

Noise Evaluation
Centennial Series (CS) 1000 Core Drilling Rig

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EXECUTIVE SUMMARY

Layne Christensen Company is aware and concerned about employee safety and health as it relates to occupational noise exposure. These considerations have prompted Layne to investigate this area in order to quantify exposure and establish proper documentation of conditions for the purpose of evaluating work practices. It also ensures that all employees have a safe and healthful work environment. This report, prepared by Layne Christensen Safety and Environmental Health Sciences Department (SEHS), summarizes the results of the noise evaluation for the CS 1000 core drill rig.

The current legislative standards, Occupational Safety and Health Administration (OSHA) 29 CFR 1910.95 and Mine Safety and Health Administration (MSHA) 30 CFR Part 56, both entitled *Occupational Noise Exposure*, require all employees who exceed an eight hour Time Weighted Average (TWA₈) of 85 dBA or a 50% dose to be placed in a hearing conservation program. A complete description of the program requirements may be found in the Layne Christensen Hearing Conservation Program.

Occupational noise dosimetry surveys are completed in order to assess the noise levels that workers are exposed to during the course of their tasks, to identify needs for control measures and to comply with the hearing conservation program. Qualified industrial hygienists conduct these surveys. Results of these surveys indicate that personnel *are* occupationally exposed to noise levels above the action level defined by Legislation during drilling tasks of the nature performed at the survey sites using the CS 1000 core drill rig. This mandates the use of hearing protection devices and participation in the Layne Christensen Company Hearing Conservation Program by all personnel operating these types of equipment.

Section - 1 Introduction

1.1 Survey Objectives

The objective of the noise evaluation survey is to sample representative personnel and conditions in order to establish a basis for which the noise hazards can be evaluated for CS 1000 core drill rig operations.

1.2 Drill Rig/Crew Specifications

The Centennial Series (CS) 1000, manufactured by Layne Christensen Company, is a core drilling rig capable of drilling over 1,000 feet into the earth. The main engine of the drill unit is a deck-mounted diesel. Associated equipment included with the rig is a hydraulic powered water pump, which runs off of power supplied by the drill unit engine. On-site equipment usually includes a pick-up truck, drill pipe trailer or truck, light plant for night shift work and a water truck. A two-employee crew consisting of a driller and a helper is the norm. The driller's duties are to run the rig, perform maintenance and supervise the overall operations. The helper's responsibilities include retrieving core from tubes, maintenance and making water haul runs. Crews commonly work 10-12 hour shifts.



Figure 1 CS 1000 Core Drill Rig

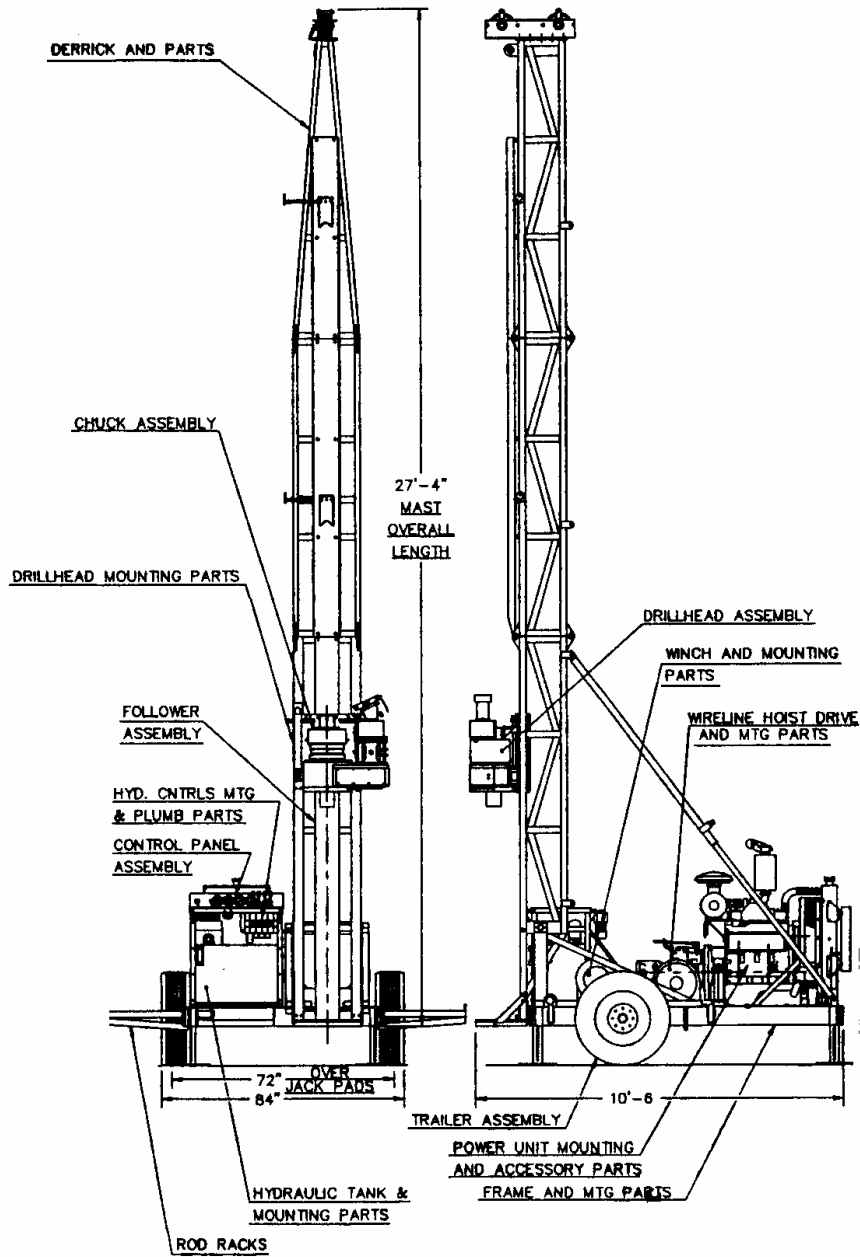


Figure 2 - Side View of CS1000 Core Drill Rig with Noise Sources Noted

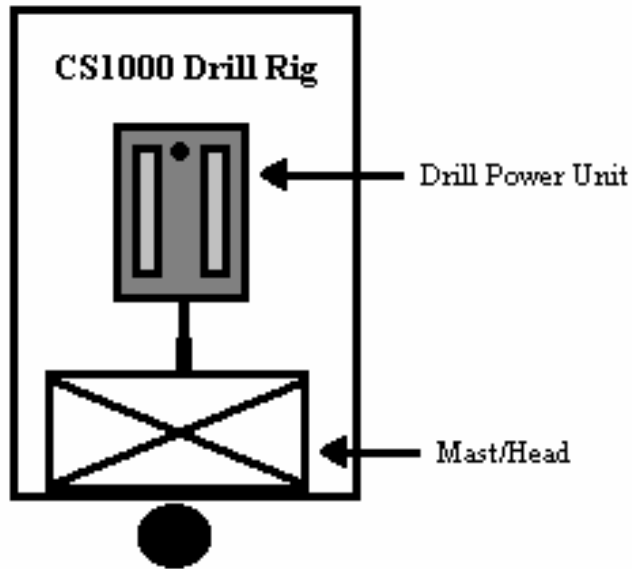


Figure 3 - Overhead View of CS1000 Core Drill Rig with Noise Sources Noted

Section 2 – Sampling Protocol

2.1 Survey Types

Layne Christensen industrial hygienists perform two types of noise surveys on employees and equipment. The Full Noise Survey and the Spot Check SLM Survey.

The Full Noise Survey consists of a sound level meter (SLM) check of the site and associated equipment, and a personal dosimeter survey of the employees on site. The information gathered from this survey includes equipment noise generation, 85 dBA hearing protection zone site requirements, maximum employee decibel exposure, employee dose % and employee 8-hour Time Weighted Average (TWA₈) exposure. The Full Noise Survey will be performed at least once every twenty-four months, when equipment or work practices change drastically, or when a Spot Check SLM Survey shows a major change in noise levels.

The second type of survey is a Spot Check SLM Survey, which only provides information on the equipment noise generation and the 85 dBA hearing protection zone requirements. The Spot Check will also be used to assess the need for a Full Survey. If the SLM readings show the 85dBA line to change by more than ten feet (10'), a Full Noise Survey will be conducted on the representative equipment within sixty days. Spot Check SLM Surveys are conducted several times per year on various pieces of representative equipment.

2.2 Technical Approach - Full Noise Survey

Dosimeters are positioned on all crewmembers for personal samples. Dosimeters may also be positioned at a static location (such as the driller's control panel). Dosimeters will be set to a 80 dBA threshold level, 90 dB criterion level, 5 dB exchange rate, A rating and slow response. The crew should wear the dosimeters for at least four hours and during all activities including sampling, water runs, maintenance and breaks. It is the attempt of the survey to capture an "average" day of drilling for the employees involved. Specific crew activities will be noted on the individual survey data reports.

For information concerning the SLM survey as part of the Full Noise Survey, see Section 2.3 Technical Approach - Spot Check SLM Survey.

2.3 Technical Approach - Spot Check SLM Survey

An instantaneous sound level meter is utilized to record noise levels at five (5) foot intervals around all four sides of the drill or pump service rig in an attempt to establish an 85 dBA line. SLM readings will be taken on at the front, rear (operator's platform/drill hole/well head), centerline left side (operator's left) and centerline right side (operator's

right) of the rig. Readings may also be taken near or around ancillary equipment such as pumps or compressors. Readings should be taken during activities that present the loudest noise generation possible, or a “*worst case*” noise exposure scenario. This may include drilling, tripping pipe, or any other activity when the engine, pumps and/or compressors are at operational levels. Readings should be taken with the SLM in slow response dBA mode and should start directly next to the rig, or the 0' line. Readings should be taken at five-foot intervals until the noise level is below 80 dBA. If a reading can not be taken at a certain point due to a piece of equipment or hazard blocking the path, that reading will be left blank, the reason noted, and the next reading taken.

2.4 Sampling Equipment

Equipment used to perform noise surveys include, Casella CEL-320 and DuPont/Ametek MK-1, MK-2 and MK-3 audio dosimeters, and a DuPont/Ametek AC-1 acoustical calibrator. Real time sound level measurements are taken using a Quest Model 215 or DSM-1000 sound level meter (SLM), or a Casella CEL-320 or DuPont/Ametek MK-1, MK-2 or MK-3 dosimeter in the SLM mode. Individual noise survey reports will outline specific sampling equipment utilized.

Section 3 – Noise Control Measures

3.1 Introduction

Noise control measures include administrative, engineering and personal protective equipment. Administrative and engineering controls should be the first choices of supervisory personnel to reduce an employee's noise exposure. Personal protective equipment should be the final choice.

Equipment and procedures will be continually reviewed by the Layne Christensen Safety Department. Contact with management, manufacturers and suppliers will continue to seek out new ideas for control measures.

For drilling operations, past history has shown administrative and engineering controls to be minimally effective in reducing an employee's TWA_8 (less than 2 dBA).

3.2 Administrative Controls

Administrative controls routinely used by Layne Christensen Company include:

- Rotating employee duties from one task to another. An example would be to switch employees making water runs or servicing a compressor. This can be difficult as operations usually run only two or three employee crews.
- Employees should back away from the drill rig or into a crew shack during down times, such as when a drill string has just been attached and it will be some time before another is added. This is very effective. Every step away from the drill string reduces noise exposure by 1 dBA.
- Avoid working directly next to extremely loud areas. For example, do not repair parts directly next to a compressor while it is in operation. The rear or front of the drill is usually the quietest area.

3.3 Engineering Controls

Engineering controls in use include:

- Position ancillary equipment such as pumps or compressors as far from the crew area as possible, or in an indirect line from the crew. Position rest areas, core stands, etc., away from noise sources.
- Never remove noise reducing equipment i.e., shrouds, mufflers, etc., from any equipment.

- Keep all equipment well maintained and lubricated.
- Do not modify manufacturer's design without a supervisor's approval.

3.4 Personal Protective Equipment

All company employees and visitors will be required to wear hearing protection when they are within a fifty-foot (50') radius of equipment in operation. Hearing protectors must attenuate employee exposure to at least a TWA_8 of 90 dBA and 85 dBA or less for employees who have experienced a standard threshold shift.

Hearing protection choices include two types of each of the following:

Foam Ear Plugs - Soft pliable material fits into and seals the ear canal. To use this type of protection, depress and roll into a very thin, crease-free cylinder. While compressed, insert plug into ear canal. Fitting is easier if the outer ear is pulled outward and upward during insertion. With fingertip, hold plug in place until it begins to expand and block noise.

Hearing Bands - Soft pliable pods fitted onto a flexible headband, designed for use with hard hats. The pods swivel to align with almost any size ear canal.

Protective Muffs - Protective earmuffs have soft cushions, which fit around the outer ear to seal out noise. There are three different band positions: over the head; behind the neck; or under the chin. Earmuffs are available that attach directly to the hard hat.

Each type of hearing protection is assigned a noise reduction rating (NRR) by the manufacturer. Since there is some contention as to the accuracy of the manufacturer assigned NRR due to testing procedures, individual ear shape, usage practices, age of protective device, etc., the NRR should be reduced by 7. This number is subtracted from the TWA_8 shown on previous surveys for that type of equipment. The resulting number is a general idea of the employee's actual TWA_8 exposure. For example, surveys for the TH75E reverse circulation drill have shown a TWA_8 of 100 dBA. An employee wearing foam earplugs with a manufacturer's NRR of 30 can expect an actual TWA_8 exposure of 77 dBA (NRR 30 minus 7, subtracted from the 100 TWA_8), which is below the 90 dBA permissible exposure limit. When selecting hearing protection devices from a supplier, the NRR must reduce the TWA_8 below 90 dBA, and 85 dBA for employees who have experienced a standard threshold shift. Keep in mind this is a general calculation and if there is any question, contact the Layne Christensen Safety Department for suggestions on PPE selection.

The Mine Safety and Health Administration has established a "dual hearing protection level" of TWA_8 105 dBA. When surveys show a TWA_8 of greater than 105 dBA, employees are required to wear plug *and* muff type hearing protectors. Only surveys conducted on underground drilling operations have shown numbers close to this level,

therefore employees working underground may be required to wear dual hearing protection.

Hearing protection devices must be kept in a clean, well-maintained condition. Disposable plugs should not be reused. Employees will be provided their choice of hearing protection at no charge, but it is a condition of employment that protectors are used in accordance with direction and training when required by supervision.

Section 4 – Conclusions

4.1 Regulatory Requirements

The current legislative standards, the Occupational Safety and Health Administration (OSHA) 29 CFR 1910.95 and Mine Safety and Health Administration (MSHA) 30 CFR Part 56, both entitled *Occupational Noise Exposure*, require all employees who exceed an eight hour Time Weighted Average (TWA_8) of 85 dBA or a 50% dose to be placed in a hearing conservation program. A complete description of the program requirements may be found in the Layne Christensen Hearing Conservation Program.

4.2 Basis for Conclusions

The evaluation of the noise exposure was based on analysis of the dosimetry results, which measure dose percentage, average sound level, maximum sound level and time.

Historical surveys for the CS 1000 core drill rig show the OSHA/MSHA specified time weighted average and dose % action levels are reached. Hearing protection and participation in the hearing conservation program is required due to the noise levels generated and duration of continuous noise exposure.

4.3 Conclusion

Sound levels are above the OSHA/MSHA action levels. The sound levels measured are considered damaging if precautions are not taken, therefore all personnel working on drilling and pump service equipment must be placed into the Layne Christensen Hearing Conservation Program. This program meets OSHA/MSHA requirements and should be implemented to the fullest extent. Layne Safety Compliance Procedure A3 encompasses the hearing protection requirements and mandates hearing protection to be worn within a fifty-foot (50') radius of equipment in operation.

Appendix A – Historical Comparison of Survey Results – CS1000

| Noise Dosimeter Survey Results | | | | | | | | |
|---------------------------------------|-------------------|------------------|-------------------|------------------|-------------------|------------------|-----------------------------|----------------------------|
| Survey Date | Driller Dose % | Helper Dose % | Driller dBAavg | Helper dBAavg | Driller dBAmax | Helper dBAmax | Driller TWA ₈ | Helper TWA ₈ |
| 22 April 1996 | 67.9 | 27.9 | 91.6 | 85.3 | 106.1 | 110.2 | 87.2 | 80.8 |

| 85 dBA Line From SLM Readings in Feet | | | | |
|--|-------|------|------|-------|
| Survey Date | Front | Rear | Left | Right |
| 22 April 1996 | 1 | 13 | 22 | - |
| 24 July 1997 | 26 | 20 | 25 | 30 |