The object of this data sheet is to provide a simple picture of the very complex subject of noise, its presence on fishing vessels and its effect on fishermen.

**What is Noise?**
It is unwanted and often unpleasant SOUND and is regarded as a form of pollution.

**What is Sound?**
A form of energy produced by vibration and pressure waves.

Sound can be transmitted through:

1) Air - Airborne noise (A.B.N.)
2) Solids - Structure-borne noise (S.B.N.)
3) Liquids - Fluid-borne noise (F.B.N.)

Generally, when talking of NOISE and SOUND they are the same but a distinction between them is that noise is not wanted and can cause distress to people and animals.

**Why the interest in Noise?**
Because above certain levels, combined with the time of exposure, human hearing is permanently damaged. Immediate effects are that senses and responses become dulled. In extreme cases, ringing ears, headaches, nausea and loss of concentration can result. Everyone is sensitive to noise to a greater or lesser degree.

Modern fishing vessels are highly mechanised, relatively small and have all the necessary conditions to produce high noise levels. This is not the case with all vessels but there are frequent serious cases of this growing problem.

In industry, hearing damage due to excessive noise exposure is now a major subject for claims against employers for injury at work.

**How are noise levels measured?**
In simple terms a meter measures the `sound pressure level' in decibels (dB). However, the human ear is responsive in varying degrees to the frequency of sound and there is an International Standard known as the `A' weighting which approximates to the response of the human ear. This results in measured noise levels being quoted as dB(A) and this should always be made clear as there are numerous other dB readings which are taken in noise diagnosis. A common diagnosis is the measurement at set frequencies producing the `Octave Band Levels', this gives a graphic picture of the contents of the noise which can be from several sources or resonating from a single source. Example shows Sound Pressure v Frequency at two locations on a typical modern fishing vessels.
How does noise relate to hearing?
The ear only responds to frequencies in the range 20Hz to 20,000 Hz. (Hz or Hertz are cycles per second). Some frequencies are more annoying than others such as screeching or several mismatched frequencies giving a discord. It is the combination of the dB level and frequency that produces a nuisance. It is the dBA level and length of time exposed to it or 'dose' that determines whether there is a risk to hearing, health and safety.

During fishing operations the noise level is variable, and a way of assessing the 'dose' to which crewmen are subjected could be to use the industrial method of 'Leq' measurement which averages the levels to a single value of dBA over a set time, very often 8 hours for a working day for normal industrial workers. In the case of fishermen a 24 hour Leq. is more meaningful.

The combination of several noise sources is logarithmic.

\[ 80\text{dBA} + 80\text{dBA} = 83\text{dBA} \text{ and not } 160\text{dBA} \]

Hence a doubling of sound energy results in a 3dBA increase in measured noise level. However, human senses are such that a 10dBA increase is needed to make the sound seem twice as loud, and a 10dBA reduction seems half as loud. Two notes struck on a guitar would hardly seem different to one, is a way of illustrating this.
What are hazardous noise levels?
The Health and Safety Executive provide a Code of Practice for employed persons on shore. From this a table is assembled of maximum exposure time at various dB(A) noise levels as follows:-

<table>
<thead>
<tr>
<th>Sound Pressure Level dBA</th>
<th>Maximum Exposure in any 24 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>85</td>
<td>24 hours</td>
</tr>
<tr>
<td>87</td>
<td>16 hours</td>
</tr>
<tr>
<td>90</td>
<td>8 hours</td>
</tr>
<tr>
<td>93</td>
<td>4 hours</td>
</tr>
<tr>
<td>96</td>
<td>2 hours</td>
</tr>
<tr>
<td>99</td>
<td>1 hour</td>
</tr>
<tr>
<td>102</td>
<td>30 minutes</td>
</tr>
<tr>
<td>105</td>
<td>15 minutes</td>
</tr>
<tr>
<td>108</td>
<td>7.5 minutes</td>
</tr>
</tbody>
</table>

The table is compiled from the principle that a person working an eight hour day should not be subjected to more than a continuous noise level of 90dBA. Also if the sound level in dBA is doubled (an increase in 3dBA) then the exposure time should be halved and vice-versa. Preventative measures should be taken at 90dBA at present but this `action level' is likely to be reduced to 85dBA with new legislation in the foreseeable future.

Inspection of the table provides two immediate conclusions:-

1. It can be seen that 85dBA is a criteria for life at sea on a fishing vessel. If noise levels in both accommodation and working spaces exceed this figure, then crewmen are at risk.

2. Since most fishing vessel engine rooms have sound levels of about 105 dBA it can be seen that it is essential to wear ear protectors when in machinery spaces.

The following are extracted from noise readings on 17 fishing vessels typical of the 1988 fleet:-
The diagram shows the predominant range and the circled figures are the highest levels measured, these relate to everyday noise as follows:

<table>
<thead>
<tr>
<th>dBA</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>115</td>
<td>jet aircraft at 150 metres</td>
</tr>
<tr>
<td>100</td>
<td>very noisy factory</td>
</tr>
<tr>
<td>90</td>
<td>heavy lorry or road drill at 7 metres</td>
</tr>
<tr>
<td>80</td>
<td>very busy street traffic</td>
</tr>
<tr>
<td>70</td>
<td>inside a car, noisy offices</td>
</tr>
<tr>
<td>60-65</td>
<td>normal conversation</td>
</tr>
</tbody>
</table>

**What is the result of over-exposure to high noise levels?**

There is a high risk that some loss of hearing will result. This often means that the ear will not detect sound at some frequencies and when this happens the loss is usually permanent. The effect is to cut out parts of works in speech, with difficulty in understanding conversation. A similar effect is noted when listening to music. The sufferer also has difficulty with his own speech level.

**What regulations cover noise on fishing vessels?**

It is important to note that the worst situation is to get used to noise that was at first a nuisance. This usually means that hearing loss has already occurred.

Basically there are none. However, the damaging effects on health and hearing efficiency which are the justification for creating noise level legislation ashore are just as valid on fishing vessels as at any other place of work.

The DTp have a Code of Practice which applies to Merchant vessels but small craft, including fishing vessels, are excluded. Typically the Code recommends that noise levels in accommodation and wheelhouse spaces should be below 65dBA and `working spaces' 90dBA. The Code is similar to that of other leading maritime nations.

**What are the sources of noise on a fishing vessel?**
The diagram shows the most typical sources of noise on fishing vessels. Noise obviously build up as the number of noise making sources increase, but it is always the high noises that dominate and eliminating these will have the most beneficial effect. Remembering that the noise level scale is logarithmic the following example illustrates this:-

\[
\begin{array}{ccc}
90\text{dBA} & + & 95\text{dBA} = 96.5\text{dBA} \\
\text{Lower} & & \text{Higher} & \text{Result}
\end{array}
\]

Reducing the higher noise source by say 10dBA to 85dBA results in 90 + 85 = 91 dBA which is a meaningful reduction of 5.5dBA.

Reducing the lower noise by 10dBA to 80dBA results in 80 + 95 = 95dBA which is not a significant improvement (noises more than 10dBA lower than the high noise make no contribution to the overall noise).

It is the assessment of the noise sources which provide guidance on any course of action.

**How do we know if we have a noise problem?**

Thus it is essential to locate the highest noise sources for corrective action. If there are a number of high noise sources they all have to be reduced to make any noticeable and measurable difference.

It will probably be obvious to the human senses and verbal communication difficulties. It will be a serious problem if ringing ears are experienced or there is difficulty in hearing when ashore after a trip.

To confirm the problem it is likely that noise level readings will need to be taken in the various compartments of the vessel in the working conditions of fishing and steaming.

To assess whether the levels would present a risk to hearing may be a complicated procedure of logging times that crewmen spend in each compartment to provide a `noise dose' for comparison with the Noise and Exposure table noted earlier.

A simple way of assessing risk is to consider the 85dBA as a maximum level in all accommodation spaces in all operating conditions of the vessel. For comfort, rest and recovery the levels ought to be lower, certainly levels above this, introduce the risk of hearing loss since working spaces usually have higher noise levels.

It is becoming normal practice for the Boat Building or Marine Surveyor to take sound level readings on the acceptance trials of fishing vessels. In the interest of crew welfare, owners and skippers should take great interest in these results.
**What action can be taken about a noise problem?**

It may be that a problem has a major single source and simple common sense solutions may apply, e.g. claddings, replacement, isolation, ear defenders.

Identification of more complex problems requires the employment of specialist skills which though expensive should prove cost-effective in recommending correct solutions. Contact with the local vessel builder may produce initial guidance and other sources of help are vessel designer, consultant, surveyor, suppliers and manufacturers of the equipment suspected of producing excessive noise. Seafish personnel will always provide advice if possible.

**Applying solutions to noise problems**

All noise problems can be overcome to some degree and solutions are usually in the following groups:

- Reduction of noise at source - choice of machinery and equipment, care in the details of installation of machinery
- Insulation of noise at source, e.g. enclosures, isolation
- Insulation of noisy compartments, e.g. engine-room
- Insulation of working spaces or accommodation
- Provision of ear protectors

It is perfectly reasonable to include consideration of noise levels in accommodation spaces in the specification of new vessels.

**Further Information**

Further information and advice can be obtained from Sea Fish Industry Authority, Seafish Technology, St. Andrews Dock, Hull.

It is proposed to compile further data sheets giving advice on specific noise problems on fishing vessels e.g. hydraulics.

The following list is a small selection of information on the subject of noise.

4. Prevention of Damage to Hearing from Noise at Work
   - Health and Safety Commission

The best time to consider potential noise problems is in the design stage of a vessel when solutions can be incorporated inexpensively as a small part of the building costs.

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