



中华人民共和国石油天然气行业标准

SY/T 6736.2—2008

中文/English

石油海上数字地震采集拖缆系统 第2部分: 水听器拖缆技术条件

Marine seismic digital streamer system—
Part 2: Standards for specifying hydrophone streamer-cable characteristic

(Geophysics, 52, no. 02, 242-248, 1987, SEG Standards
for marine seismic hydrophones and streamer cables—
Part II: Standards for specifying hydrophone streamer-cable
characteristics, MOD)

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目 次

前言 II

1 范围 1

2 规范性引用文件 1

3 术语和定义 1

4 要求 1

4.1 水听器组合 1

4.2 工作段 3

4.3 辅助设备 4

4.4 前导段 4

4.5 甲板电缆 5

4.6 弹性段 5

4.7 充填物指标 6

5 检验和试验 6

5.1 电缆工作段 6

5.2 电缆压载物腐蚀性 6

附录 A（资料性附录） 本部分章条编号与 SEG Geophysics, 52, no. 02, 242 – 248, 1987, Part II 条款对照 7

附录 B（资料性附录） 本部分与 SEG Geophysics, 52, no. 02, 242 – 248, 1987, Part II 技术差异及其原因 8

前 言

SY/T 6736《石油海上数字地震采集拖缆系统》分为三个部分：

- 第 1 部分：水听器技术条件；
- 第 2 部分：水听器拖缆技术条件；
- 第 3 部分：中央记录系统。

本部分是 SY/T 6736 的第 2 部分。

本部分修改采用国际地球物理家学会 SEG Geophysics, 52, no. 02, 242 - 248, 1987, Part II《海上数字拖缆标准 第 2 部分》。

本部分根据 SEG Geophysics, 52, no. 02, 242 - 248, 1987, Part II 重新起草。在附录 A 中给出了本部分章条编号与 SEG Geophysics, 52, no. 02, 242 - 248, 1987, Part II 条款对照一览表，以供参考。

由于我国石油勘探工业的特殊需要，本标准在采用国际标准时进行了修改。有关技术性差异已编入正文中并在它们所涉及的条款的页边空白处用垂直单线标识。在附录 B 中给出了本部分与 SEG Geophysics, 52, no. 02, 242 - 248, 1987, Part II 技术性差异及其原因一览表，以供参考。

本部分的附录 A 和附录 B 是资料性附录。

本部分由石油仪器仪表专业标准化技术委员会提出并归口。

本部分起草单位：中海油田服务股份有限公司物探事业部、中国石油天然气集团东方地球物理勘探有限公司西安物探装备分公司、石油工业仪器仪表质量监督检验中心、国土资源部广州海洋地质调查局。

本部分主要起草人：于湛海、何国信、尹振国、张在陆、李佩昌、褚荣英、曹占全、汉泽西、陈洁、韩晓泉、赵伟、连艳红。

本部分以中文和英文两种文字出版，当英文和中文两种版本有歧义时，以中文版本为准。

石油海上数字地震采集拖缆系统

第2部分：水听器拖缆技术条件

1 范围

SY/T 6736 的本部分规定了水听器组合参数，工作段、前导段、弹性段、甲板电缆以及可选的辅助设备的指标，还包括压载物指标。

本部分适用于水听器拖缆的制造、检验和质量评价。

2 规范性引用文件

下列文件中的条款通过 SY/T 6736 的本部分的引用而成为本部分的条款。凡是注日期的引用文件，其随后所有的修改单（不包括勘误的内容）或修订版均不适用于本部分，然而，鼓励根据本部分达成协议的各方研究是否可使用这些文件的最新版本。凡是不注日期的引用文件，其最新版本适用于本部分。

GB/T 5096 石油产品铜片腐蚀测定法 (GB/T 5096—1985, eqv ASTM D 130; 1983)

SY/T 6736.1 石油海上地震采集拖缆系统 第1部分：水听器技术条件

SEG Geophysics, 53, no. 03, 415—416 (Badger, A. S., 1988) Digital seismic recorder specification standards

3 术语和定义

3.1 下列术语和定义适用于 SY/T 6736 的本部分。

测量单位 units of measurement

本部分的测量单位是按 SI 公制系统单位制和 SEG 公制分委员会 1981 年发布的公制试行标准执行。

以下是两个例外：

——波长：用希腊字母 λ 表示；

——组合长度：用大写英文字母 L 表示。

3.2

公差 tolerance

所有测量结果如果不带有公差 ($\pm XXX$)，则是以其标称值表示。

4 要求

4.1 水听器组合

4.1.1 物理特性

对水听器组合的物理特性要求应包括如下内容：

- 水听器：每个组合的水听器类型和数量。
- 组合：每段的组合数量。
- 组合尺寸：道长度，单位为米 (m)。
- 道间距：相邻组合中心点间的距离，单位为米 (m)。
- 水听器间距：在组合内水听器的间距，单位为米 (m)。

- f) 图形：如水听器间距不等时，以图形示明尺寸。
- g) 工作深度：推荐工作深度，单位为米（m）。
- h) 最大深度：水听器组合在没有损坏或灵敏度显著的永久性变化未超过 1dB 时的最大深度，单位为米（m）。
- i) 可编程性：如果可以编程，说明可选组态。
- j) 指标列表：依照 SY/T 6736.1 规定的水听器参数标准，提供典型水听器指标，可列表。

4.1.2 响应特性

水听器组合响应特性包括如下内容：

- a) 电器图：提供工作段的电器电路示意图，包括水听器连接、耦合电路。
- b) 电容：每个水听器组合的总电容，单位为微法（ μF ），允许误差 $\pm X\%$ 。
- c) 输出阻抗：复输出阻抗，以图形形式表示。
- d) 灵敏度：声学灵敏度，单位为伏每微帕（ $\text{V}/\mu\text{Pa}$ ），允许误差 $\pm \text{XdB}$ （ $\mu\text{V}/\mu\text{bar}$ ）。
- e) 灵敏度与深度关系：灵敏度随深度变化关系， dB/m 。
- f) 电权值：组合单独单元电权值。
- g) 振幅响应：振幅响应以图形形式表示，频率单位为赫〔兹〕（Hz），振幅单位为分贝（dB），以 $1\text{V}/\mu\text{Pa}$ 为 0dB，见图 1。
- h) 相位响应：相位响应以图形形式表示，相位单位为弧度（rad），频率单位为赫〔兹〕（Hz），见图 1。
- i) 空间响应：空间响应应以图形形式表示，空间响应是组合长度与波长比（ L/λ ）的函数，见图 2。

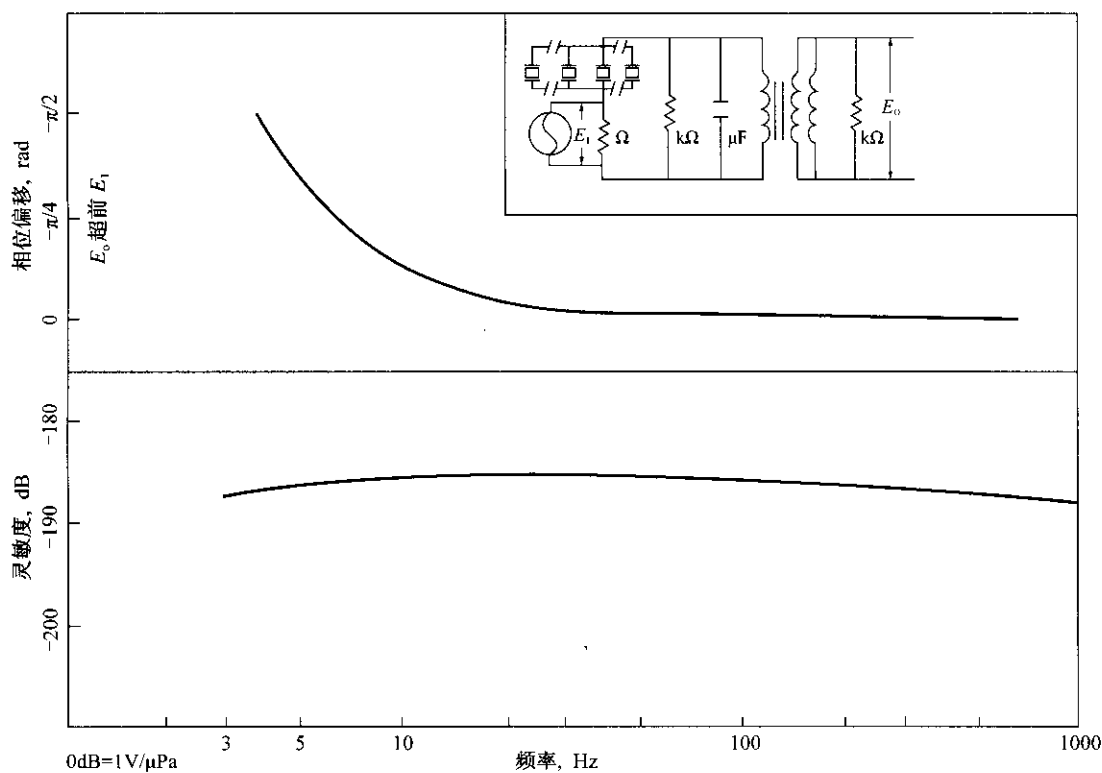


图 1 组合频率响应

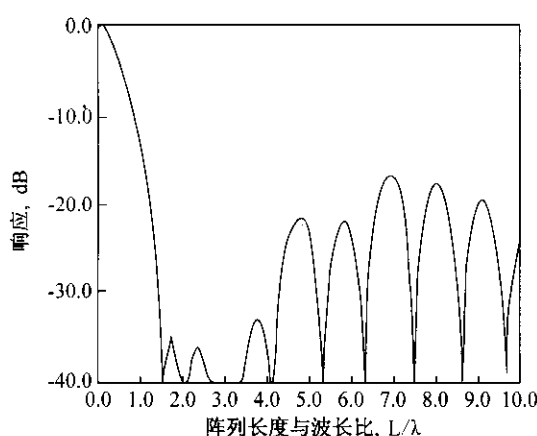


图2 组合空间响应

4.2 工作段

4.2.1 物理特性

工作段的物理特性要求应包括以下内容：

- a) 长度：单位为米（m）。
- b) 外径：单位为厘米（cm）。
- c) 护套：护套类型、厚度，单位为厘米（cm）。
- d) 加强构件：加强构件材质，类型、尺寸、数目。
- e) 拖断力：最小拖断力，单位为牛（N）。
- f) 干重：每段在干燥空气中的质量，单位为千克（kg）。
- g) 湿重：填充定量液体后在干燥空气中的质量，单位为千克（kg）。
- h) 潜水质量：在标准温度 20℃ 和标准压力 101325Pa（一个标准大气压）下，计算或测量的每段电缆在净水中的排水量，单位为千克（kg）。
- i) 压载物：使用压载物体积，单位为立方米（m³）。
- j) 工作温度：工作温度范围，单位为摄氏度（℃）。
- k) 存储温度：存储温度范围，单位为摄氏度（℃）。
- l) 连接器：电缆段连接器类型。
- m) 材质：制造厂商应规定水听器的材质，说明与其接触的压载物之间的化学兼容性，并说明替代材质的指标。
- n) 连接器指标：外径、净水中的质量、长度（包括电子模块）。
- o) 极限深度：不导致工作段损坏或物理电气性能不显著变化的最大深度，单位为米（m）。
- p) 弯曲半径：电缆和连接器可经受的最小弯曲半径，单位为米（m）。

4.2.2 模拟电气性能

模拟电气性能参数要求应包括以下内容：

- a) 电参数：在特定环境下，导体的环路直流电阻和电容，单位分别为欧〔姆〕每米（Ω/m）、微法每米（μF/m）。
- b) 工作道：工作道数目和备份数量。
- c) 辅助道：辅助道数目和备份数量。
- d) 测试线对：电子模块质量控制测试线对的数目。
- e) 导体：指明实际使用的导体类型，如双绞线、同轴线、光纤等。

f) 漏电：在特定环境测量，道间漏电电阻的可容许标称值为兆欧 (MΩ)。

4.2.3 数字电气特性

4.2.3.1 电子模块指标

按照 SEG Geophysics, 53, no. 03, 415 - 416 (Badger, A. S., 1988) 的规定：

- a) 每模块道数：每模块地震道数 (2, 4, 12, 16, 24 可选) 和辅助道数。
- b) 高截频率 (Hz)：根据采样间隔选择 (1648, 824, 412, 306, 103)。
- c) 低截频率 (Hz)：可选 (0~5)。
- d) A/D 转换器：24 位 $\Delta-\Sigma$ 类型。
- e) 动态范围 (dB)：在 2ms 采样时，大于 114。
- f) 总谐波畸变 (dB)：在 2ms 采样时，大于 -105。
- g) 前置放大器：类型，差分输入电阻，单位为欧 [姆] (Ω)。

4.2.3.2 工作段指标

工作段指标要求应包括以下内容：

- a) 数据传输链：类型和数传链带宽 [即同轴电缆、光缆、带宽 (MHz)]。
- b) 相邻模块间和中继器间最大数传距离，单位为米 (m)。
- c) 功率：功率需求，单位为千瓦 (XXkW @XXV)。
- d) 电缆长度：能满足功率和数传需求的最大电缆长度
- e) 辅助导线：非地震数传导线的类型、指标、数量和实用功能。
- f) 漏电：在特定场地测量，可允许漏电的漏电电阻值应大于 100MΩ。

4.3 辅助设备

4.3.1 设备类型

设备可有以下类型：

- a) 水断水听器：类型、数量、位置。
- b) 电缆深度传感器：类型、数量、位置。
- c) 罗盘：方位指示器，可允许布置的位置。
- d) 电缆回收装置：类型、描述。
- e) 电缆深度控制器：自动、手动或可编程，可允许布置的位置。
- f) 节：尾节、类型、容量。
- g) 尾标：声学定位系统、测向电台、GPS。
- h) 电缆定位设备：声学定位设备，位置、类型，测量范围，船上及电缆上配置，数传方法。

4.3.2 设备输出信号

对设备输出信号要求应包括如下内容：

- a) 信号输出标准：对特殊类型的辅助设备，提供信号输出类型 (数字或模拟)、测量单位 (例如电缆深度传感器为 V/m)、分辨率、精度，功率要求的指标，特别是在电缆表面安装的设备、影响电缆噪声及拖曳配置的设备应说明其物理特性。
- b) 指标来源：对于商业上有现货供应的设备，电缆制造厂商可根据已出版的辅助设备指标作为参考，避免指标列表繁杂。

4.4 前导段

前导段物理特性应包括如下内容：

- a) 长度：单位为米 (m)。
- b) 外径：单位为厘米 (cm)。
- c) 护套：类型，护套厚度，单位为厘米 (cm)。
- d) 导体：数量，类型，AWG 导线规格，线束的屏蔽。

- e) 铠装：铠装类型，加强构件指标。
- f) 强度：最小拖断力，单位为牛（N）。
- g) 干重：空气中质量，单位为千克（kg）。
- h) 潜重：在标准压力和温度下净水中质量，单位为千克（kg）。
- i) 工作温度：工作温度范围，单位为摄氏度（℃）。
- j) 存储温度：存储温度范围，单位为摄氏度（℃）。
- k) 减震装置：减震装置类型。
- l) 电气特性：在特定环境测量的环路直流电阻、电容和漏电，单位分别为欧〔姆〕（Ω）、微法（μF）和兆欧（MΩ）。
- m) 连接器：连接器类型。
- n) 浮力：如有浮漂，浮力类型，单位为千克（kg）。
- o) 弯曲半径：最小弯曲半径，单位为米（m）。

4.5 甲板电缆

甲板电缆物理特性应包括如下内容：

- a) 长度：单位为米（m）。
- b) 外径：单位为厘米（cm）。
- c) 护套：护套类型。
- d) 导体：数量，类型，AWG 导线规格。
- e) 铠装：铠装类型，屏蔽，加强构件。
- f) 强度：最小拖断力，单位为牛（N）。
- g) 干重：空气中质量，单位为千克（kg）。
- h) 工作温度：工作温度范围，单位为摄氏度（℃）。
- i) 存储温度：存储温度范围，单位为摄氏度（℃）。
- j) 连接器：连接器类型，嵌入式、旋转式、滑环式等。
- k) 弯曲半径：最小弯曲半径，单位为米（m）。
- l) 电气特性：在特定环境测量的环路直流电阻，电容，标称漏电阻。

4.6 弹性段

弹性段指标应包括如下内容：

- a) 长度：单位为米（m）。
- b) 外径：单位为厘米（cm）。
- c) 护套：护套类型、厚度，单位为厘米（cm）。
- d) 导体：数量，类型，AWG 导线规格。
- e) 加强构件：弹性加强构件类型和数量。
- f) 强度：最小拖断强度，单位为牛（N）。
- g) 可拉伸性：也称伸长度，即每牛顿载荷段组在 Z 牛顿载荷张力经 Y 小时后不应超过 X%，应提供适用的图件。
- h) 干重：在干燥空气中的质量，单位为千克（kg）。
- i) 湿重：填充定量液体后在干燥空气中的质量，单位为千克（kg）。
- j) 潜重：标准温度压力下，充以规定量压载液体后在净水中的质量，单位为千克（kg）。
- k) 工作温度：工作温度范围，单位为摄氏度（℃）。
- l) 存储温度：存储温度范围，单位为摄氏度（℃）。
- m) 电气特性：每单位长度的往返直流电阻，单位为欧〔姆〕每米（Ω/m）；电容，单位为微法每米（μF/m）；漏电标称值，单位为兆欧（MΩ）。

- n) 连接器：连接器类型。
- o) 充填物：充填物体积，单位为立方米（m³）。
- p) 水听器，如能带有水听器的，应规定工作传感器数量和类型以及合适的位置，同时应列出在作为地震电缆段时的电气模拟和数字特性。

4.7 充填物指标

充填物有以下三种类型：液体、胶体、固体。

液态充填物或简单的电缆油都是硫、芳香烃和烯烃的含量可忽略不计的一些无臭味的煤油，适用的电缆油都是选自链烃类，如标准的煤油、异链烷烃、环烷烃。这类碳氢溶剂只有当其随机含量占到一定的成分时，其特征参数才会在随后的段落被确定，凡超出下列指标的电缆油会对电缆结构带来损害。

电缆油的特性应包括如下内容：

- a) 密度：0.750g/cm³ ± 0.040g/cm³。
- b) 闪点：闪点是点火瞬间，蒸气点燃时的最低的温度，应大于 58℃。
- c) 芳香族化合物含量：10cm³/L（1%）。
- d) 塑料兼容性：杉木乙醇的含量是衡量树脂塑料对油的侵蚀能力的一种方法。其 K/B 值不应超过 30，最好为 25。
- e) 防臭性：专业测试方法是特别参考硫磺和硫醇对溶剂的除臭的程度加以衡量。
- f) 腐蚀性：对硫磺含量和油的腐蚀测试，应根据 GB/T 5096 的规定，腐蚀性指标不应超过 1 或 1a 级。
- g) 硫磺含量：1mg/kg。
- h) 石蜡：石蜡含量应为 99% 或大于标准值或异链烷烃。
- i) 烯烃：烯烃含量 10cm³/L（1%）。

采用胶体、固体等其他充填物的电缆也应符合安全、环保相关的规定。

5 检验和试验

5.1 电缆工作段

对电缆工作段的各项技术指标的试验，应根据 SEG Geophysics, 53, no.03, 415 - 416 (Badger, A. S., 1988) 的相关的方法进行，结果应符合 4.2 的要求。

5.2 电缆压载物腐蚀性

对电缆压载物腐蚀性的检验，应根据 GB/T 5096 的规定执行，结果应符合 4.7f) 的要求。

附 录 A
(资料性附录)

本部分章条编号与 SEG Geophysics, 52, no. 02, 242 – 248, 1987, Part II 条款对照

表 A.1 给出了本部分章条编号与 SEG Geophysics, 52, no. 02, 242 – 248, 1987 Part II 条款内容对照一览表。

表 A.1 本部分章条编号与 SEG Geophysics, 52, no. 02, 242 – 248, 1987, Part II 条款对照

本部分章条编号	SEG Geophysics, 52, no. 02, 242 – 248, 1987 Part II
1 范围	第 6 页: Scope
2 规范性引用文件	第 8 页: Electrical characteristics, digital (1) Digital specifications
3.1	第 6 页: Units of measurement
3.2	第 6 页: Tolerance
4.1 水听器组合	第 7 页: Hydrophone arrays
4.2 工作段	第 7 页: Streamer cable section
4.3 辅助设备	第 8 页: Ancillary equipment
4.4 前导段	第 9 页: Lead – in cable
4.5 甲板电缆	第 9 页: Deck cable
4.6 弹性段	第 9 页: Stretch cable
4.7 充填物指标	第 9 页: Ballast fluid specifications

附 录 B
(资料性附录)

本部分与 SEG Geophysics, 52, no. 02, 242 – 248, 1987, Part II 技术差异及其原因

表 B.1 给出了本部分与 SEG Geophysics, 52, no. 02, 242 – 248, 1987 Part II 技术差异及其原因一览表。

表 B.1 本部分与 SEG Geophysics, 52, no. 02, 242 – 248, 1987, Part II 技术差异及其原因

本部分 章条编号	技术性差异	原 因
1	删除了 SEG 标准的“目的 (purpose)”和“结论 (Conclusions)”	“目的”和“结论”的表述已经不适用于我国标准的表述
2	将 SEG Geophysics, 53, no. 03, 415 – 416 (Badger, A. S., 1988) 和 GB/T 5096 作为规范性引用文件	为了方便使用和编排的需要
4.2.3.1	增加了对水听器电缆工作段数字采集模块具体技术指标的规定	为了便于实施和质量控制
5	增加了： 1) 对电缆工作段的各项技术指标试验； 2) 对电缆压载物腐蚀性的检验的规定	为了方便使用和编排的需要



The People's Republic of China
Standard of Petroleum and Natural Gas Industry

SY/T 6736.2—2008

Marine seismic digital streamersystem —
Part 2: Standards for specifying hydrophone
streamer-cable characteristics

(Geophysics, 52, no. 02, 242 – 248, 1987, SEG Standards
for marine seismic hydrophones and streamer cables —
Part II : Standards for specifying hydrophone
streamer-cable characteristics, MOD)

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Contents

Foreword 12

1 Scope 13

2 Normative references 13

3 Terms and definition 13

4 Requirements 13

4.1 Hydrophone arrays 13

4.2 Streamer cable section 14

4.3 Ancillary equipment 16

4.4 Lead – in cable 16

4.5 Deck cable 16

4.6 Stretch cable section specifications 17

4.7 Ballast fluid specifications 17

5 Inspection and test 18

5.1 Streamer cable section 18

5.2 Ballast fluid corrosiveness 18

Annex A (Informative) Comparison between the numbers of clause, sub – clause in this
part and the provision in SEG Geophysics, 52, no. 02, 242 – 248,
1987, Part II 19

Annex B (Informative) Technical differences and the justification of changes between
this part and the SEG Geophysics, 52, no. 02, 242 – 248, 1987,
Part II 20

Foreword

SY/T 6736 *Marine seismic digital streamer system* includes three parts:

- Part 1: *Standards for specifying hydrophone parameters*;
- Part 2: *Standards for specifying hydrophone streamer – cable characteristics*;
- Part 3: *Central recording system*.

This is the Part 2 of SY/T 6736.

This part is modified in relation to SEG *Standards for marine seismic hydrophones and streamer cables* (Geophysics, 52, no. 02, 242 – 248, 1987) Part II: *Standards for specifying hydrophone streamer – cable characteristics*.

This part was redrafted in accordance with SEG Geophysics, 52, no. 02, 242 – 248, 1987, Part II. In Annex A provides the table of comparison between the numbers of clause, sub – clause in this part and the provision in SEG Geophysics, 52, no. 02, 242 – 248, 1987, Part II, for reference.

Owing to the special requirements of China petroleum exploration industry, while adopting SEG Standards, this part was modified. The technical differences between this part and the SEG standards have been edited into the main article, and the discrepancies have been marked by the vertical side lines in the blank space by

the edge of those pages respectively. In Annex B provides the table of the technical differences between this part and the SEG Geophysics, 52, no. 02, 242 – 248, 1987, Part II and the reasons, for reference.

Annex A and Annex B of this part are informative.

This part was proposed by China National Offshore Oil Corporation.

This part is under the jurisdiction of The Committee of Petroleum Instrument Standardization. This part was drafted by China National Offshore Oil Corporation, Don Fang Geophysical Exploration Incorporated Company, Petroleum Industry Instrument Quality Surveillance and Test Center and Guangzhou Marine Geological Survey Ministry of Land and Resources, P. R. China.

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This part is issued in both Chinese and English versions. In the event of any discrepancy between the texts, the Chinese versions shall prevail.

Marine seismic digital streamer system— Part 2: Standards for specifying hydrophone streamer — cable characteristics

1 Scope

The part of SY/T 6736 specification set to follow will include hydrophone array parameters, physical characteristics of the streamer cable sections, the lead-in cable, isolator sections, deck cable, and optional ancillary equipment. Specifications for acceptable ballast fluids are also included.

2 Normative references

The following normative documents contain provisions, which, through reference in the part of SY/T 6736, constitute provisions of the part. For dated references, subsequent amendments to, or revisions of, any of these publications (exclude errata) do not apply. However, parties to agreements based on the part are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies.

GB/T 5096 *Petroleum products – Corrosive to copper – Copper strip test* (GB/T 5096 1985, eqv ASTM D130; 1983)

SY/T 6736.1 *Marine seismic digital streamer system—Part 1: Standards for specifying hydrophone parameters*

SEG Geophysics, 53, no. 03, 415–416 (Badger, A. S., 1988) *Digital seismic recorder specification standards*

3 Terms and definition

The following terms and definitions applicable to this part of SY/T 6736.

3.1

units of measurement

Units of measurement shall conform to the recommendations of the SEG Metrication Subcommittee as published in SI Metric System of Units and SEG Tentative Metric Standard. The preferred SI unit symbols used here are approved “abbreviations”. Alternate units of measurement follow in parentheses. There are two exceptions to the above rule:

Wavelength is expressed by the Greek symbol λ , and array length is expressed symbolically as L .

3.2

tolerance

All measurements should be expressed as typical unless a tolerance ($\pm XXX$) is specified.

4 Requirements

4.1 Hydrophone arrays

4.1.1 Physical characteristics

Physical characteristics as follows:

- a) Hydrophones: Number and type of hydrophones per array.
- b) Arrays: Number of arrays per section.
- c) Array dimensions: Length of active arrays, m.
- d) Array spacing: Array spacing, center-to-center, m.
- e) Hydrophone spacing: Hydrophone spacing within array, m.
- f) Drawings: Dimensional diagram if hydrophone spacing is not equal, m.
- g) Operating depth: Recommended normal operating depth, m.
- h) Maximum depth: Specify depth in m (ft) to which the hydrophone array may be barely

operated without destruction or permanent significant change in sensitivity exceeding 1 dB.

- i) Programmability: If programmable, state configuration options.
- j) Specification sheet: Provide specification sheet for typical hydrophone per SY/T 6736. 1.

4.1.2 Response characteristics

Response characteristics as follows:

- a) Electrical diagram: Provide schematic electrical diagram of cable section including hydrophone connections, coupling network.
- b) Capacitance: Total capacitance of each hydrophone array $\mu\text{F} \pm X\%$.
- c) Output impedance: Complex output impedance of hydrophone array in graphical form.
- d) Sensitivity: Acoustic sensitivity, $\text{V}/\mu\text{Pa} \pm X \text{ dB } (\mu\text{V}/\mu\text{bar})$.
- e) Sensitivity versus depth: Change in sensitivity with depth, dB/m.
- f) Weighting, electrical: Electrical weighting of individual units of array if any.
- g) Amplitude response: Amplitude response in graphical form, in units of frequency, in Hz versus dB referred to $1\text{V}/\mu\text{Pa}$. See Fig. 1.
- h) Phase response: Phase response of array in graphical form expressed as rad/Hz. See Fig. 1.
- i) Spatial response: Spatial response in graphical form in Hz as a function of the ratio of array length to wave length, L/λ . See Fig. 2.

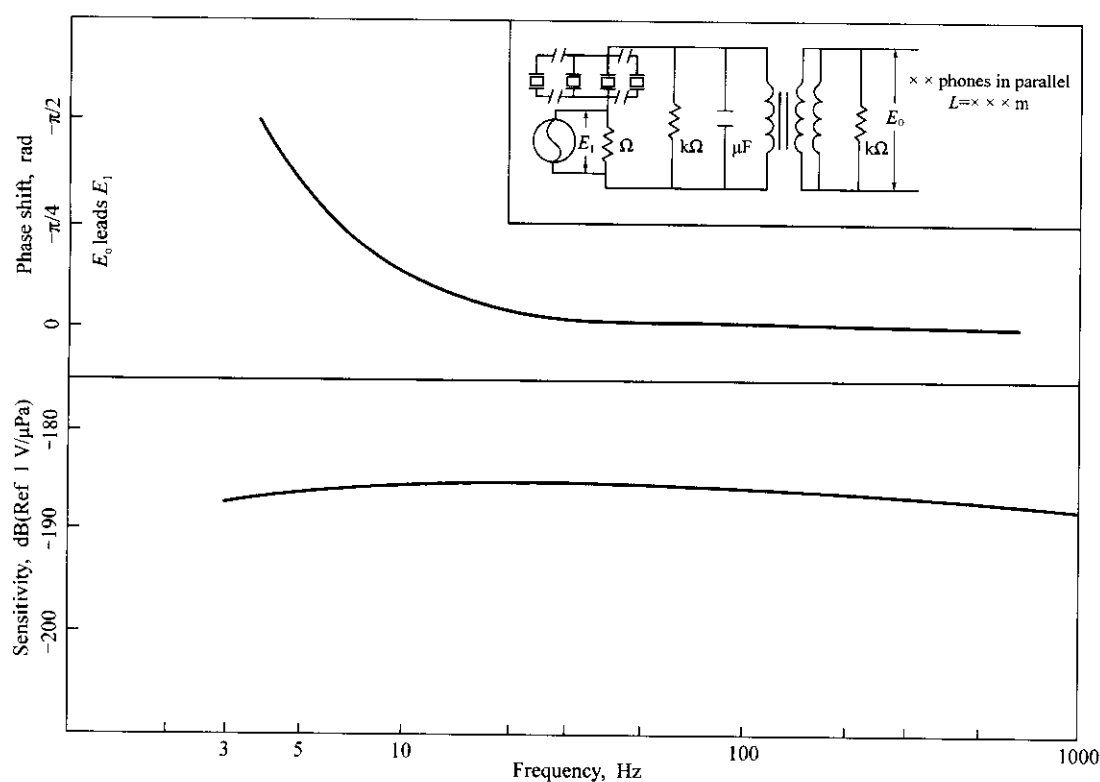


Fig. 1 Array frequency response

4.2 Streamer cable section

4.2.1 Physical characteristics

Physical characteristics as follows:

- a) Length: m.
- b) Outside diameter: cm.
- c) Jacket: Type of jacket, thickness, cm.
- d) Stress members: Stress members, material, type, size, number.
- e) Breaking strength: Minimum breaking strength, N.

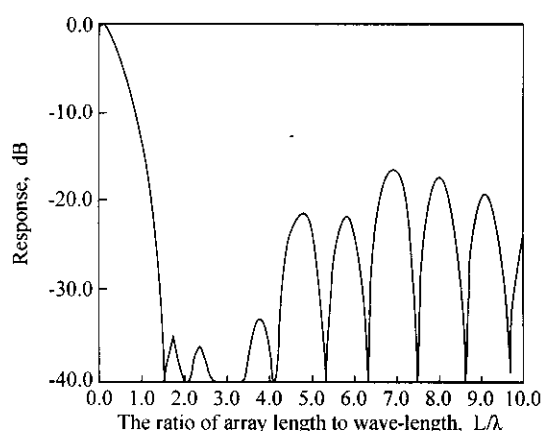


Fig. 2 In - line response of array

- f) Dry weight: weight in the air without fluid, kg.
- g) Wet Weight: Weight per section in air, filled with specified quantity of fluid, kg.
- h) Submerged weight: Section weight in water, kg, under the condition of fresh water at a standard temperature of 20°C and a standard pressure of 101325 Pa (1 atm) . This can be obtained by measuring the amount of overflow fresh water and then calculate the weight of the section.
- i) Ballast fluid: Capacity of ballast fluid required, m³.
- j) Operating temperature: Operating temperature range, °C.
- k) Storage temperature: Storage temperature range, °C.
- l) Connectors: Type of cable - section connectors.
- m) Materials: Hydrophone materials should be specified by the manufacturer, and explain the chemical compatibility between hydrophone assembly and contacting fluids. A statement should be included in the attached material specification.
- n) Connector specifications: Outside diameter, weight in fresh water, and the electronic module length.
- o) Depth limit: The maximum depth, in m which the streamer cable without destruction or suffer significant physical or electrical change.

- p) Bent radius: Specify the minimum bent radius, m to which the cable section and connectors before breakage.

4.2.2 Electrical characteristics, analog

Electrical characteristics, analog as follows:

- a) Electrical parameters: Conductor round - trip Dc resistance and capacitance in Ω/m , $\mu\text{F}/\text{m}$ respectively.
- b) Active channels: Number of active channels and spares.
- c) Auxiliary channels: Number of auxiliary channels and spares.
- d) Test pairs: Number of test pairs for quality control testing of active or passive electronic modules.
- e) Conductors: Type of conductors; twisted pairs, coaxial, fiber - optic, etc. , specify functional use.
- f) Leakage: Minimum measured cross channels leakage value allowable in M Ω in the field.

4.2.3 Electrical characteristics, digital

4.2.3.1 Digital data acquisition module specifications.

Digital data acquisition module specifications shall conform to SEG Geophysics 53, no. 03, 415 - 416 (Badger, A. S. , 1988) which is incorporated herein by reference:

- a) Channels Numbers: Number of seismic channels (2, 4, 12, 16, 24 optional) and auxiliary channels per module.
- b) High cut frequency (Hz): According to the corresponding sampling interval for selection (e.g. 1648, 824, 412, 306, 103) .
- c) Low cut frequency (Hz): (0~5) optional.
- d) A/D converter: delta - sigma type, 24 bits fixed point.
- e) Dynamic range (dB): > 114 (at 2ms sampling interval) .
- f) Total harmonic distortion (dB): > -105 (at 2ms sampling interval) .
- g) The preamplifier: the voltage, charge, or differential input mode.

4.2.3.2 Streamer cable sections specifications.

Streamer cable sections specifications as follows:

- a) Data transmission link: Type and bandwidth of data transmission link (e.g., coaxial cable, fiber optic, bandwidth in MHz).
- b) Module separation: Maximum data transmission distance between modules and/or repeaters, m.
- c) Power: Power requirements, in XX kW @ XXV.
- d) Cable length: Maximum total cable length with respect to power requirements, m.
- e) Auxiliary conductors: Specify the number, function, type of the non-seismic data transmission conductors.
- f) Leakage: Measured minimum value of leakage should higher than 100 MΩ in specific field.

4.3 Ancillary equipment

4.3.1 Types of equipment

Types of equipment as follows:

- a) Water break: Water break detector type, number, location.
- b) Cable depth transducer: Type, number, permissible spread location.
- c) Compasses: Azimuth indicators (compasses), permissible spread locations.
- d) Cable retriever: Cable retriever system, type, and description.
- e) Depth controllers: Cable depth controllers, automatic, manual, or programmable. Permissible spread location.
- f) Swivel: Tail swivel, type, capacity.
- g) Tail buoy: Acoustic positioning system, RF radio, GPS or passive such as marker buoy and radar target.
- h) Cable positioning: Acoustical positioning devices, locations, types, range, shipboard and cable configurations and method of data transmission.

4.3.2 Output signals

Output signals as follows:

- a) Specification of signal outputs: For each specialized type of ancillary equipment, where

appropriate, specify the type of signal output (digital or analog), the units of measurement, e.g., V/m for a cable-depth detector, resolution, accuracy, power requirements at specified voltage. Specify their physical characteristics, particularly if such devices are external to the cable or if they would affect cable noise or towing configuration.

- b) Source of specifications: Many ancillary devices are commercially available off the shelf. To avoid an inordinately long standard specification list, the cable manufacturer may prefer to incorporate by reference the published ancillary-device specifications.

4.4 Lead-in cable

Physical description as follows:

- a) Length: m.
- b) Outside diameter: cm.
- c) Jacket: Type and thickness of jacket, cm.
- d) Conductors: Number, type, and AWG of conductors and bundle shielding.
- e) Armoring: Type of armoring, stress member specifications.
- f) Strength: Minimum breaking strength, N.
- g) Dry weight: Weight in air, kg.
- h) Submerged weight: Weight in fresh water at standard temperature and pressure, kg.
- i) Operating temperature: Operating temperature range, °C.
- j) Storage temperature: Storage temperature range, °C.
- k) Fairing: Type of fairing, if any.
- l) Electrical characteristics: Round trip dc resistance, capacitance, and leakage measured in situ, Ω, μF, MΩ.
- m) Connectors: Type of connectors.
- n) Flotation: Type of flotation if any. Buoyancy, kg.
- o) Bent radius: Minimum bent radius, m.

4.5 Deck cable

Physical description as follows:

- a) Length: m.
- b) Outside diameter: cm.

- c) Jacket: Type of jacket.
- d) Conductors: Number, type, and AWG of conductors.
- e) Armoring: Type of armoring, shielding, stress member.
- f) Strength: Breaking strength, if applicable, N.
- g) Dry weight: Weight in air, kg.
- h) Operating temperature: Operating temperature range in °C.
- i) Storage temperature: Storage temperature range in °C.
- j) Connectors: Type of connectors, plug - in, swivels, slip ring, etc.
- k) Bent radius: Minimum bent radius, m.
- l) Electrical characteristics: Dc resistance, capacitance, nominal leakage, measured in Ω , μF , $\text{M}\Omega$ respectively.

4.6 Stretch cable section specifications

Stretch cable section specifications as follows:

- a) Length: m.
- b) Outside diameter: cm.
- c) Jacket: Type and thickness of jacket, cm.
- d) Conductors: Number, type, and AWG of conductors.
- e) Stress members: Type and number of elastic stress members.
- f) Strength: Minimum breaking strength, N.
- g) Stretchability: Elongation, meters per newton loading. Set of section should not exceed X% after Y hours of tension at Z newtons loading. Graphical description is preferable.
- h) Dry weight: Weight in air without fluid, kg.
- i) Wet weight: Weight in air when filled with specified quantity of ballast fluid.
- j) Submerged weight: Weight in fresh water filled with specified quantity of ballast fluid, kg, standard temperature, and pressure.
- k) Operating temperature: Operating temperature range, in °C.
- l) Storage temperature: Storage temperature range, in °C.
- m) Electrical characteristics: Per unit length round trip dc resistance, nominal leakage

and capacitance, measured in Ω/m , $\text{M}\Omega$, $\mu\text{F}/\text{m}$, respectively.

- n) Connectors: Type of connectors.
- o) Ballast fluid: Quantity of ballast fluid, m^3 .
- p) Hydrophones: Specify the number and type of sensors, and list its analog or digital characteristics for the seismic cable sections.

4.7 Ballast fluid specifications

Ballast could be three types: fluid, colloid or solid. Ballast fluids or simply cable oils are odorless kerosenes that have a negligible content of sulfur, aromatics, and olefins. Suitable cable oils are selected from the generic hydrocarbon group of the aliphatics such as normal paraffin, isoparaffin, and naphthene. The properties of hydrocarbon solvents are defined in part by certain arbitrary quantities which will be defined in the following paragraphs. Cable oils that fall outside the below - listed specifications may be hazardous and damage to the cable structure.

Cable oil properties:

- a) Density: $0.750\text{g}/\text{cm}^3 \pm 0.040\text{g}/\text{cm}^3$.
- b) Flash point: The flash point is the lowest temperature at which vapors will ignite momentarily when exposed to a flame. Preferably greater than 58°C (136°F).
- c) Aromatic content: $10\text{ cm}^3/\text{L}$ (1%) .
- d) Plastic compatibility: The kauri butanol number is a measure of the ability of the oil to attack resinous plastics. The K/B number should be less than 30, and preferably 25.
- e) Deodorization: The doctor test is the measure of the degree of deodorization of the solvent with particular reference to sulfur and mercaptans. The doctor test must be negative, particularly since the cable oil must be used within the close confines of a ship.
- f) Corrosiveness: The sulfur and oil corrosive test should be tested in according to GB/T 5096. The copper - strip corrosive test is a measure of the sulfur content and corrosiveness of the oil. The index should not be greater than 1 or 1a.

- g) Sulfur: Sulfur content: 1 mg/kg (1×10^6) .
 - h) Paraffin: The paraffin content should be 99%, or greater than normal or isoparaffin.
 - i) Olefin: The olefin content: 10 cm³/L (1%) .
- Colloid or solid selected as cable ballast, the ballast cable shall be conformed to the related regulations for safety and environment.

5 Inspection and test

5.1 Streamer cable section

The technical specification of streamer cable sec-

tion listed in 4.2 shall be tested, according to *Digital seismic recorder specification standards* (Geophysics, 53, no. 03, 415 – 416, 1988) . The result should be in compliance with requirements of 4. 2.

5.2 Ballast fluid corrosiveness

Ballast fluid corrosiveness shall be inspected in according to GB/T 5096 the copper – strip corrosive test; the result should be in compliance with requirements of 4. 7f) .

Annex A
(Informative)

**Comparison between the numbers of clause, sub – clause in this part and
the provision in SEG Geophysics, 52, no. 02, 242 – 248, 1987, Part II**

Table A. 1 provides the comparison between the numbers of clause, sub – clause in this part and the provision in SEG Geophysics, 52, no. 02, 242 – 248, 1987, Part II .

**Table A. 1 Comparison between the numbers of clause, sub – clause in this part
and the provision in SEG Geophysics, 52, no. 02, 242 – 248, 1987, Part II**

The numbers of clause, sub – clause in this part	SEG Geophysics, 52, no. 02, 242 – 248, 1987 Part II
1 Scope	Scope
2 Normative references	P8: Electrical characteristics, digital (1) Digital specifications
3. 1	P6: Units of measurement
3. 2	P6: Tolerance
4. 1 Hydrophone arrays	P7: Hydrophone arrays
4. 2 Streamer cable section	P7: Streamer cable section
4. 3 Ancillary equipment	P8: Ancillary equipment
4. 4 Lead – in cable	P9: Lead – in cable
4. 5 Deck cable	P9: Deck cable
4. 6 Stretch cable section specifications	P9: Stretch cable
4. 7 Ballast fluid specifications	P9: Ballast fluid specifications

Annex B
(Informative)

**Technical differences and the justification of changes between this part
and the SEG Geophysics, 52, no. 02, 242 – 248, 1987, Part II**

Table B. 1 provides the technical differences between this part and the SEG Geophysics, 52, no. 02, 242 – 248, 1987, Part II.

**Table B. 1 Technical differences between this part and the SEG
Geophysics, 52, no. 02, 242 – 248, 1987, Part II and the comments**

The numbers of clause, sub – clause in this part	Technical differences	Comments and justification
1	The “purpose”, “ Conclusions” in Part II of the SEG standards have been deleted in this part	They are not suitable for the standard statement in China
2	SEG standards Geophysics, 53, no. 03, 415 – 416 (Badger, A. S. , 1988) and GB/T 5096 Above two standards have been supplemented as normative references	This is for convenience of the application and the editorial requirements
4. 2. 3. 1	This part has been supplemented with the regulation for digital data acquisition module specifications	This is for convenience of the operation and quality control
5	<i>Streamer cable section test</i> and <i>Ballast fluid corrosiveness inspection</i> have been supplemented as the clause 5	This is for convenience of the application and the editorial requirements