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NAVY UNDERWATER SOUND REFERENCE LAB ORLANDO FLA
SANGAMO AN/SQS-23 TRANSDUCER ELEMENTS SERIALS 223, 5426, 5636, --ETC(U)
MAY 62

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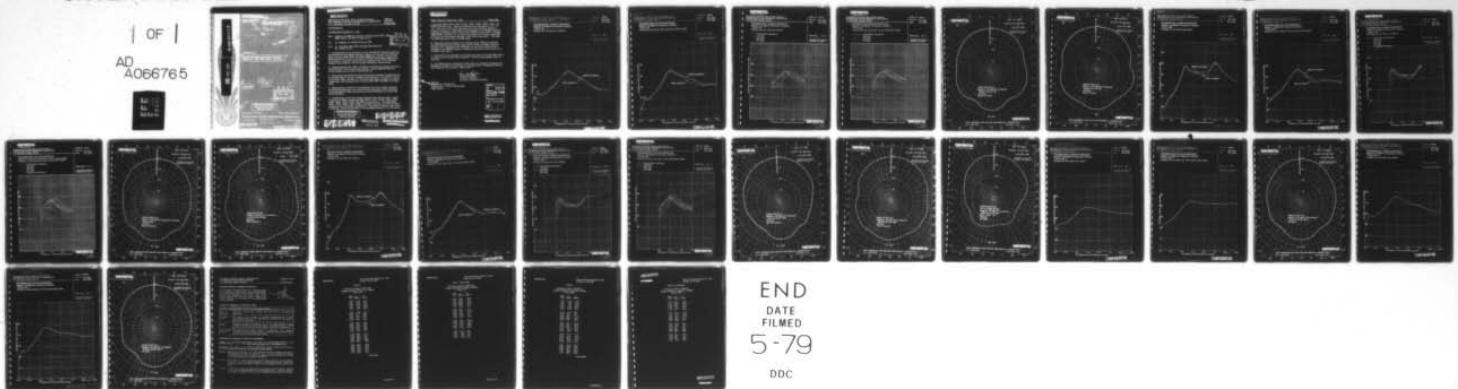
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USRL-CALIBRATION-1856

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UDRC Report

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LEVEL II

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MOST 4

Calibration of

①
Sungamo AN/SG-22 Transducer Elements
Serials 123, 5436, 5638, A44-2, and T44-1.

⑪
1 May 1970

⑫
38p.

Good

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P. O. Box 8337, Orlando, Florida

EMR/hs
RP-2335
7 May 1962

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CALIBRATION REPORT No. 1856

Subj: Sangamo AN/SQS-23 transducer elements serials 223, 5426, 5636, A44-2, and T44-1; calibration of

Ref: (a) Sangamo ltr ECO320 of 22 Jan 1962

Encl: (1) Drawings USRL 27212 through 27236 and 20113
(2) Tables 1 and 2

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1. Arrangements for the calibration of five AN/SQS-23 transducer elements, manufactured by the Sangamo Electric Company in connection with Bureau of Ships contracts NObsr-81532 and NObsr-85261, were made by reference (a). Measurements were made in accordance with the test program submitted as an enclosure to reference (a) and the oral requests of Mr. W. H. Benedict, Sangamo representative, who was present during the measurements.
2. Elements serials 223, 5426, and 5636 were production models and serials A44-2 and T44-1 were experimental models. Serials 5426 and 5636 contained transformers; the other elements did not.
3. The project was divided into three parts which consisted of measurements in the open water on the five elements; measurements in the anechoic tank on serials 223, 5426, and 5636, as a function of hydrostatic pressure at ambient temperature; and remeasurement of serials 223, 5426, and 5636 in the open water.
4. Measurements consisted of transmitting current and voltage responses and directivity patterns on all of the elements; equivalent series impedance on serials 5426 and 5636; and equivalent parallel admittance on serials 223, A44-2 and T44-1.
5. Transmitting current and voltage responses from the open-water measurements are shown on drawings USRL 27212, 27213, 27218, 27219, 27224, 27225, 27231, 27232, 27234, and 27235 of enclosure (1). Drawings USRL 27214, 27215, 27220, 27221, 27226, and 27227, enclosure (1) show the transmitting current and voltage responses for a hydrostatic pressure range from 0 to 500 psig. Directivity patterns for the operating frequency, 5 kc, are shown

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USRL Calibration Report No. 1856

7 May 1962

on drawings USRL 27216, 27217, 27222, 27223, 27228, 27229, 27233, and 27236 of enclosure (1). Directivity patterns were also taken at 4.0, 4.5, 5.5, and 6.0 kc, both in the open water and in the anechoic tank as a function of pressure. These patterns were supplied to the Sangamo Electric Company in preliminary form and are not included in this report. Drawing USRL 27230, enclosure (1), is a directivity pattern for element serial 5636 at 5.25 kc for the pressure 500 psig, under low and high power. The input was 1000 watts with a 6 per cent duty cycle.

6. Equivalent series impedance for element serial 5636 and equivalent parallel admittance for element serial 223 are shown on Tables 1 and 2 of enclosure (2). Impedance and admittance for the other elements were furnished to the Sangamo Electric Company in preliminary form and are not included in this report.

7. Orientation was according to the method described on drawing USRL 20113, enclosure (1), for a piston-type transducer, with the serial number in the +Z direction.

8. All measurements reported here were made in accordance with American Standard Procedures for Calibration of Electroacoustic Transducers Particularly Those for Use in Water, Z24.24-1957.

Eva M. Raybun
EVA M. RAYBUN
Technical Assistant
Acoustics Calibration Division

Copy to:
BUSHIPS (A. Chartock)(1)
Sangamo Elec Co (W. H. Benedict)(1)
USRL (200)(1)

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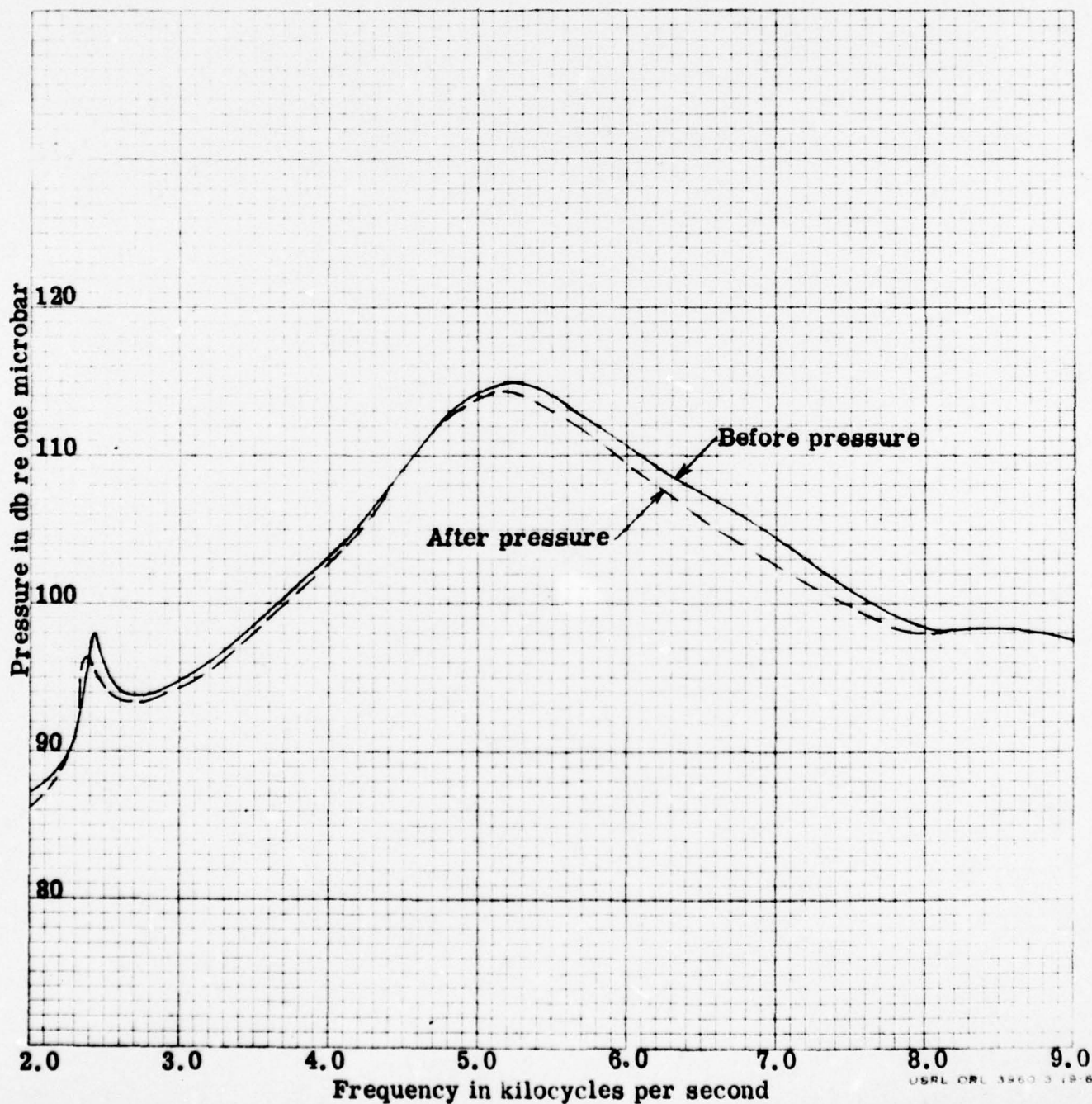
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USRL No. 27212
Proj. No. RP-2335
Date: Feb 1962

TRANSMITTING CURRENT RESPONSE
Sangamo AN/SQS-23 Transducer Element
Serial 223
Pressure at one meter per ampere

Water temp: 15 °C

MEASUREMENTS MADE IN ACCORDANCE WITH AMERICAN STANDARD Z 24.24-1957



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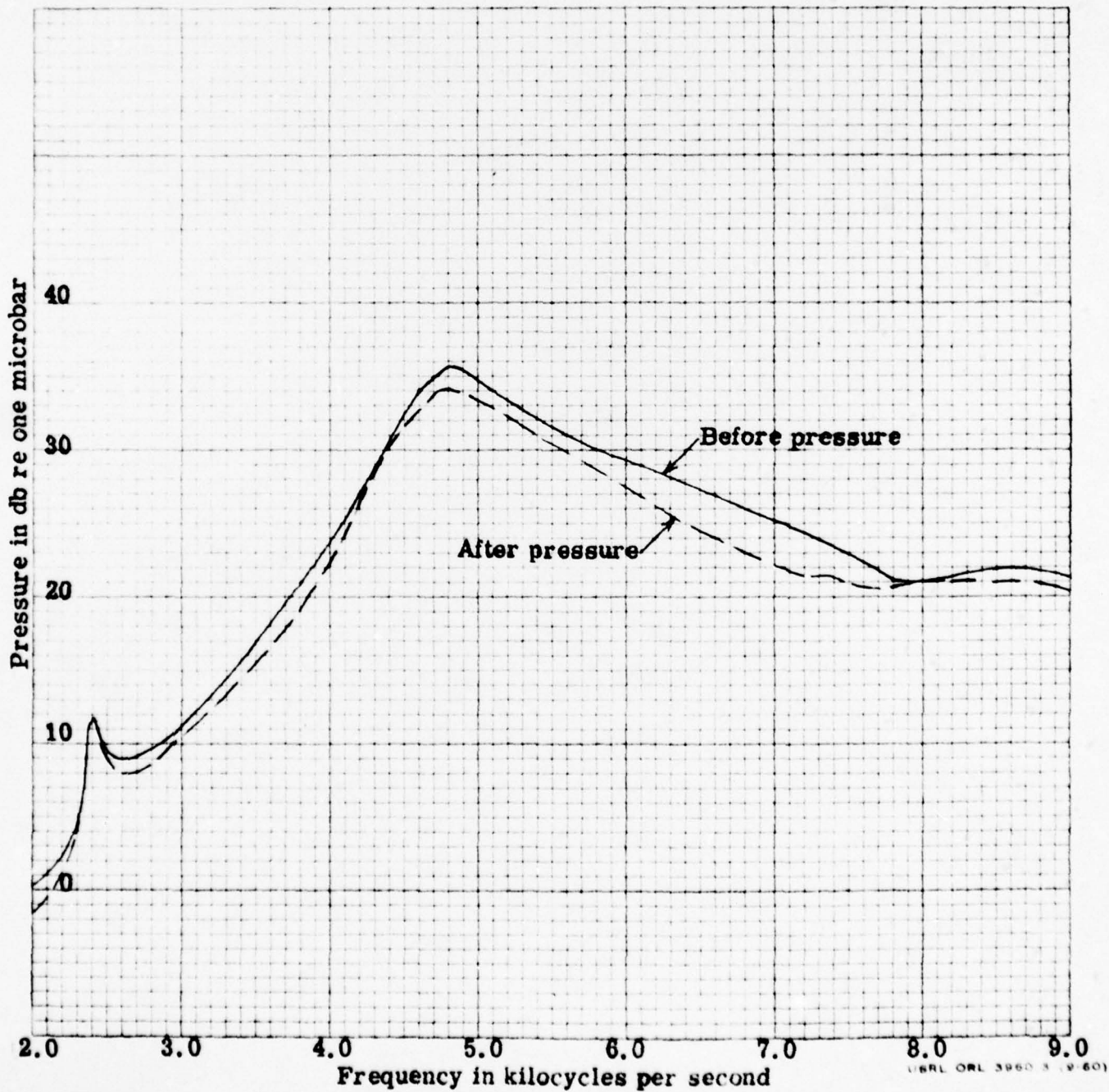
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Proj. No. **RP-2335**
Date: **Feb 1962**

TRANSMITTING VOLTAGE RESPONSE
Sangamo AN/SQS-23 Transducer Element
Serial 223
Pressure at one meter per volt at end of 58-ft cable

Water temp: **15 °C**

MEASUREMENTS MADE IN ACCORDANCE WITH AMERICAN STANDARD Z 24.24-1957



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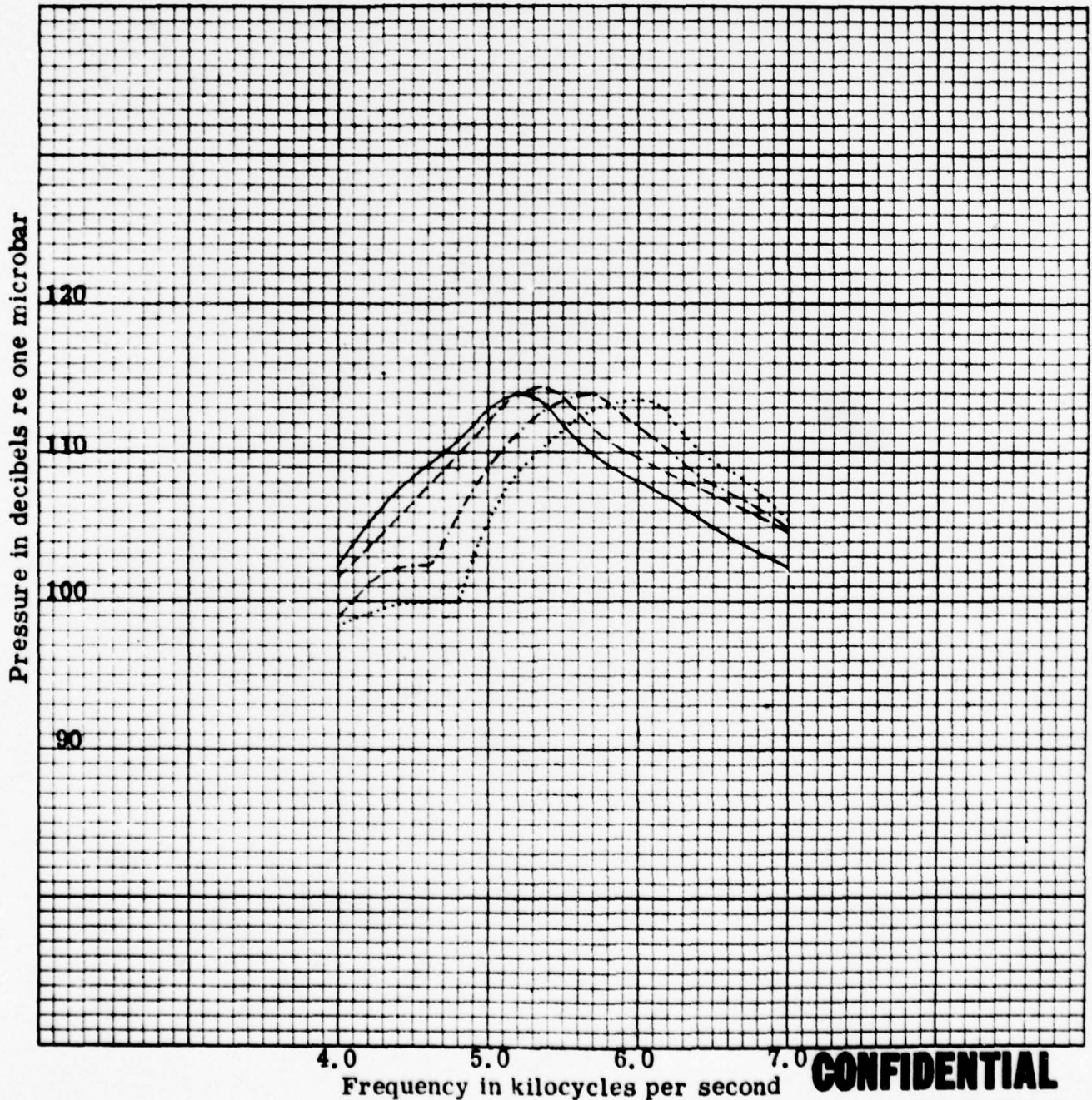
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Proj. No. RP-2335
Date: Feb 1962

TRANSMITTING CURRENT RESPONSE
Sangamo AN/SQS-23 Transducer Element
Serial 223
Pressure at one meter per ampere

- 0 psig before pressure
- - - 100 psig
- · - · 300 psig
- · · · 500 psig

Water temp: 14 °C

MEASUREMENTS MADE IN ACCORDANCE WITH AMERICAN STANDARD Z.34.24-1957



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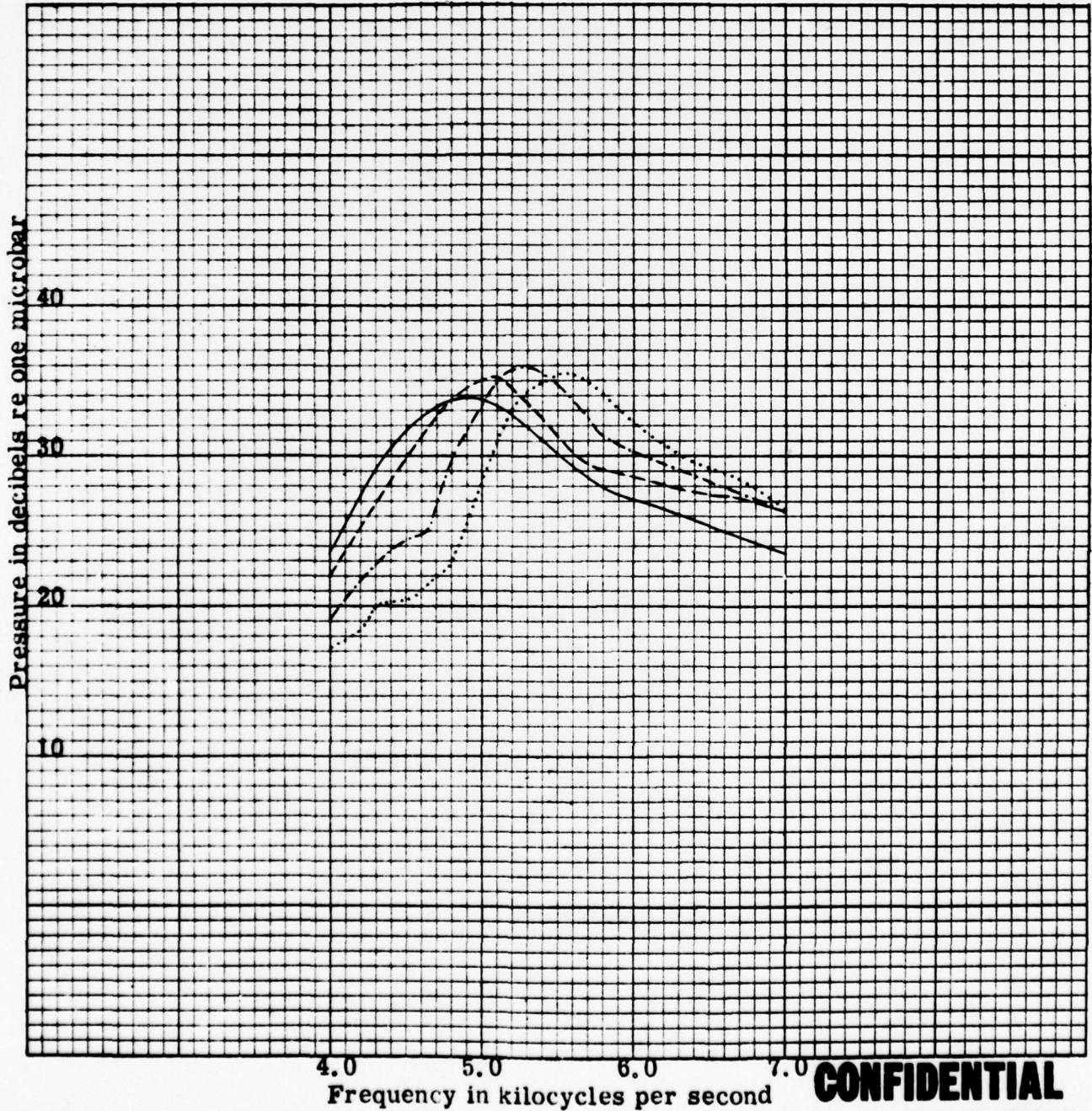
USRL No. 27215
Proj. No. RP-2335
Date: Feb 1962

TRANSMITTING VOLTAGE RESPONSE
Sangamo AN/SQS-23 Transducer Element
Serial 223
Pressure at one meter per volt at end of 58-ft cable

————— 0 psig before pressure
- - - - - 100 psig
- · - · - 300 psig
· · · · · 500 psig

Water temp: 14 °C

MEASUREMENTS MADE IN ACCORDANCE WITH AMERICAN STANDARD Z.24.24-1957



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USRL NO. 27216

PROJECT NO. RP-2335

DATE: Feb 1962

MEASUREMENTS MADE IN ACCORDANCE WITH AMERICAN STANDARD Z 24.24-1957

RELATIVE RESPONSE IN DB

DIRECTIVITY OF
Sangamo AN/SQS-23 Transducer
Element Serial 223
XY plane
Before pressure

5.0 KC

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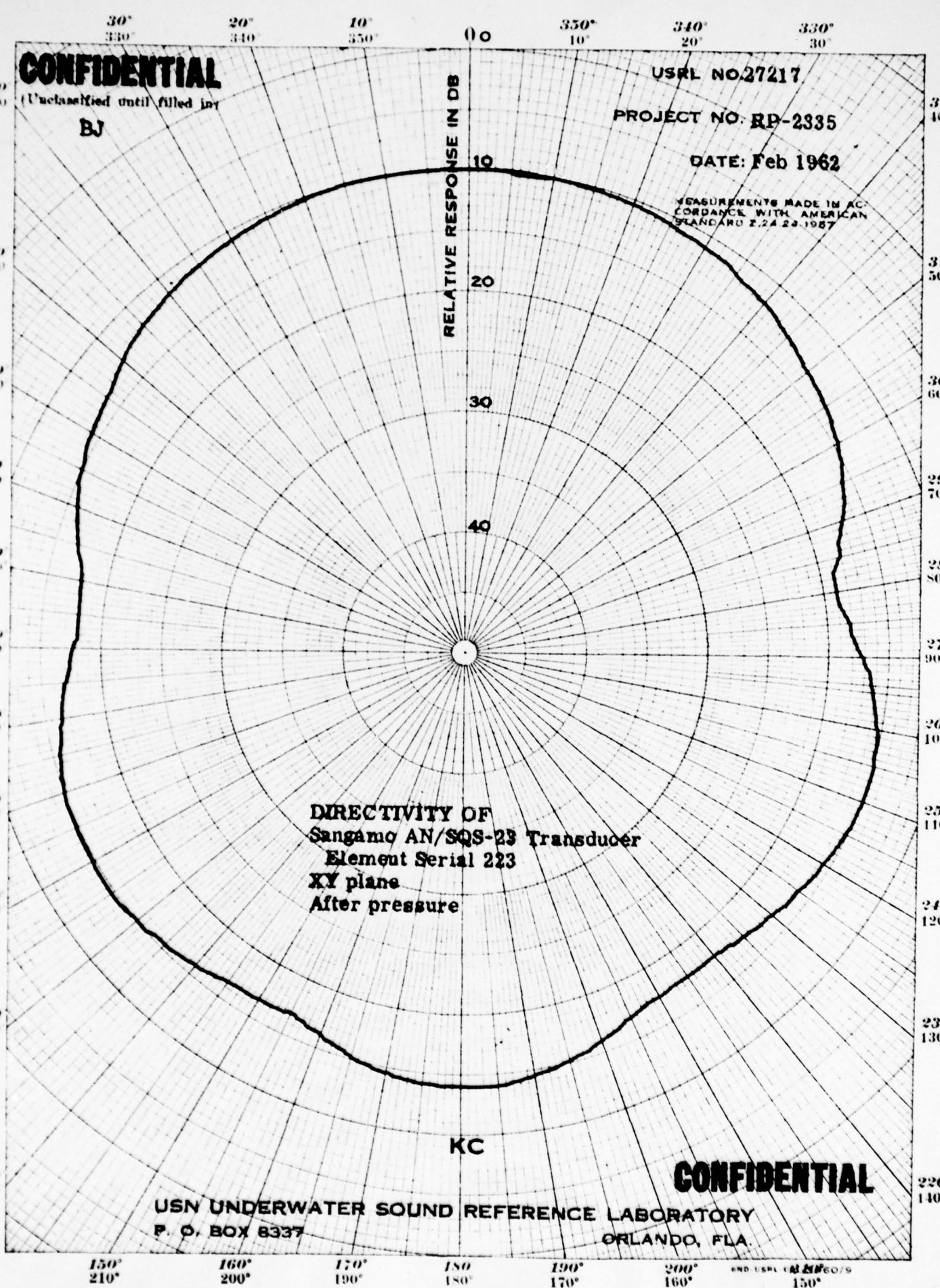
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PROJECT NO. RP-2335

DATE: Feb 1962

MEASUREMENTS MADE IN ACCORDANCE WITH AMERICAN STANDARD Z.24.23-1967

RELATIVE RESPONSE IN DB



DIRECTIVITY OF
Sangamo AN/SQS-23 Transducer
Element Serial 223
XY plane
After pressure

KC

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CONSOLE ENGINE COMPANY INC. NORWICH, MASSACHUSETTS

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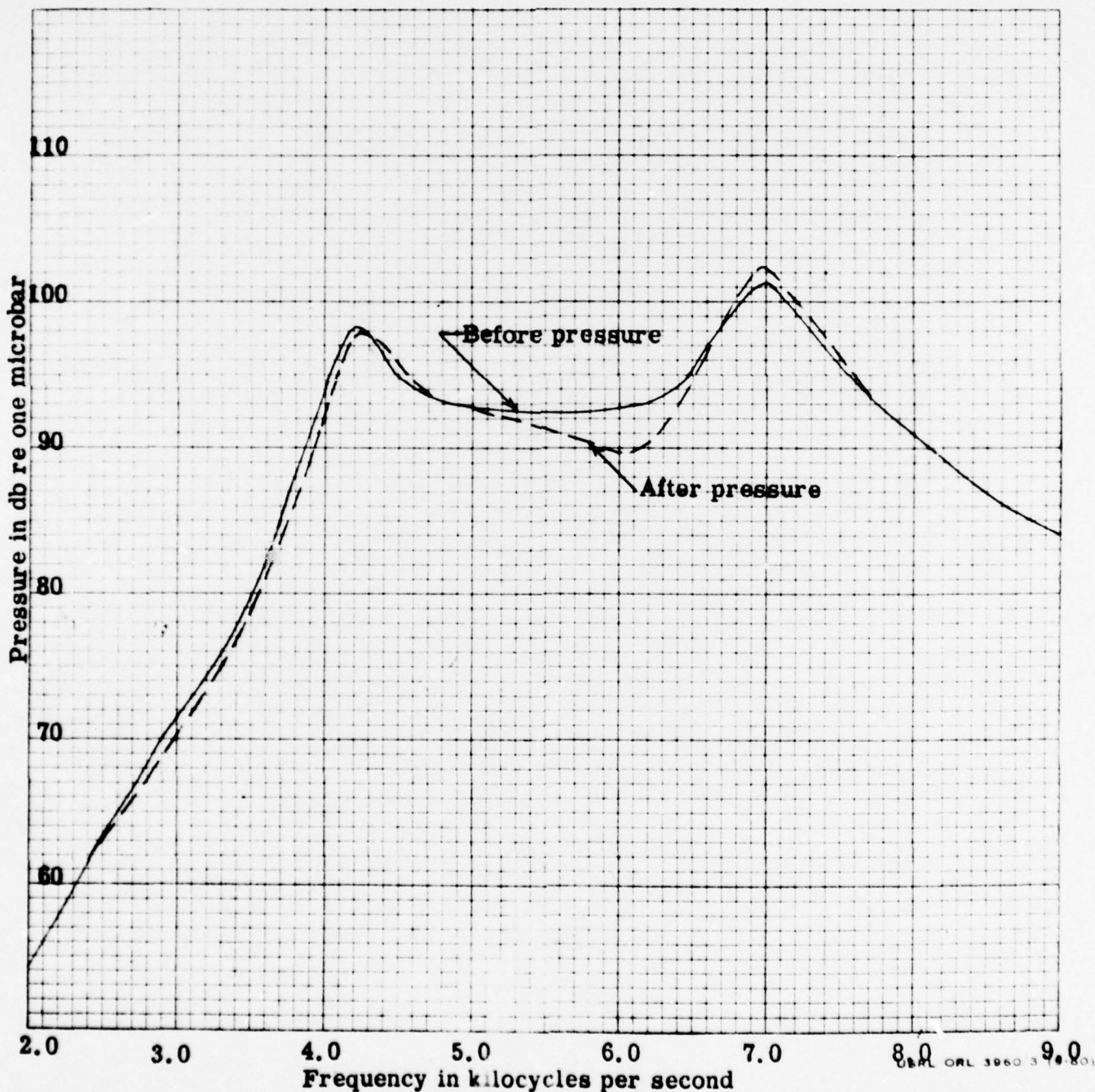
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USRL No 27218
Proj. No. RP-2335
Date: Feb 1962

TRANSMITTING CURRENT RESPONSE
Sangamo AN/SQS-23 Transducer Element
Serial 5426
Pressure at one meter per ampere

Water temp: 15 °C

MEASUREMENTS MADE IN ACCORDANCE WITH AMERICAN STANDARD Z 24.24-1957



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USRL No 27219

Proj. No. RP-2335

Date: Feb 1962

TRANSMITTING VOLTAGE RESPONSE

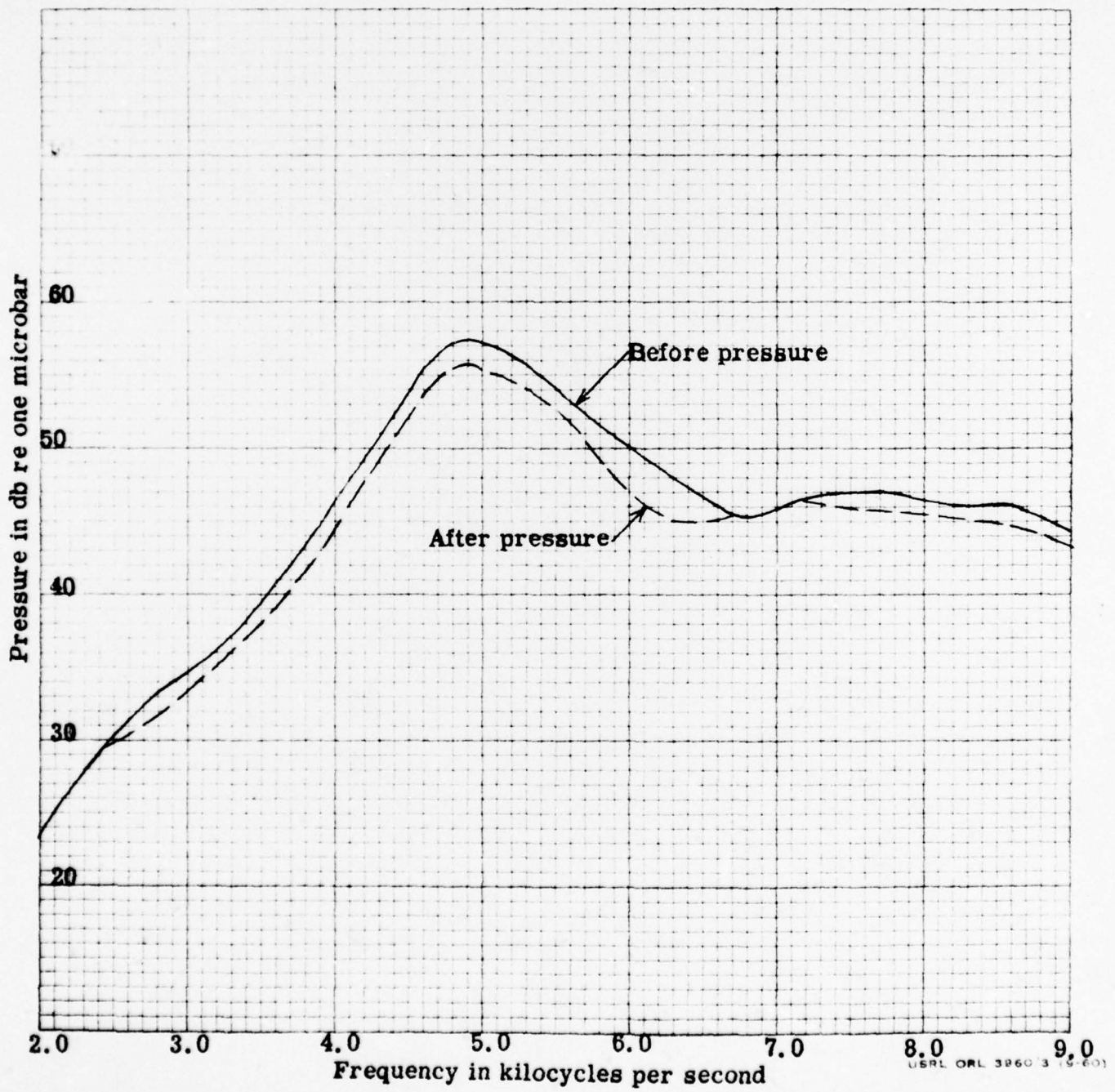
Sangamo AN/SQS-23 Transducer Element

Serial 5426

Pressure at one meter per volt at end of 58-ft cable

Water temp: 16 °C

MEASUREMENTS MADE IN ACCORDANCE WITH AMERICAN STANDARD Z 24.24-1957



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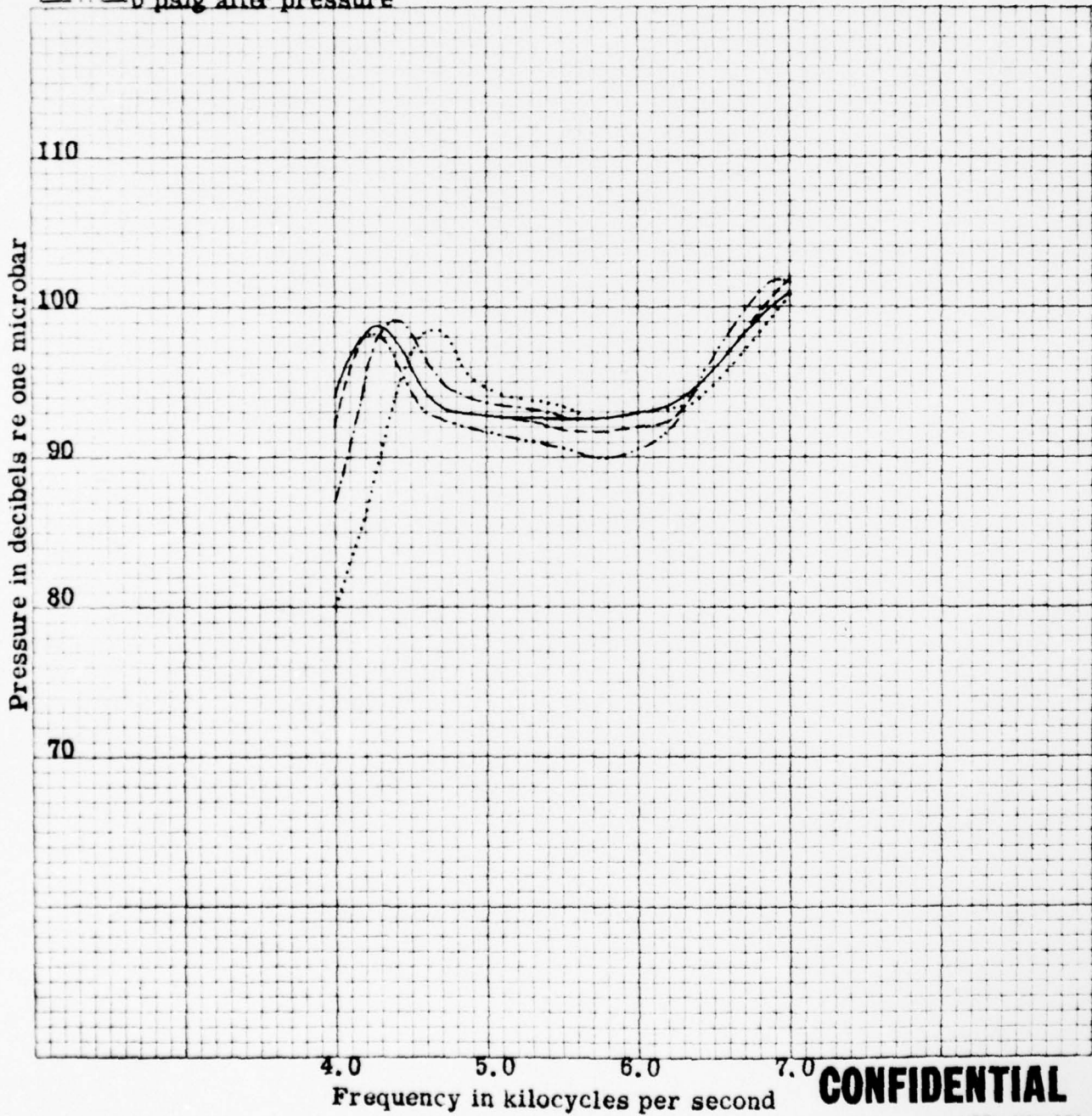
USRL No. 27220
Proj. No. RP-2335
Date: Feb 1962

TRANSMITTING CURRENT RESPONSE
Sangamo AN/SQS-23 Transducer Element
Serial 5426
Pressure at one meter per ampere

- 0 psig before pressure
- - - - 100 psig
- · - · - 300 psig
- · · · · 500 psig
- · — · 0 psig after pressure

Water temp. 14 °C

MEASUREMENTS MADE IN ACCORDANCE WITH AMERICAN STANDARD Z 24 24-1957



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Proj. No. RP-2335

Date: Feb 1962

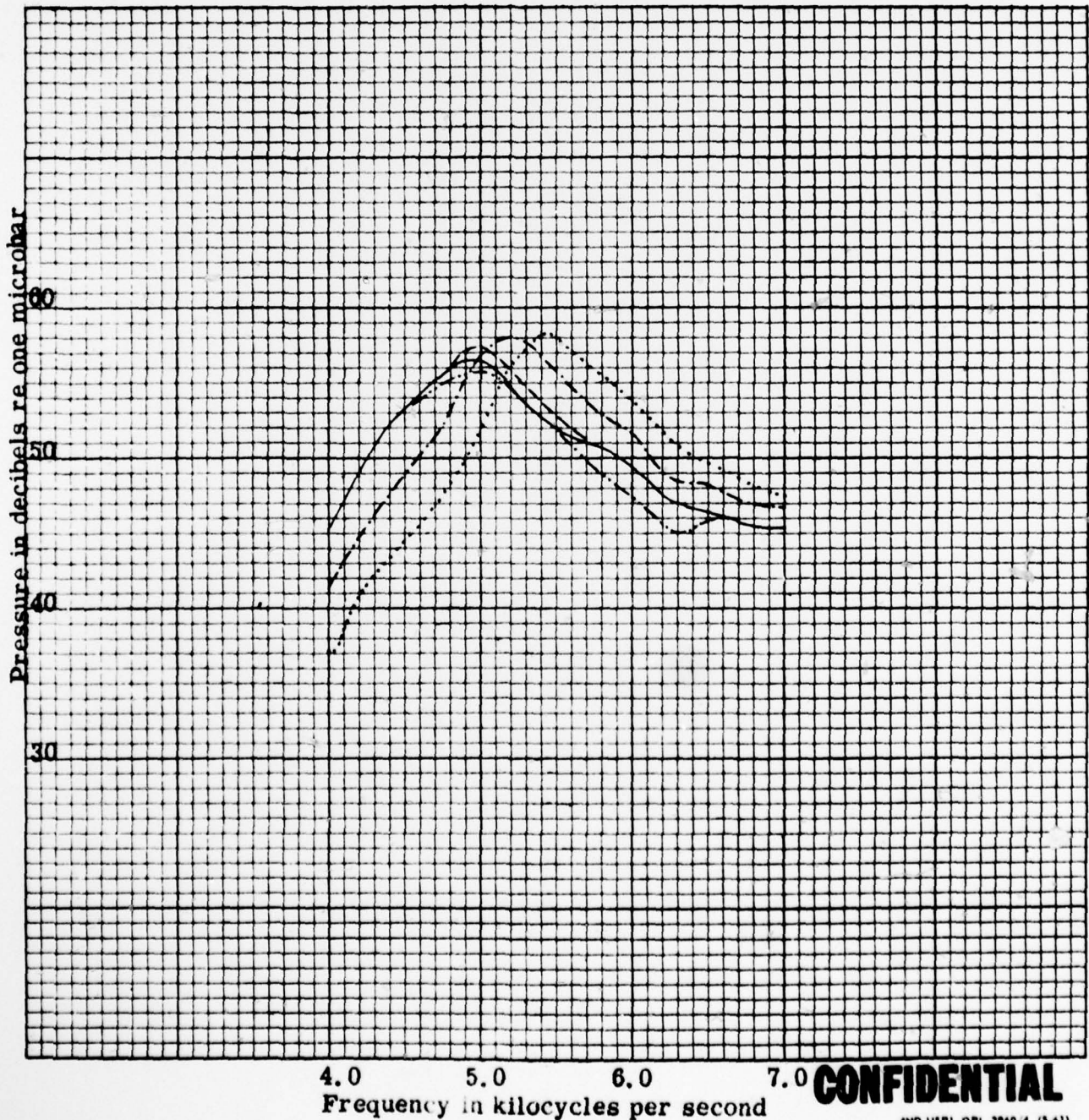
TRANSMITTING VOLTAGE RESPONSE

Sangamo AN/SQS-23 Transducer Element Serial 5426
Pressure at one meter per volt at end of 58-ft cable

- 0 psig before pressure
- 100 psig
- 300 psig
- 500 psig
- 0 psig after pressure

Water temp: 14 °C

MEASUREMENTS MADE IN AC-
CORDANCE WITH AMERICAN
STANDARD Z.24.24-1957



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NAVY OPPO ORD JAX

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PROJECT NO. RP-2335

DATE: Feb 1962

MEASUREMENTS MADE IN ACCORDANCE WITH AMERICAN STANDARD Z 24.24.1957

RELATIVE RESPONSE IN DB

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DIRECTIVITY OF
Sangamo AN/SQS-23 Transducer Element
Serial 5426
XY plane
Before pressure

5.0 KC

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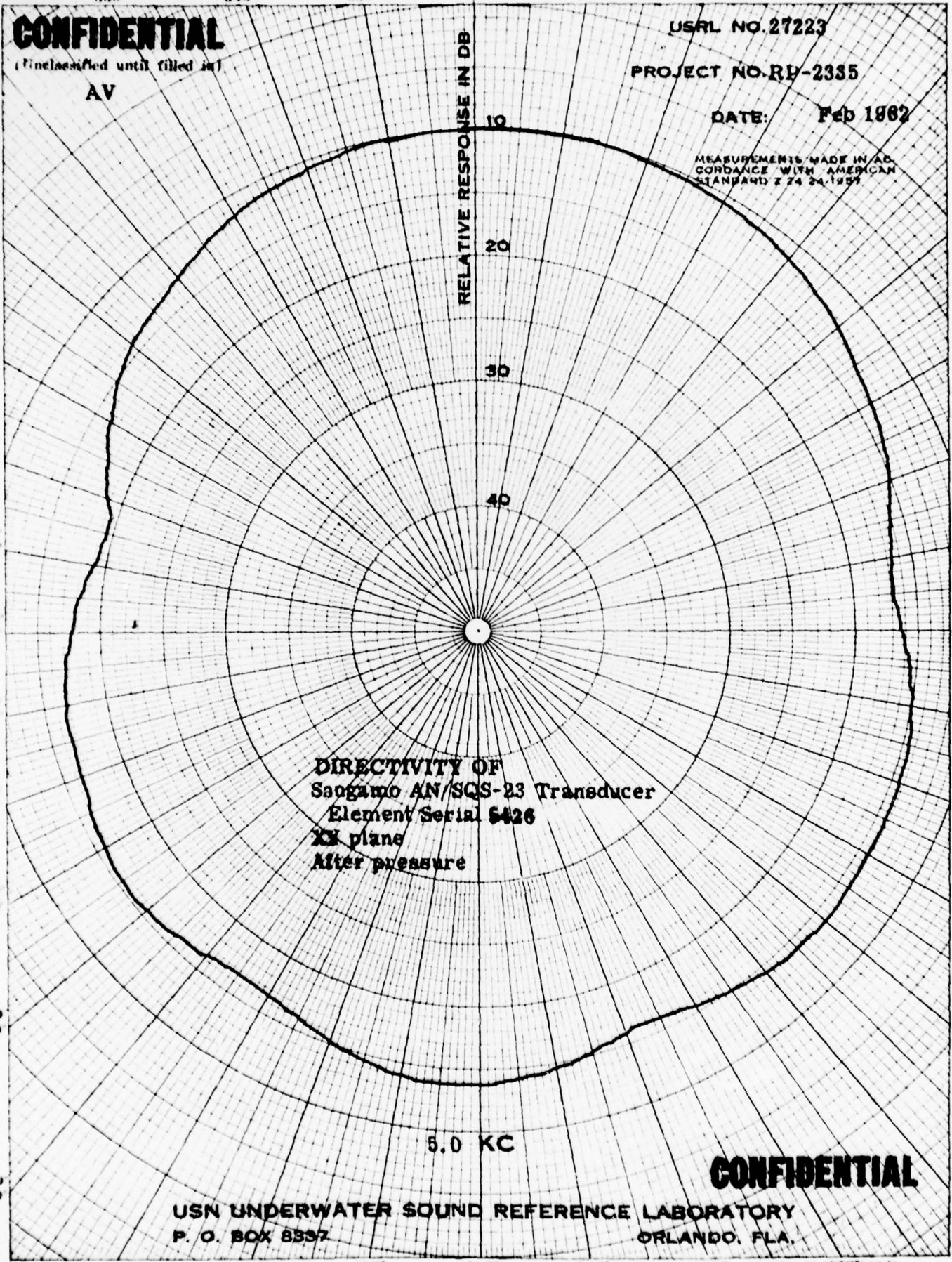
USRL NO. 27223

PROJECT NO. RP-2335

DATE: Feb 1962

MEASUREMENTS MADE IN ACCORDANCE WITH AMERICAN STANDARD Z 39.24-1957

RELATIVE RESPONSE IN DB



DIRECTIVITY OF
 Saogamo AN/SQS-23 Transducer
 Element Serial 5426
 XX plane
 After pressure

5.0 KC

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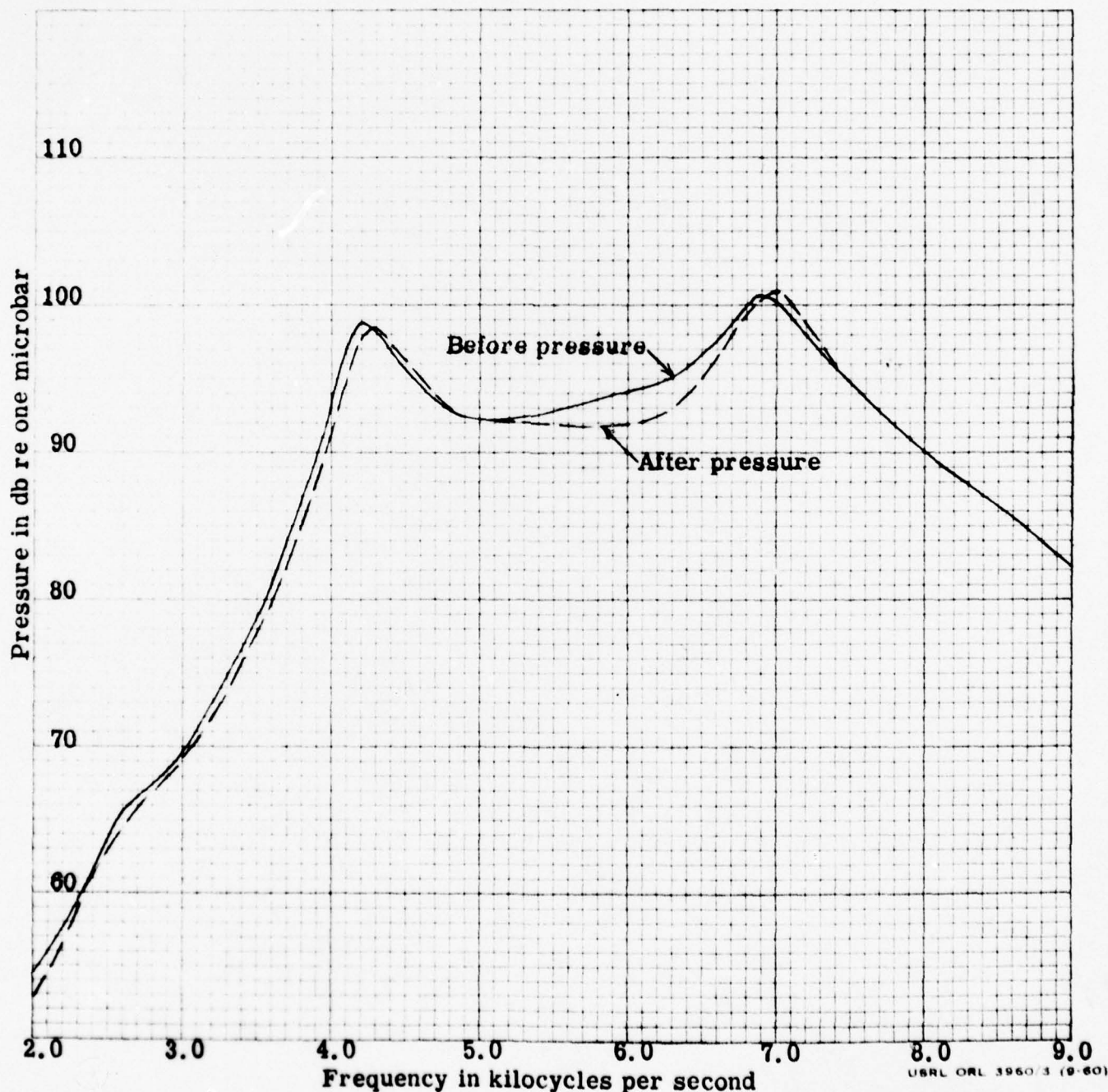
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USRL No. **27224**
Proj. No. **RP-2335**
Date: **Feb 1962**

TRANSMITTING CURRENT RESPONSE
Sangamo AN/SQS-23 Transducer Element
Serial 5636
Pressure at one meter per ampere

Water temp: 15 °C

MEASUREMENTS MADE IN ACCORDANCE WITH AMERICAN STANDARD Z 24.24-1957



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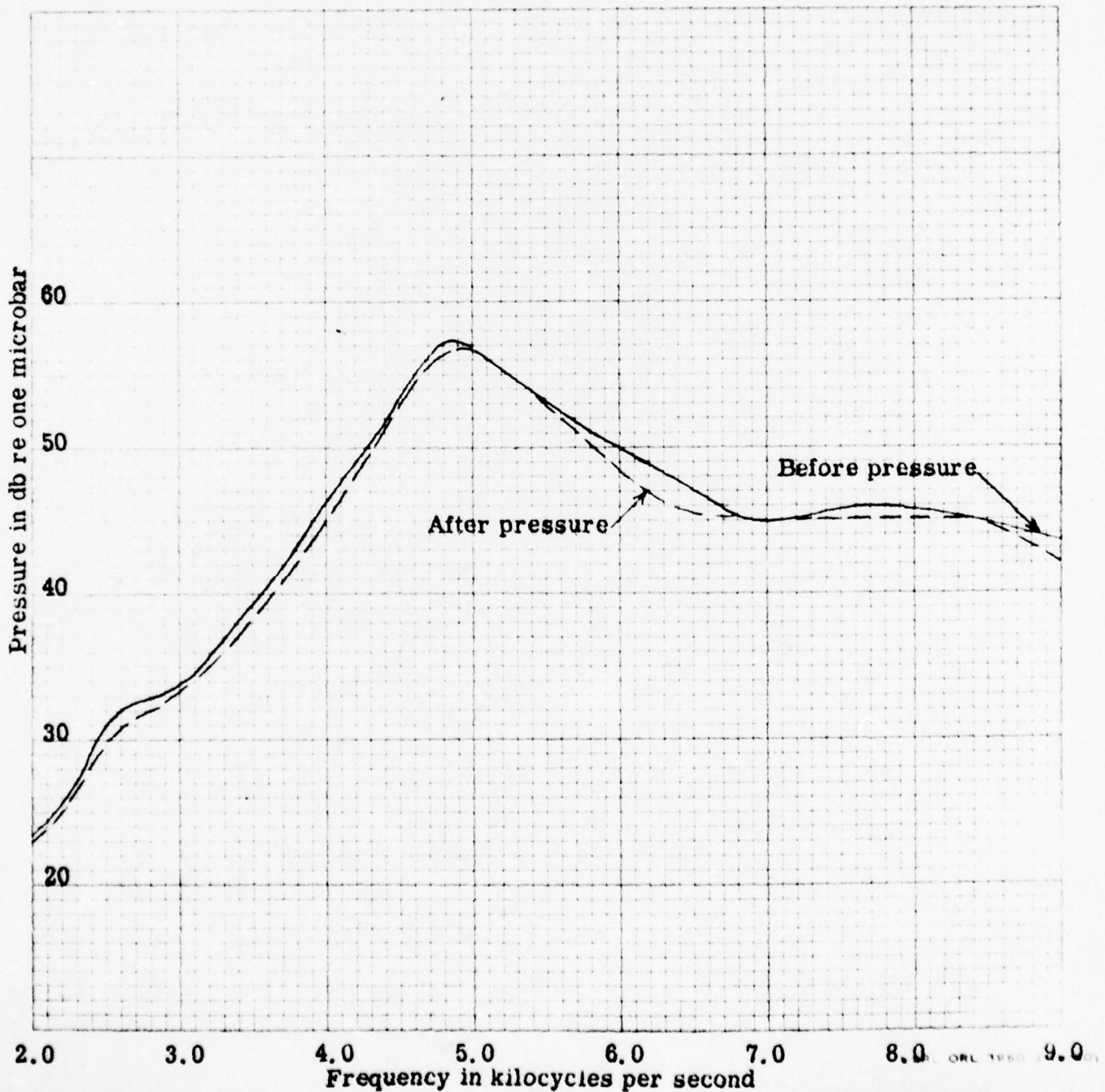
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USRL No. 27225
Proj. No. RP-2335
Date: Feb 1962

TRANSMITTING VOLTAGE RESPONSE
Sangamo AN/SQS-23 Transducer Element
Serial 5636
Pressure at one meter per volt at end of 58-ft cable

Water temp: 15 C

MEASUREMENTS MADE IN ACCORDANCE WITH AMERICAN STANDARD Z 24.24-1957



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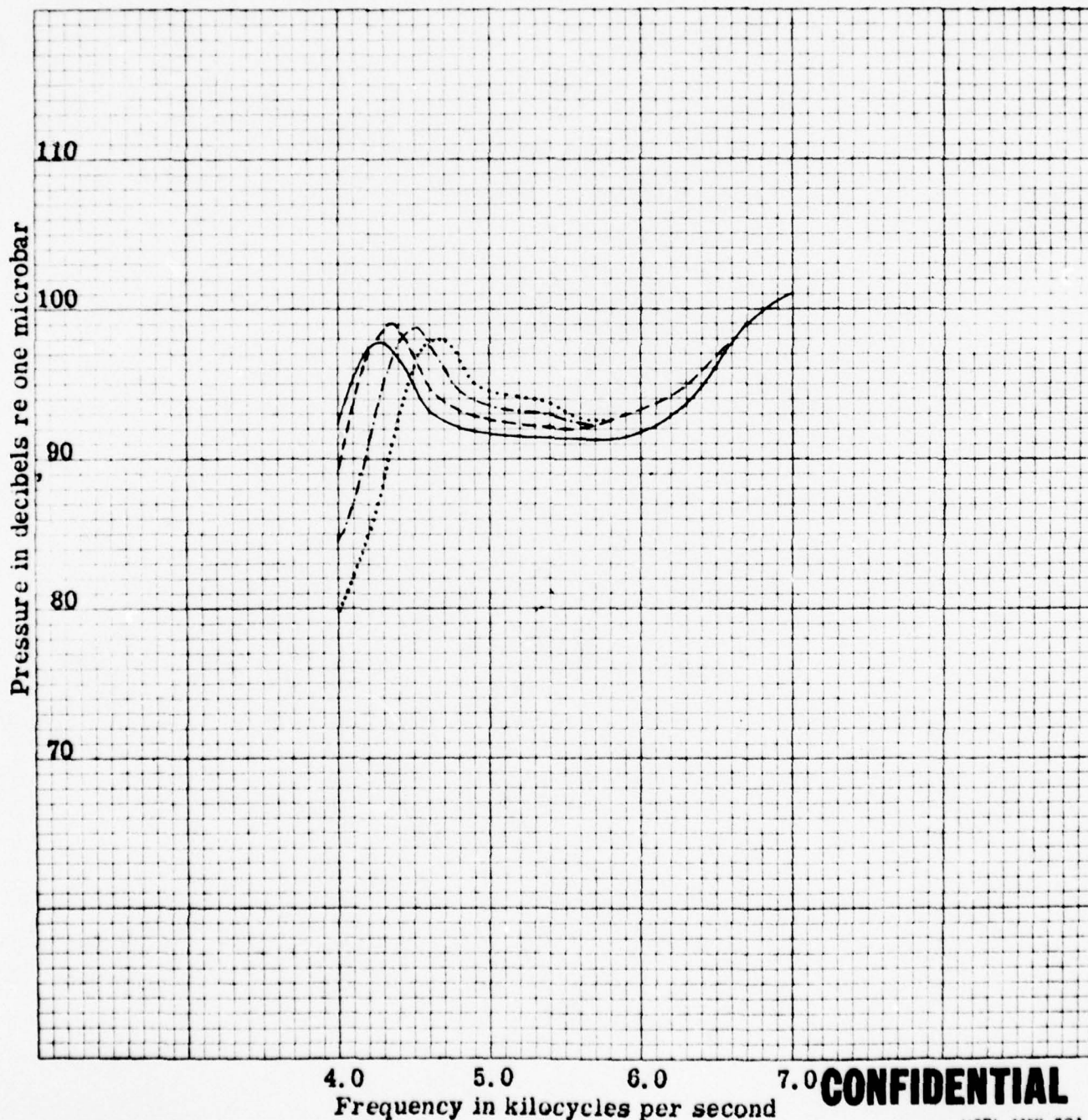
USRL No. 27226
Proj. No. RP-2335
Date: Feb 1962

TRANSMITTING CURRENT RESPONSE
Sangamo AN/SQS-23 Transducer Element
Serial 5636
Pressure at one meter per ampere

——— 0 psig before pressure
- - - 100 psig
- . - 300 psig
..... 500 psig

Water temp: 14 °C

MEASUREMENTS MADE IN AC-
CORDANCE WITH AMERICAN
STANDARD Z 24 24-1957



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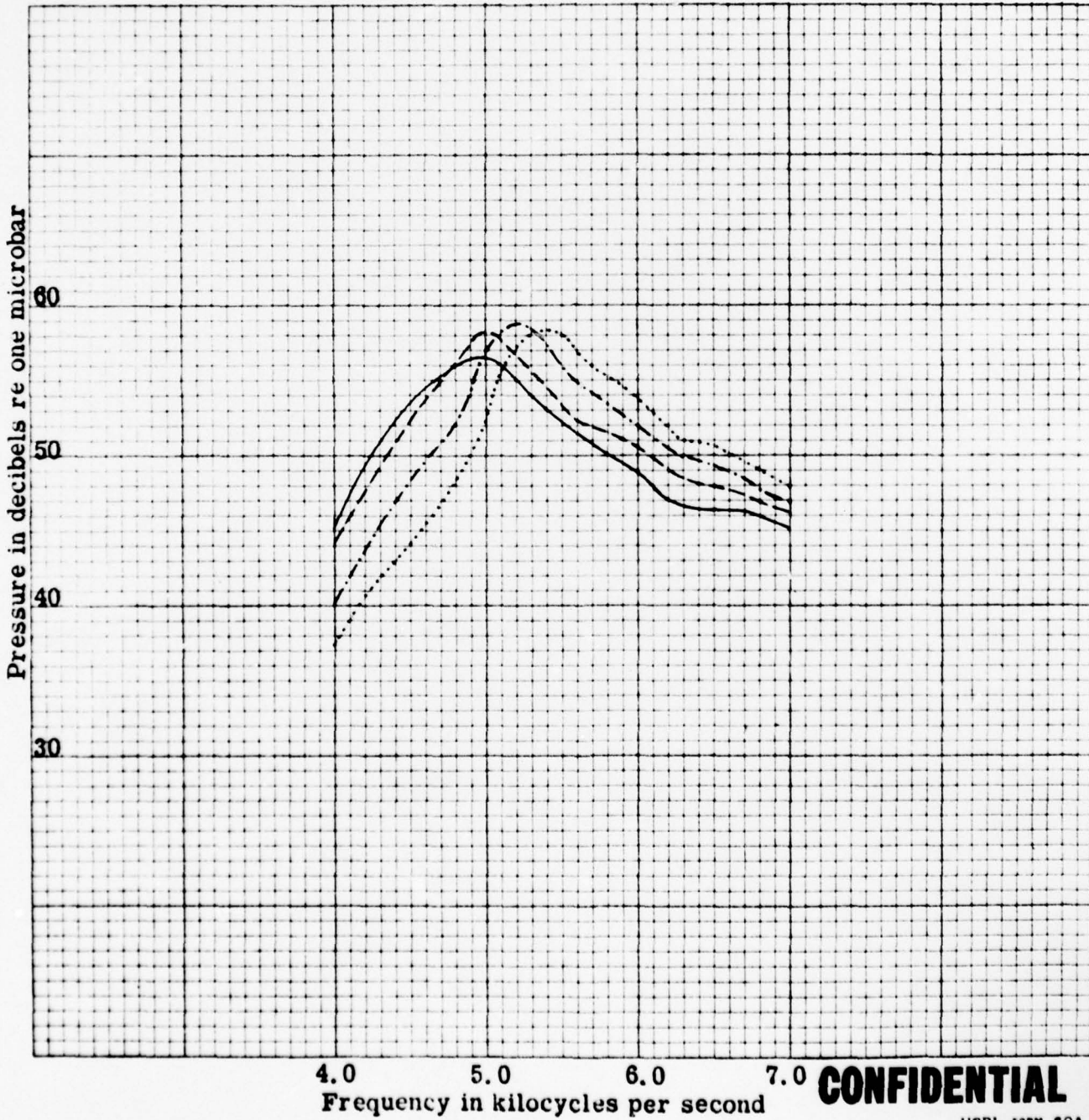
USRL No. 27227
Proj. No. RP-2335
Date: Feb 1962

TRANSMITTING VOLTAGE RESPONSE
Sangamo AN/SQS-23 Transducer Element
Serial 5636
Pressure at one meter per volt at end of 58-ft cable

- 0 psig before pressure
- 100 psig
- - - - - 300 psig
- 500 psig

Water temp: 14 °C

MEASUREMENTS MADE IN ACCORDANCE WITH AMERICAN STANDARD Z 24 24-1957



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USRL NO. 27228

PROJECT NO. RP-2335

DATE: JRD 1962

MEASUREMENTS MADE IN ACCORDANCE WITH AMERICAN STANDARD Z.24 29 1957

RELATIVE RESPONSE IN DB

F

DIRECTIVITY OF
Sangamo AN/SQS-23 Transducer
Element Serial 5836
XY plane
Before pressure

5.0 KC

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USRL NO. 27228

PROJECT NO. RP-2335

DATE: Feb 1962

MEASUREMENTS MADE IN ACCORDANCE WITH AMERICAN STANDARD Z 24.24-1957

RELATIVE RESPONSE IN DB

DIRECTIVITY OF
Sangamo AN/SQS-23 Transducer
Element Serial 5836
XY plane
After pressure

5.0 KC

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USRL NO. 27230

PROJECT NO. RP-2335

DATE: Feb 1962

MEASUREMENTS MADE IN ACCORDANCE WITH AMERICAN STANDARD Z 39.24.1957

RELATIVE RESPONSE IN DB

DIRECTIVITY OF
Low and High Power
Sangamo AN/SQS-23 Transducer
Element Serial 5636
Water temp: 14°C
500 psig
XY plane

5.25 KC

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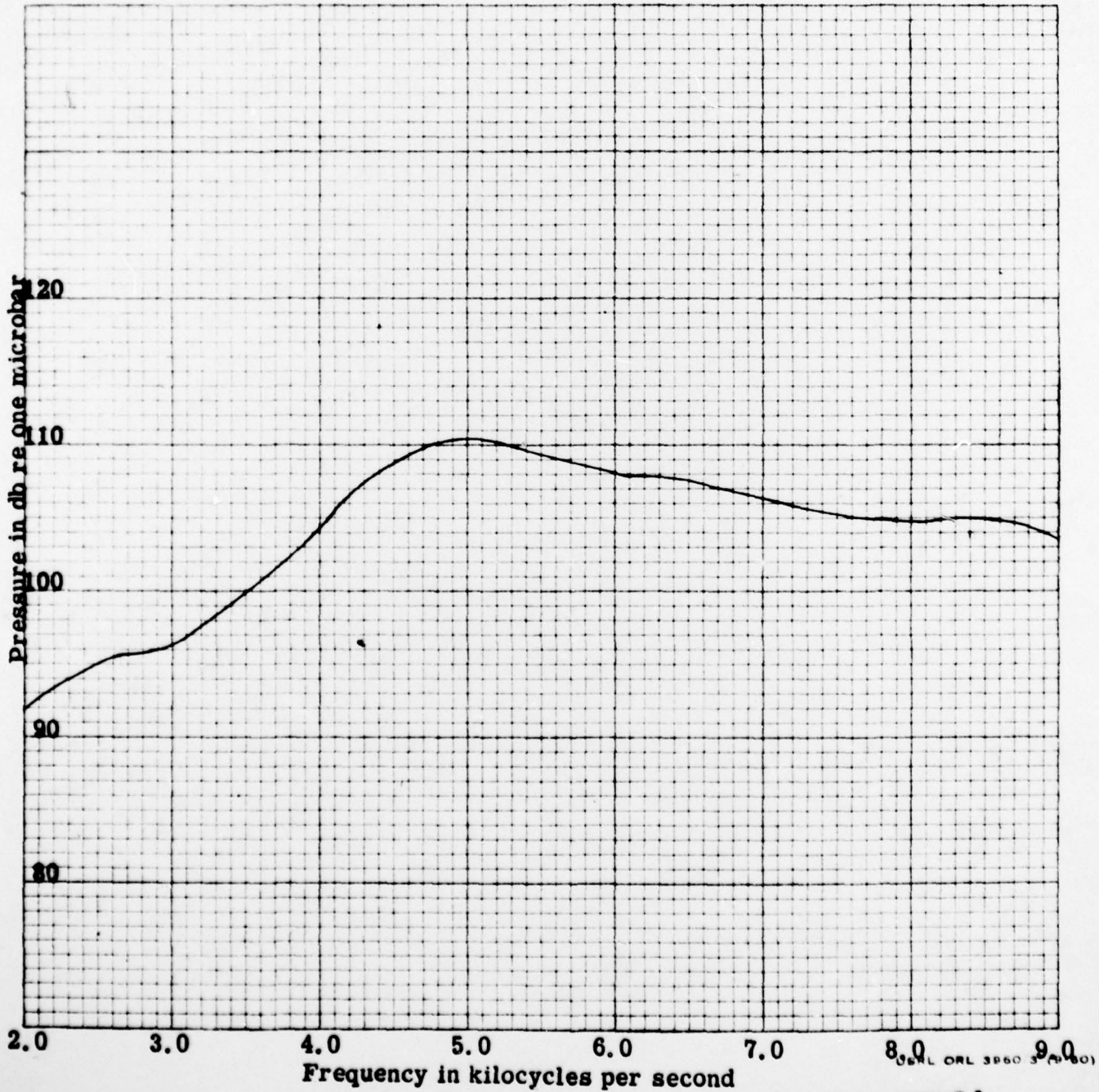
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USRL No. **27231**
Proj. No. **RP-2335**
Date: **Feb 1962**

TRANSMITTING CURRENT RESPONSE
Sangamo AN/SQS-23 Transducer Element
Serial A44-2
Pressure at one meter per ampere

Water temp: **15 °C**

MEASUREMENTS MADE IN AC-
CORDANCE WITH AMERICAN
STANDARD Z 24 24-1957



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USRL ORL 3860 3 (Rev. 50)

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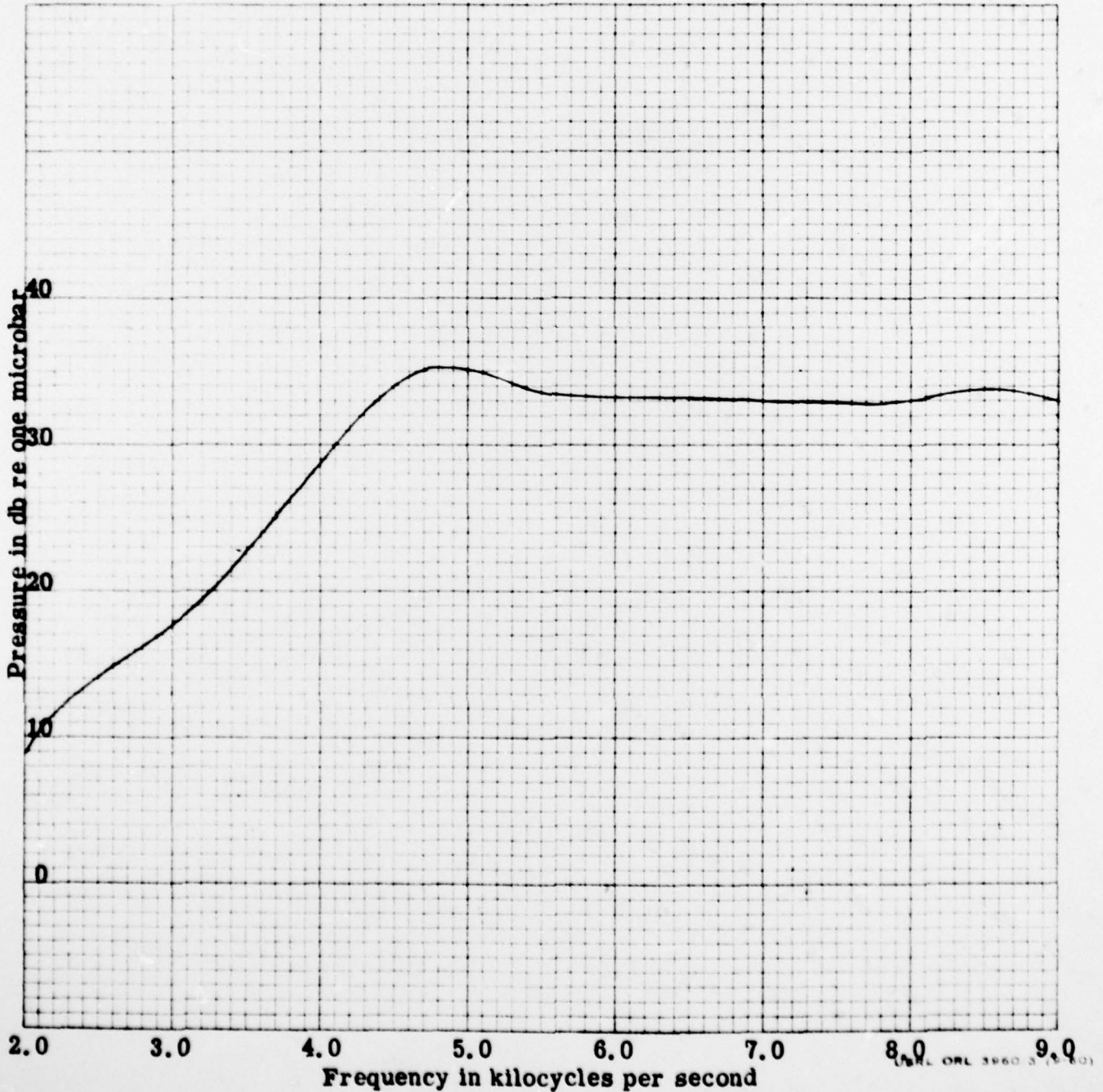
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USRL No 27232
Proj No RP-2335
Date: Feb 1962

TRANSMITTING VOLTAGE RESPONSE
Sangamo AN/SQS-23 Transducer Element
Serial A44-2
Pressure at one meter per volt at end of 29-ft cable

Water temp: 15 °C

MEASUREMENTS MADE IN ACCORDANCE WITH AMERICAN STANDARD Z 24.24-1957



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USRL NO. 27293

PROJECT NO. RP-2335

DATE: Feb 1962

MEASUREMENTS MADE IN ACCORDANCE WITH AMERICAN STANDARD Z.39.1-1957

RELATIVE RESPONSE IN DB

DIRECTIVITY OF
Sangamo AN/SQS-23 Transducer
Element Serial A44-2
XY plane

5.0 KC

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NO. 3124 POLAR COORDINATE

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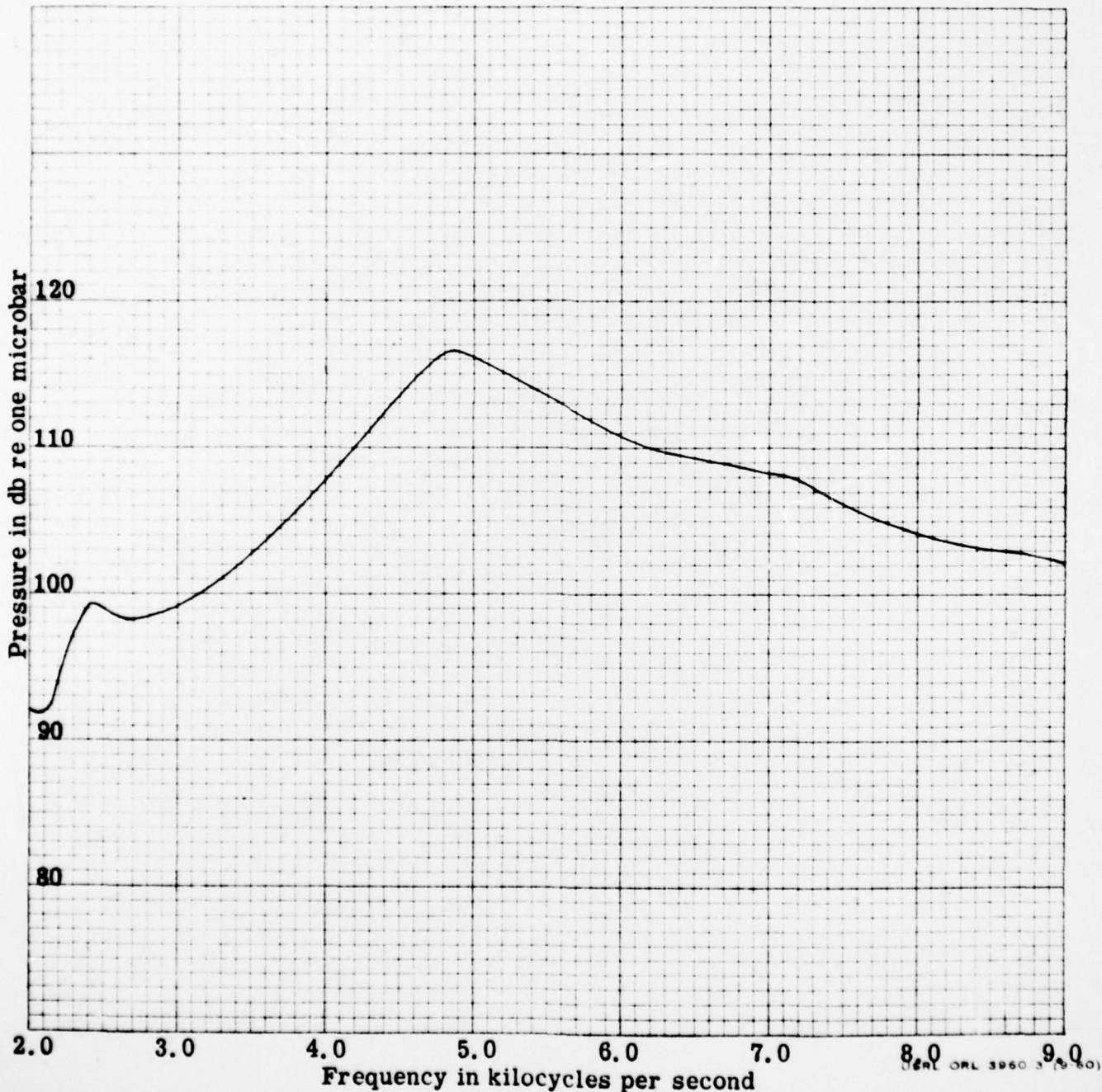
Department of the Navy, Office of Naval Research
UNDERWATER SOUND REFERENCE LABORATORY
P. O. Box 8337, Orlando, Florida

USRL No 27234
Proj. No. RP-2335
Date: Feb 1962

TRANSMITTING CURRENT RESPONSE
Sangamo AN/SQS-23 Transducer Element
Serial T44-1
Pressure at one meter per ampere

Water temp: 15 °C

MEASUREMENTS MADE IN ACCORDANCE WITH AMERICAN STANDARD Z 24.24-1957



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NAVY OPD 820 JAL

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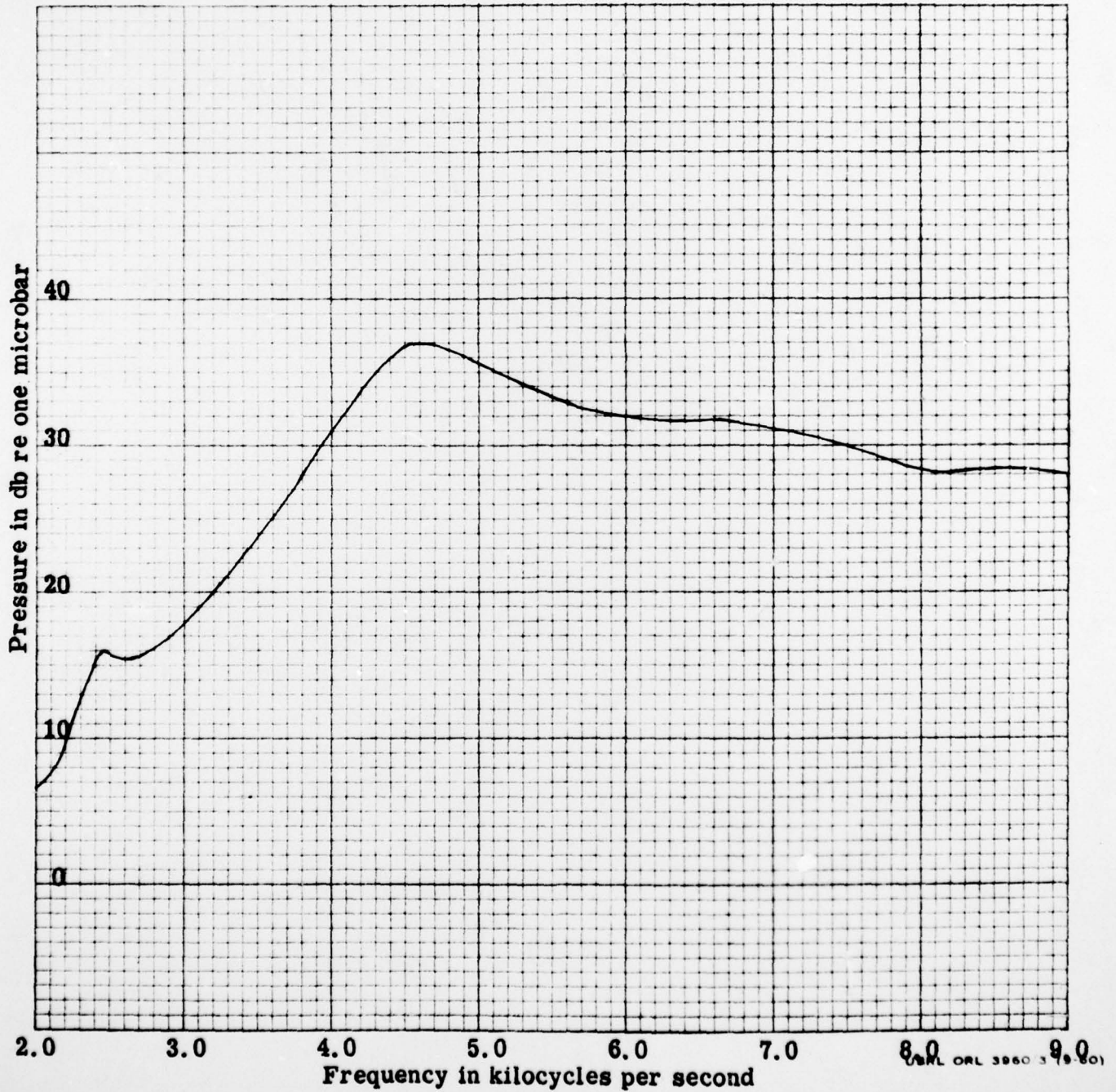
Department of the Navy, Office of Naval Research
UNDERWATER SOUND REFERENCE LABORATORY
P. O. Box 8337, Orlando, Florida

USRL No. 27235
Proj. No. RP-2335
Date: Feb 1962

TRANSMITTING VOLTAGE RESPONSE
Sangamo AN/SQS-23 Transducer Element
Serial T44-1
Pressure at one meter per volt at end of 29-ft cable

Water temp: 15 °C

MEASUREMENTS MADE IN ACCORDANCE WITH AMERICAN STANDARD Z.24 24-1957



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NAVY DFFO AND JAX

30° 20° 10° 0° 350° 340° 330°
330 340 350 10° 20° 30°

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(Unclassified until filled in)

USRL NO. 27236

PROJECT NO. RP-2335

DATE: Feb 1962

MEASUREMENTS MADE IN ACCORDANCE WITH AMERICAN STANDARD Z 39.24-1957

AC

RELATIVE RESPONSE IN DB

10
20
30
40

DIRECTIVITY OF
Sangamo AN/SQS-23 Transducer
Element Serial T44-1
XY plane

5.0 KC

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USN UNDERWATER SOUND REFERENCE LABORATORY
P. O. BOX 8337 ORLANDO, FLA.

150° 160° 170° 180° 190° 200° 210°
210° 200° 190° 180° 170° 160° 150°

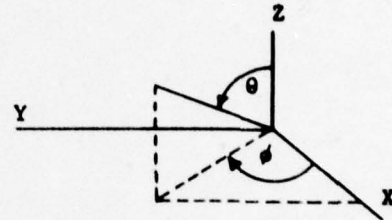
CODING ROCK COMPANY, INC. WILMINGTON, MASSACHUSETTS
NO. 3124 POLAR CO-ORDINATE

49 320
50 310
60 300
70 290
80 280
90 270
100 260
110 250
120 240
130 230
140 220

320° 10°
310° 50°
300° 60°
290° 70°
280° 80°
270° 90°
260° 100°
250° 110°
240° 120°
230° 130°
220° 140°

COORDINATE SYSTEM FOR TRANSDUCER ORIENTATION

The left-handed coordinate system of the American Standard Procedures for Calibration of Electroacoustic Transducers Particularly Those for Use in Water, Z24.24-1957, is used. The transducer is fixed with respect to the coordinate system and has its acoustic center at the origin. The angle ϕ is equivalent to the azimuth angle in sonar operation.



PLACEMENT OF TRANSDUCER IN COORDINATE SYSTEM

Transducer Type	Transducer Orientation in Coordinate System
Point, or Spherical	Points on surface that coincide with the X and Z axes shall be specified.
Cylindrical, or Line	The axis of the cylinder or line shall coincide with the Z axis. A reference mark in the XZ plane and in the direction of the positive X axis will be specified.
Plane, or Piston	The plane or piston face shall be in the YZ plane with the X axis normal to the face at its acoustic center. A reference mark in the XZ plane and in the direction of the positive Z axis will be specified.
Other Configurations	Orientation shall be shown by sketch or description. This category includes line and piston types of transducers operated in an orientation other than those specified above.

ORIENTATIONS FOR RESPONSE AND DIRECTIVITY MEASUREMENTS

Response. The calibration measurements are made for sound propagated parallel to the positive X axis ($\phi = 0, \theta = 90$), unless otherwise specified on the response curve.

Directivity. The plane of the pattern is specified, and the following conventions are observed, if another orientation is not specified on the pattern:

XY Plane: The positive X axis ($\phi = 0, \theta = 90$) coincides with the zero-degree direction on the pattern and the positive Y axis ($\phi = 90, \theta = 90$) is at 90 degrees measured in a clockwise direction. Rotation is around the Z axis; the positive Z axis is directed upward from the plane of the paper.

XZ Plane: The positive X axis coincides with the zero-degree direction and the positive Z axis ($\theta = 0$) is at 90 degrees measured in a clockwise direction. Rotation is around the Y axis; the negative Y axis is directed upward from the plane of the paper.

YZ Plane: The positive Y axis coincides with the zero-degree direction and the positive Z axis is at 90 degrees measured in a clockwise direction. Rotation is around the X axis; the positive X axis is directed upward from the plane of the paper.

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USRL Calibration Report No. 1856
Project No. RP-2335

Table 1

EQUIVALENT PARALLEL ADMITTANCE
Sangamo AN/SQS-23 Transducer Element
Serial 223

Freq (kc)	G (mhos)	B (mhos)
1.00	0.00	20.6
1.50	0.00	31.0
2.00	0.00	42.2
2.50	1.00	54.2
3.00	2.00	66.7
3.50	3.00	82.7
4.00	10.0	106.
4.20	18.0	120.
4.30	25.0	127.
4.35	31.0	130.
4.40	37.0	132.
4.45	45.0	134.
4.50	54.0	134.
4.55	64.0	133.
4.60	74.0	128.
4.65	80.0	119.
4.70	86.0	109.
4.75	90.0	100.
4.80	90.0	84.8
4.85	86.0	77.4
4.90	80.0	68.4
4.95	75.0	62.8
5.00	67.0	58.1
5.05	62.0	56.5
5.10	56.0	56.1

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USRL Calibration Report No. 1856
Project No. RP-2335

Table 1 (continued)

EQUIVALENT PARALLEL ADMITTANCE
Sangamo AN/SQS-23 Transducer Element
Serial 223

Freq (kc)	G (mhos)	B (mhos)
5.15	50.0	55.7
5.20	45.0	56.2
5.25	40.0	57.7
5.30	36.0	58.9
5.35	33.0	60.2
5.40	30.0	61.8
5.50	25.0	66.7
5.60	23.0	71.1
5.70	20.0	75.2
5.80	19.0	79.1
5.90	16.0	82.3
6.00	15.0	85.6
6.20	14.0	90.8
6.40	12.0	96.9
6.60	11.0	101.
6.80	11.0	106.
7.00	9.00	110.
7.50	7.00	121.
8.00	3.00	133.

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USRL Calibration Report No.1856
Project No. RP-2335

Table 2

EQUIVALENT SERIES IMPEDANCE
Sangamo AN/SQS-23 Transducer Element
Serial 5636

Freq (kc)	R (ohms)	X (ohms)
1.00	1.54	15.0
1.50	1.75	23.6
2.00	2.13	33.9
2.50	2.85	46.9
3.00	4.47	66.5
3.50	11.4	104.
4.00	107.	211.
4.20	287.	97.2
4.30	240.	22.2
4.35	115.	48.1
4.40	157.	50.0
4.45	129	47.2
4.50	108.	37.9
4.55	92.7	29.5
4.60	79.8	20.4
4.65	71.6	12.4
4.70	64.1	3.12
4.75	60.5	3.56
4.80	55.0	10.1
4.85	52.0	16.3
4.90	50.0	22.7
4.95	48.7	28.7
5.00	47.1	33.7
5.05	46.5	39.6
5.10	46.5	44.4

(continued)

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USRL Calibration Report No. 1856
Project No. RP-2335

Table 2 (continued)

EQUIVALENT SERIES IMPEDANCE
Sangamo AN/SQS-23 Transducer Element
Serial 5636

Freq (kc)	R (ohms)	X (ohms)
5.15	46.8	49.4
5.20	47.0	54.5
5.25	48.2	60.0
5.30	50.0	64.0
5.35	51.0	68.7
5.40	53.0	73.9
5.50	57.9	83.3
5.60	63.2	92.4
5.70	70.4	102.
5.80	78.4	113
5.90	86.5	124.
6.00	96.5	135.
6.20	127.	167.
6.40	184.	204.
6.60	302.	238.
6.80	528.	160.
7.00	642.	142.
7.50	132.	314.
8.00	39.7	195.

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