electronic type. The signal may be stored on tape, analysed directly by means of an FFT-analyser or by means of PC based equipment.

312 The following analysis parameters should be used during measurement of structural vibration:

— frequency range 1 to 100 Hz
— at least 400 spectral lines
— window function which gives an accurate estimate of the amplitude values of the single peaks in the frequency spectra (e.g. “flat-top” window)
— the data is to be averaged over a time period of approximately one minute.

313 Vibration levels greater than those specified in the rules may be accepted on a case by case basis. In no case will more than 20% of the locations be allowed to exceed the relevant vibration criteria by more than 1 mm/s.

314 The report is to comply with the requirements in ISO 4867. The positions of the structural vibration measurements are to be plotted on general arrangement drawings of the craft.
D. Machinery Vibration

D 100  Scope

Machinery vibration levels will be indicators of sound mounting, balancing and alignment for new installations as well as indicators of working condition for machinery in operation.

D 200  Criteria

The criteria below are not to be exceeded for the relevant machinery and components, unless it can be documented by a manufacturer that a particular item designed to operate for prolonged times at a higher vibration level than specified in 202 to 213. In such a case the manufacturers recommended maximum vibration level should be applied.

201  Shaft line bearings

<table>
<thead>
<tr>
<th>Displacement</th>
<th>Velocity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 2 Hz</td>
<td>2 to 100 Hz</td>
</tr>
<tr>
<td>0.4 mm</td>
<td>5 mm/s</td>
</tr>
</tbody>
</table>

To be measured horizontally or vertically in height with the shaft centre. Main class requirements related to shafting and vibrations are given in Pt. 4 Ch. 2.

202  Diesel engines, < 200 r.p.m.

<table>
<thead>
<tr>
<th>Displacement</th>
<th>Velocity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 2.4 Hz</td>
<td>2.4 to 100 Hz</td>
</tr>
<tr>
<td>vertical or longitudinal</td>
<td></td>
</tr>
<tr>
<td>10.5 mm</td>
<td>8 mm/s</td>
</tr>
<tr>
<td>transverse</td>
<td>1.0 mm</td>
</tr>
</tbody>
</table>

To be measured at the top of the A-frame at engine ends.

203  Diesel engines, > 200 r.p.m.

<table>
<thead>
<tr>
<th>Displacement</th>
<th>Velocity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 4.8 Hz</td>
<td>4.8 to 100 Hz</td>
</tr>
<tr>
<td>0.5 mm</td>
<td>15 mm/s</td>
</tr>
</tbody>
</table>

To be measured in the transverse direction fore and aft on engine top.

205  Turbochargers

<table>
<thead>
<tr>
<th>Displacement</th>
<th>Velocity</th>
<th>Acceleration</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 to 4.8 Hz</td>
<td>4.8 to 26.5 Hz</td>
<td>26.5 to 300 Hz</td>
</tr>
<tr>
<td>1.0 mm</td>
<td>30 mm/s</td>
<td>5000 mm/s²</td>
</tr>
</tbody>
</table>

To be measured in any direction on the bearings.

206  Diesel driven generators

<table>
<thead>
<tr>
<th>Displacement</th>
<th>Velocity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 3.2 Hz</td>
<td>3.2 to 100 Hz</td>
</tr>
<tr>
<td>0.5 mm</td>
<td>10 mm/s</td>
</tr>
</tbody>
</table>

To be measured fore and aft on the bearings.

207  Turbines

<table>
<thead>
<tr>
<th>Velocity</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 to 1000 Hz</td>
</tr>
<tr>
<td>5 mm/s</td>
</tr>
</tbody>
</table>

208  Turbine driven generators

<table>
<thead>
<tr>
<th>Displacement</th>
<th>Velocity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
209  *Gears*

Velocity
5 to 1000 Hz
5 mm/s

To be measured in any direction on the bearings.

210  *Electric motors, separators, hydraulic pumps (screw or centrifugal), pumps (screw or centrifugal), compressors (screw or centrifugal), fans.*

<table>
<thead>
<tr>
<th>Displacement</th>
<th>Velocity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 2.0 Hz</td>
<td>2.0 to 100 Hz</td>
</tr>
<tr>
<td>0.4 mm</td>
<td>5 mm/s</td>
</tr>
</tbody>
</table>

To be measured in any direction on the bearings.

211  *Hydraulic pumps, compressors, pumps (reciprocating piston types).*

<table>
<thead>
<tr>
<th>Displacement</th>
<th>Velocity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 3.2 Hz</td>
<td>3.2 to 100 Hz</td>
</tr>
<tr>
<td>0.5 mm</td>
<td>10 mm/s</td>
</tr>
</tbody>
</table>

To be measured in any direction on the bearings.

212  *Boilers*

<table>
<thead>
<tr>
<th>Displacement</th>
<th>Velocity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 4.8 Hz</td>
<td>4.8 to 100 Hz</td>
</tr>
<tr>
<td>1 mm</td>
<td>30 mm/s</td>
</tr>
</tbody>
</table>

To be measured on stiff parts, e.g. lugs, flanges etc.

213  *Incinerators*

<table>
<thead>
<tr>
<th>Displacement</th>
<th>Velocity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 3.2 Hz</td>
<td>3.2 to 100 Hz</td>
</tr>
<tr>
<td>0.5 mm</td>
<td>10 mm/s</td>
</tr>
</tbody>
</table>

To be measured on stiff parts, e.g. lugs, flanges etc.

D 300  *Measurements*

301  When a craft is completed, the building yard is responsible for execution of the necessary measurements. If a piece of machinery is modified or rebuilt the owner is responsible for documenting any changes in the vibration levels. Measurement of vibration levels should in any case be carried out at least once every five years for craft in operation. The measurements are to be carried out by a competent body approved by the Society.

302  The machinery vibration measurements are to be carried out at the normal operating speed and load or capacity for the machinery in question. When the normal operating speed, load or capacity covers a range of conditions, measurements should be carried out at a condition corresponding to at least 90% of the maximum.

303  A test program shall be approved by the Society prior to execution of the measurements. The test program shall at least contain:

— a description of the intended measuring locations
— required operating conditions
— instrumentation to be used.

304  The instrumentation to be used for the measurements is to be of an electronic type. The signal may be stored on tape, analysed directly by means of an FFT-analyser or by means of PC based equipment.
305 The following analysis parameters should be used:

— frequency range 1 Hz to the upper frequency specified for an item
— at least 400 spectral lines
— window function which gives an accurate estimate of the amplitude values of the single peaks in the frequency spectra (e.g. “flat-top” window)
— the data is to be averaged over a time period of approximately one minute.

306 The report shall at least contain the following information:

— description of measuring positions
— actual operating conditions during the test
— instrumentation used during the measurements
— frequency plots of the vibration levels in the required frequency range.