J. Kane
1 of
1/21/82

SUBJECT: MIDLAND PLANT, UNITS 1 AND 2 UNDERGROUND PIPING CONCERNS

DATE: JANUARY 21, 1982, 3:30-4:30 & Jan. 22, 1982 Afternoon in CPC Landow Office

PLACE: AIR RIGHTS BUIDLING, ROOM 2242

AGENDA

I INTRODUCTION

II FUTURE MONITORING PROGRAM

III GEOTECHNICAL CONCERNS

IV SEISMIC AND MISCELLANEOUS CONCERNS

MONITORING SELECTION CRITERIA

1. ALL POINTS ABOVE 2% OVALITY (Above current measurements)

2. FOUR (4) POINTS MINIMUM PER LINE

3. ONE (1) POINT BASED ON HIGHEST SEISMIC STRESS - INCLUSIVE WITH ITEM 2

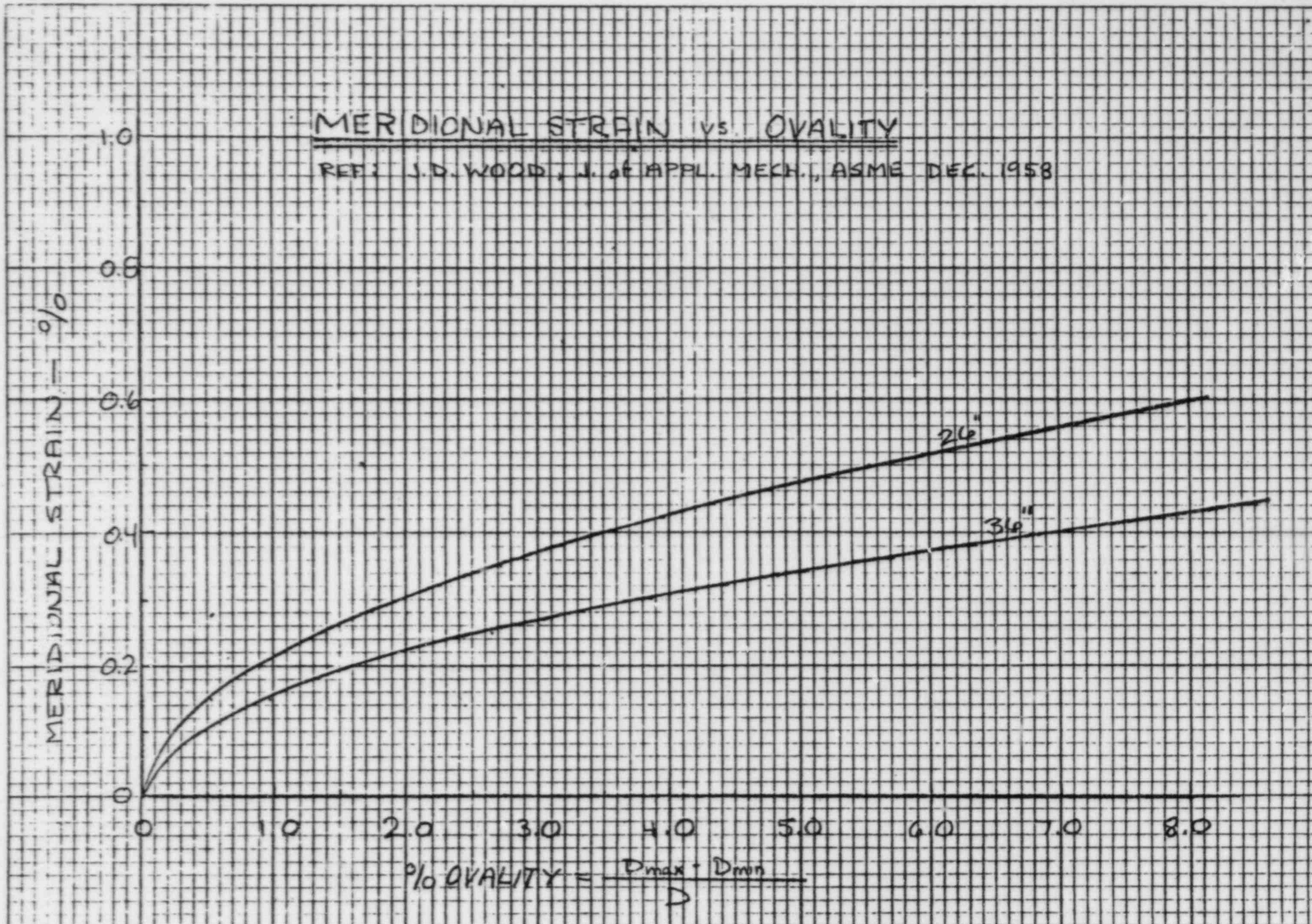
4. MONITOR FIRST ANCHOR POINT - INSIDE BUILDING

Above criteria results in

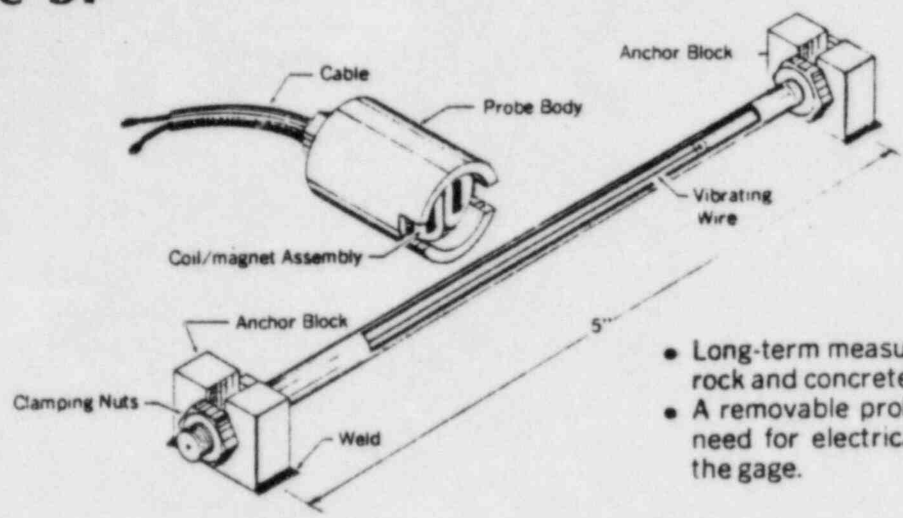
Monitor 65 Points

41 Fxd locations
24 Anchor

Measure Ovality w/ Vibrating Wire Strain Gauge


MERIDIONAL STRAIN vs OVALITY
REF: J.D. WOOD, J. of APPL. MECH., ASME DEC. 1958
MERIDIONAL STRAIN – %
1.0
0.8
0.6
0.4
0.2
0
26"
36"
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
% OVALITY = Dmax - Dmin / D

Vibrating Wire Strain Gage, Type SP



- Long-term measurements on steel, rock and concrete surfaces.
- A removable probe eliminates the need for electrical connections to the gage.

The IRAD GAGE Type SP Vibrating Wire Strain Gage is a low cost unit designed to monitor strain changes in steelwork as well as on rock and concrete structures where easy access to the gage is possible. The gage is unique in having no permanent connections between the electronic readout and the mechanical strain-sensing components; the readings are taken by holding a removable probe against the casing of the gage.

The basic unit consists of two end pieces, a spacing tube and a length of high tensile steel wire that is clamped between the end pieces. The gages are installed by rigidly clamping them between anchor blocks which are welded or bolted to the structure at a predetermined spacing using a special jig. The initial wire tension is set to the required value by rotating the clamping nuts using a standard wrench. The wire is vibrated and the vibrations are picked up by holding a removable probe, containing a coil/magnet assembly, against the spacing tube. The magnetic field radiating from the coil penetrates the tube walls and both drives and responds to the wire motions. The probe is used in conjunction with the IRAD GAGE Model MB-6 Digital Readout.

The coefficient of expansion of the wire is closely matched to that of structural steel eliminating the need for temperature corrections. Calibration data are supplied to allow for easy conversion of the vibration period readings to strains.

Specifications

Model No.		SP-1	SP-5
Active Gage Length (anchor block spacing)	inches (mm.)	1 (25.4)	5 (127)
Maximum Strange Range	μ in./in.	2000	2000
Sensitivity (average)	μ in./in.	0.5	1
Temperature Range	°F	-40° to 150°F	-40° to 150°F
Overall Length	Inches (mm.)	1¼ (32)	6 (152)
Tube Diameter	inches (mm.)	0.09 (2.3)	¼ (6.4)
End Block Dimensions	inches	1 x 3/8 x 3/8	1 x ½ x 3/8

Accessories

Setting Jig (bolting type).
Setting Jig (weldable type).
Wrench.
Model MB-6 Readout Box.
Type SP Probe.

Ordering Information

Specify: 1. Model Number.
2. Weldable or Bolted End Blocks.

MONITORING FREQUENCY

1. All Monitoring Stations
   * 90 Day Interval - First Five Years
2. Anchor Stations (After Five Years)
   * Yearly Interval - Remainder of Operating Life
3. Evaluate The Need To Continue Monitoring Field Stations
4. At Technical Specification Limit
   * Monthly

ACCEPTANCE CRITERIA

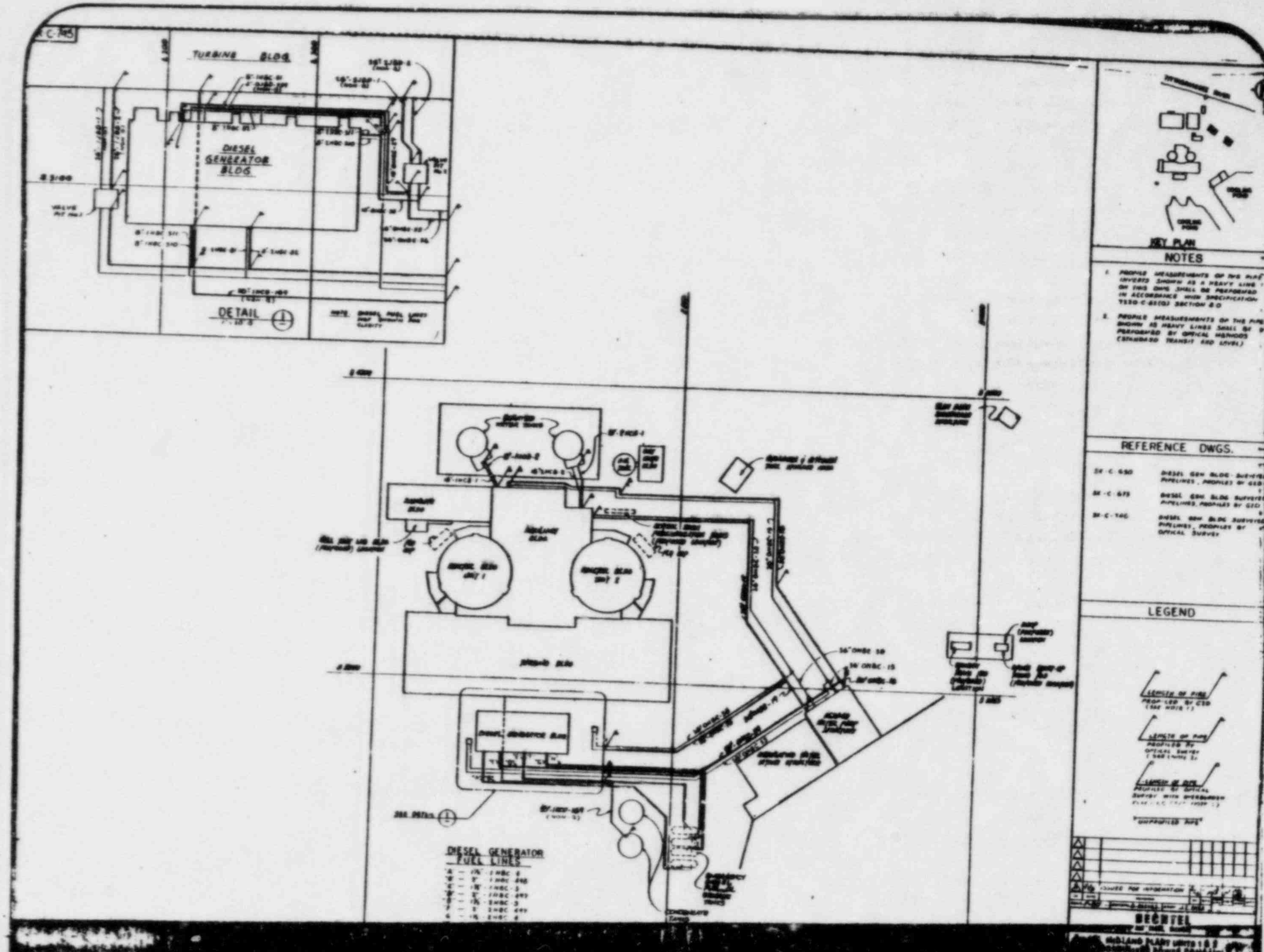
1. TECHNICAL SPECIFICATION LIMIT - 6 % OVALITY (FSAR - Chapt 16

   A. REPORT TO NRC if 6% limit is reached

   B. INCREASE MONITORING FREQUENCY - MONTHLY

   C. ENGINEERING EVALUATIONS BEGIN

2. MAXIMUM ALLOWABLE - 8 % OVALITY


TURBINE BLDG
DIESEL GENERATOR BLDG
DETAIL 1
KEY PLAN
NOTES
1. PROFILE MEASUREMENTS OF THE PIPE INVERTS SHOWN AS A HEAVY LINE ON THIS DWG SHALL BE PERFORMED IN ACCORDANCE WITH SPECIFICATION 7220-C-81(Q) SECTION 8.0
2. PROFILE MEASUREMENTS OF THE PIPES SHOWN AS HEAVY LINES SHALL BE PERFORMED BY OPTICAL METHODS (STANDARD TRANSIT AND LEVEL)
REFERENCE DWGS.
DIESEL GEN BLDG SURVEYED PIPELINES, PROFILES BY OPTICAL SURVEY
LEGEND
UNPROFILED PIPE
DIESEL GENERATOR FUEL LINES
ISSUED FOR INFORMATION
BECHTEL
MIDLAND PLANT UNITS 1 & 2
CONSUMERS POWER COMPANY

1/21/82
1 of
J. Kane

Meeting w/ CPC on Underground Piping – Jan. 21, 1982
Room 2242 A/R

Jim Meisenheimer – CPC

(Dwg to be provided) Borrus Anchors in fill itself – When installed?
9 locations (@ 7' to 12')
BA-13, 14 & 34 are the shallow anchors

B A installed
Dec. 78
Sept. 79

(BA-13, 14: near ." in 3 yrs; 34: 2" in 3 yrs)

BA-100 series (~6 locations) – .4" in 2 yrs (due to dewatering)
└ Depth of installation – El. 627

Pipes installed in 1977
First profiles in 1979 Then in 1981

Use log time plots of B.A. – Projecting 3" max. addt'l. settlement (incl. dewatering & shakedown) during plant life (40 yrs) @ BA-34

Max Different. Settlement would be 3" (believed would occur @ a support)

Looked @ subsurface data along pipe alignment
Observed N from 2 to 3 up to high blow counts
26-01+BC
Profiling have indicated pipes have already settled about 3". Other areas have settled more (6+)

1/22/82
Rec'd from J. Meisenhamer and D. Reeves

SUMMARY OF SOIL CONSTANTS

	OBE .06g	SSE .18g*	References
Compression Wave Velocity	10,000 fps	10,000 fps	1,2
Shear Wave Velocity (Lower Soil Layers)	5,000 fps	5,000 fps	1,2
Surface Wave Velocity	4,675 fps	4,675 fps	1,3
Maximum Particle Velocity (All Wave Types)	2.88 in/sec	8.64 in/sec	4
Maximum Particle Acceleration (All Wave Types)	23.16 in/sec^2	69.48 in/sec^{2*}	3,8
Soil Unit Weight	120 pcf	120 pcf	7
Poisson's Ratio	.4	.4	7
Angle of Internal Friction	37°	37°	7
Coefficient of Lateral Pressure	.67	.67	3
Coefficient of Friction	.3636	.3636	5
Shear Wave Velocity (Upper Soil Layers) E=E + 0%	6,000 in/sec	6,000 in/sec	6
E=E + 50%	7,350 in/sec	7,350 in/sec	6
E=E - 50%	4,242 in/sec	4,242 in/sec	6
Shear Modulus = Soil Mass Density (Shear Wave Velocity)^{2**} Modified by Seed & Idriss curve for sands			3,9
Maximum Soil Strain	(6.17) 10^{-5} in/in	(1.85) 10^{-4} in/in	1

* SSE acceleration has been increased 50% to allow a margin for the site specific response spectra.

**Shear wave velocity of upper soil layers.

SUMMARY OF SOIL CONSTANTS

References:

1) TPO Design Guide C-2.44, Seismic Analyses of Structures and Equipment for Nuclear Power Plants, Rev 0.

2) Subsurface Investigation and Foundation Soil Report, Vol 2 of 2, Dec 1975, Appendix 2C.

3) Iqbal, M.A. And Goodling, E.C. Jr., Seismic Design of Buried Piping, 2nd ASCE Specialty Conference on Structural Design of Nuclear Power Plant Facilities, New Orleans, Louisiana, Dec. 1975.

4) Newmark, N.M., Blume, J.A. and Kapur, K.K., Seismic Design Spectra for Nuclear Power Plants, ASCE, Journal of the Power Division, Nov. 1973.

5) Potyondy, J.G., Skin Friction between Various Soils and Construction Materials, Geotechnique, Vol. XI, Dec. 1961.

6) Responses to NRC 10CFR50.54f Questions, Rev 11.

7) Midland Final Safety Analysis Report, Rev 39.

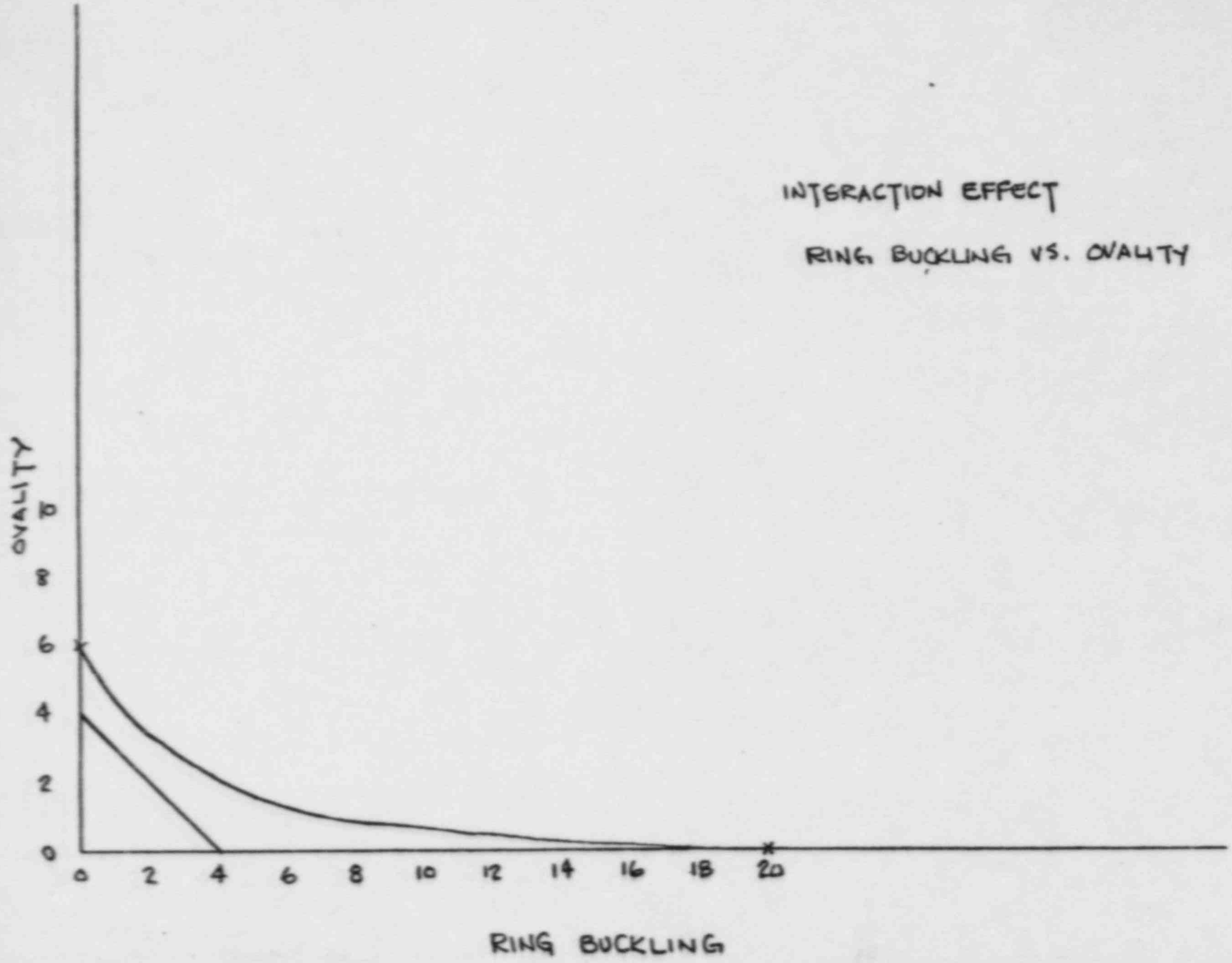
8) Midland Civil Design Criteria, Standard C-501, Rev 11.

9) Seed, H.B. and Idriss, I.M., Soil Moduli and Damping Factors For Dynamic Response Analyses, Earthquake Engineering Research Center, University of California, Berkeley, California, Dec. 1970.

Handout by CPC
Underground Piping Meeting
1/22/82

INTERACTION EFFECT

RING BUCKLING VS. OVALITY



3. AVAILABLE INFORMATION

3.1 BURIED PIPELINES -- A Manual of Structural Design and Installation.

...is DOCUMENT PROVIDES GUIDANCE AS FOLLOWS:

General -not ring buckling

1. Buckling can be ignored in uncompacted backfill if the OVALITY IS LIMITED TO 5%.

2. RING BUCKLING can occur when OVALITY reaches 20%. Good DESIGN PRACTICE would LIMIT OVALITY to 5%.

3.2 R. E. BARHARD - Design and Deflection Control of Buried Steel Pipe Supporting Earth Loads and Live Loads.

This paper reaches the same conclusions as 3.1 above.

3.3 A.W.W.A., Steel Pipe Design and Installation
MEYERHOF, G. G. and FISHER, C. L. Composite Design of Underground Steel Structures
SPANGLER, M. G., The Structural Design of Flexible Pipe Culverts
SPANGLER, M. G. and DONOVAN, Applications of the Modulus of Passive Resistance of Soil in the Design of Flexible Pipe Culverts

THESE PAPERS SUPPORT 3.1 and 3.2 above.

1/22/82
CPC Handout
Underground Piping Meeting

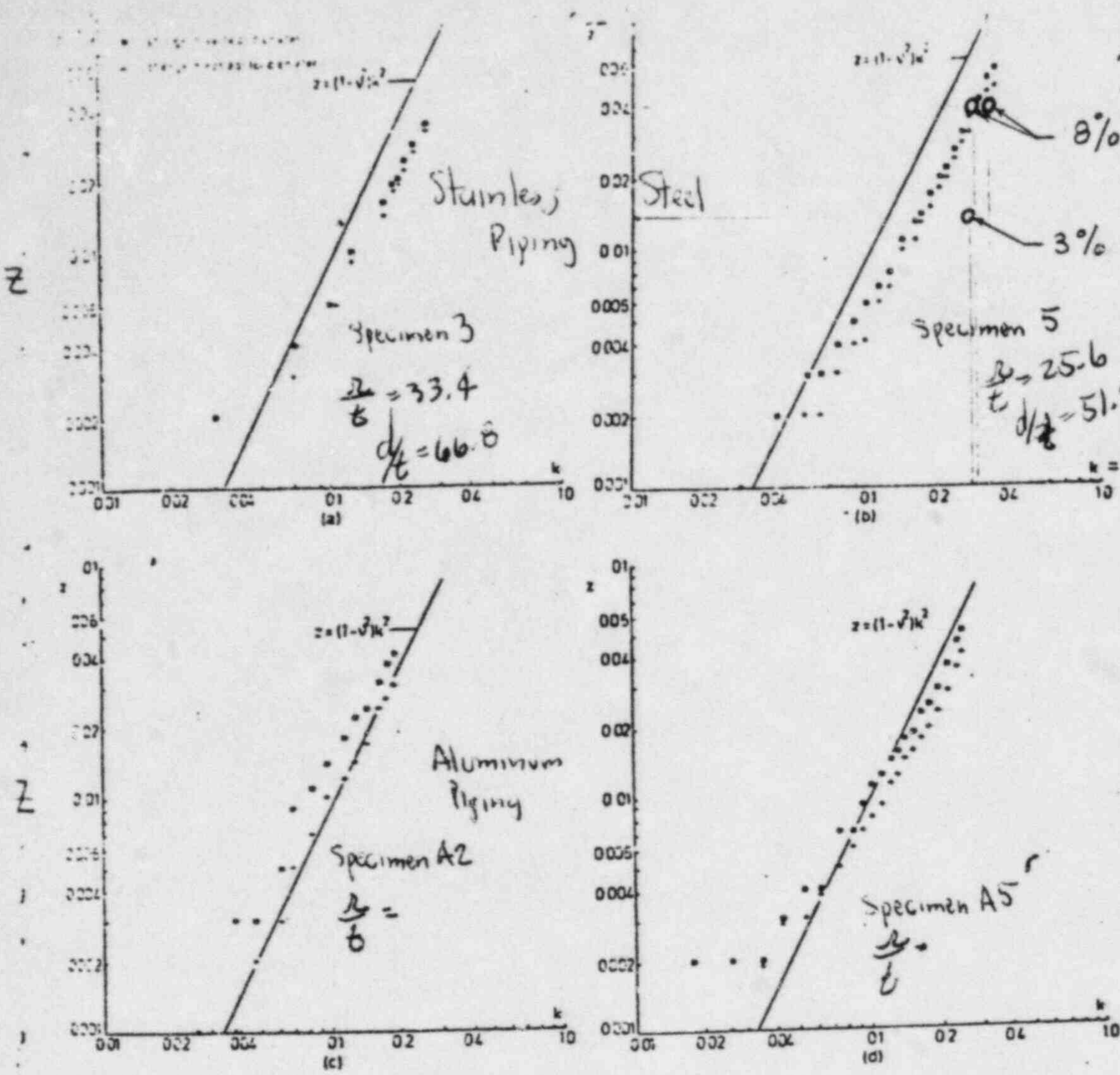


Fig. 9. Experimental values of z vs dimensionless curvature k for specimen 3(a), 5(b), A2(c) and A5(d).

crit. of buckling

aluminium specimens, and those of Batterman, show a similar relationship to radius-thickness ratio: this also applies to the points for our steel tests, when compared to those of Refs.[5] and [6]. With this similarity between results of cylinders tested under pure bending and axial compression in mind, the critical strains for the present set of tests were compared with the theoretical predictions of Batterman[8] for axially compressed tubes. Figures 10(a) and 10(b) show the experimental strains plotted vs r/t, where they are normalised with respect to Batterman's[8] theoretical values for J_2 flow theory and J_2 deformation theory, ϵ_{ci} and ϵ_{cd}, respectively: these are found from Batterman's formulae for incremental and deformation theory critical stresses,

$$\frac{\sigma_{ci}}{E} = \frac{2t}{r}\{3[(5-4\nu)E/E_T-(1-2\nu)^2]\}^{-1/2} \tag{7a}$$

$$\frac{\sigma_{cd}}{E} = \frac{2t}{r}\{3[(3E/E_s+2-4\nu)E/E_T-(1-2\nu)^2]\}^{-1/2} \tag{7b}$$

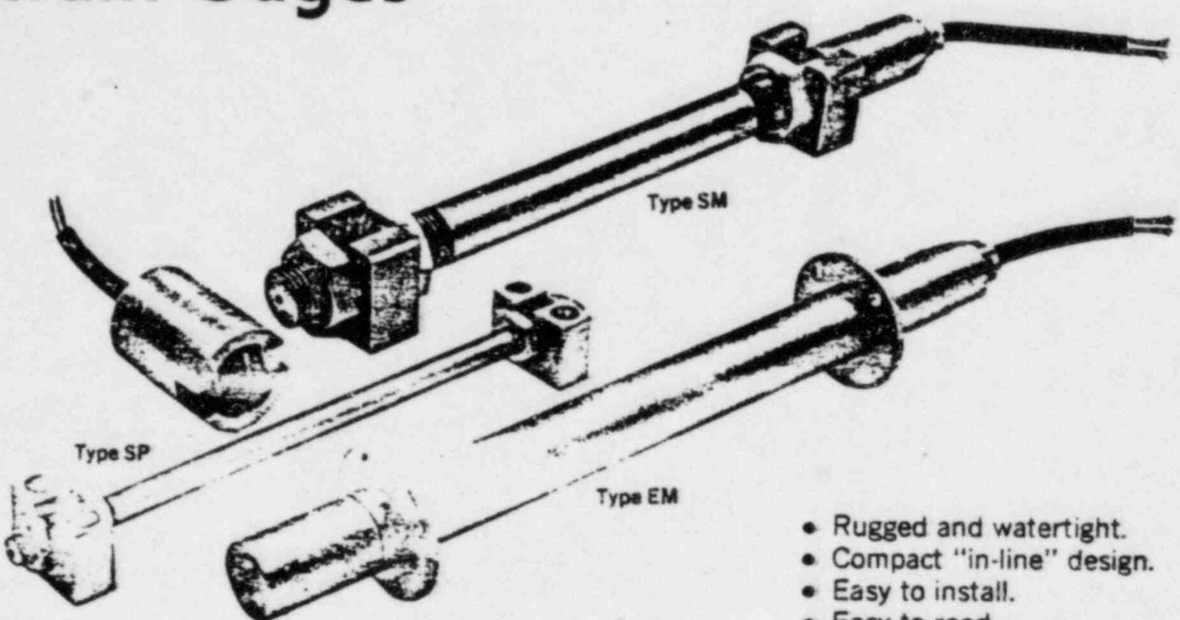
and the uniaxial stress–strain curves (Table 1 and eqn 1). Both graphs show a great amount of scatter of the points, but the deformation theory predictions of critical strains are seen to be generally very much closer than those using flow theory. This discrepancy between the predictions of flow and deformation theories is one which has been shown to occur in many

Impt. Difference between NRC & CPC is position that the larger the d/t ratio (larger diameter pipe) the lower the percentage of critical ovality (ovality @ rupture) (this is NRC Position

DATA SHEET

1/22/82
CPC Handout
Underground Piping

Vibrating Wire Strain Gages



- Rugged and watertight.
- Compact "in-line" design.
- Easy to install.
- Easy to read.
- Highly sensitive.
- Excellent long-term stability.
- Frequency signal eliminates limitations on lead length and reduces contact resistance and ground leakage problems.

IRAD GAGE Vibrating Wire Gages measure strains in steel work, on rock and concrete surfaces and inside concrete constructions.

The IRAD GAGE Vibrating Wire Strain Gages are designed to measure strains in steel, rock and concrete constructions over long periods of time. They are particularly suitable for use under adverse environmental conditions and where high resolution coupled with high reliability is required.

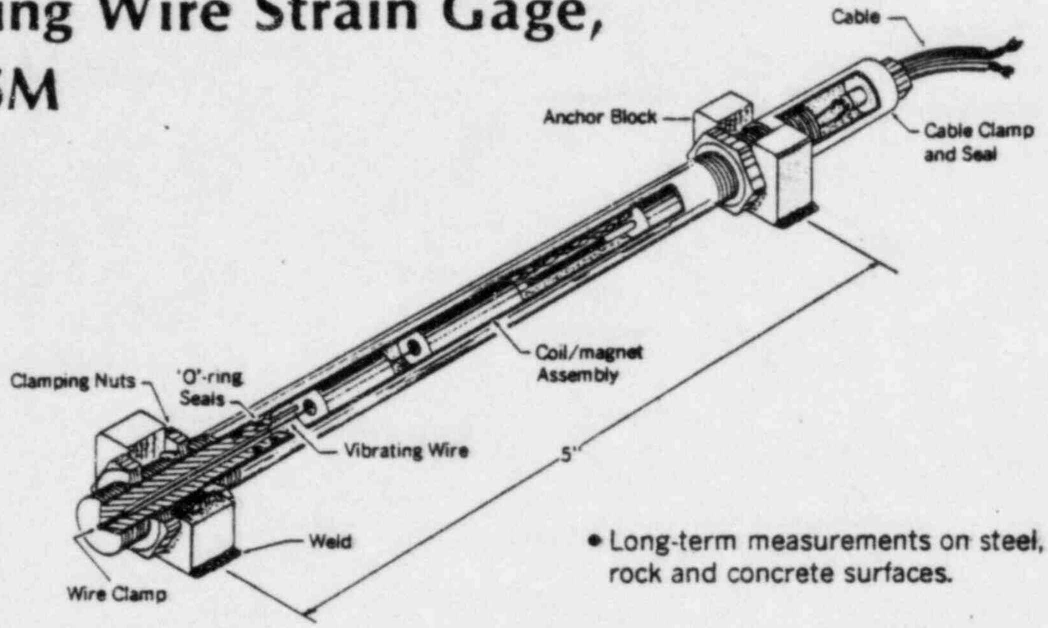
The gages consist essentially of a length of high tensile steel wire clamped between two end blocks which are welded or bolted to the surface of a structure (or in the case of concrete they are cast in place). Forces acting on the structure produce strains which introduce relative movements between the end blocks and thus a change of tension in the wire. When the wire is vibrated using a coil/magnet assembly the resonant frequency of the vibration, which varies according to the wire tension, gives a measure of strain in the structure.

The gages are read by the IRAD GAGE MB-6 portable Digital Readout Box (see data sheet); in coal mines the permissible MB-3 Readout Box is used. Because they generate a signal that is a frequency rather than a voltage or a current, vibrating wire gages are insensitive to lead wire resistance changes and contact resistance and ground leakage problems are negligible. Lead lengths of over one mile are acceptable. The period of vibration using either of the readout meters can be measured repeatedly to 10^{-7} seconds giving a strain resolution of better than 1μ in./in.

Vibrating Wire Strain Gages are well known for their long-term stability which results from the fact that measurements of the tensioned wire are of its mechanical rather than its electrical properties. This inherent stability is further enhanced in the IRAD GAGE designs by the unique method of wire clamping (using stainless steel capillary tubing extruded under high pressure over the ends of the wire during manufacture). This method of clamping and the miniature coil/magnet assembly allows for exceeding compact design.

Except for the vibrating wire itself the mechanical gage components are made from stainless steel. The internal elements are sealed by double 'O' rings allowing for indefinite use under complete submersion.

Vibrating Wire Strain Gage, Type SM



- Long-term measurements on steel, rock and concrete surfaces.

The IRAD GAGE Type SM Vibrating Wire Strain Gage has been designed to measure strains on structural steel work as well as on the surface of rock and concrete constructions. The gages are rigidly clamped by anchor blocks which are welded or bolted to the structure at predetermined spacing using a special jig. The initial wire tension is set to the required value by rotating the clamping nuts using a standard wrench.

The wire vibrations are measured using a coil/magnet assembly mounted inside the gage. The lead wires to this assembly are brought out through one of the ends. The period of the resonant frequency is easily read on the display of the IRAD GAGE Readout Box MB-6 (or MB-3).

Either tensions or compressions can be monitored and no loads other than those required to tension the vibrating wire are applied to the structure. As the coefficient of expansion of the wire is closely matched to that of the structural steel there are no temperature corrections. If temperature measurements are required they can be monitored by a thermistor (optional extra) mounted inside the gage.

Where gages are susceptible to impact damage such as in high traffic areas or during shotcreting, it is recommended that they be shielded by a metal cover (optional extra).

The gages are provided with heavy duty cable. Further cable protection can be provided by means of flex conduit coupled to the gage cover.

Calibration data are supplied with the gages to enable the observer to convert the period readings to strains.

Specifications

Model No.	SM-5
Active Gage Length (anchor block spacing)	5 inches (127 mm.)
Maximum Strain Range	2000 μ in./in.
Sensitivity	1 μ in./in.
Temperature Range	−40° to 150°F
Overall Length	7½ inches (190 mm.)
Tube Diameter	½ inch (12.7 mm.)
End Block Dimensions - (weldable)	1 x 1 x ½ inches
(bolted)	1½ x 1 x ½ inches
Weight with 10 ft. of cable	1 lb.

Essential Accessories

Setting Jig (bolting type).
Setting Jig (weldable type).
Wrench.
Model MB-3 (or MB-6) Readout Box.

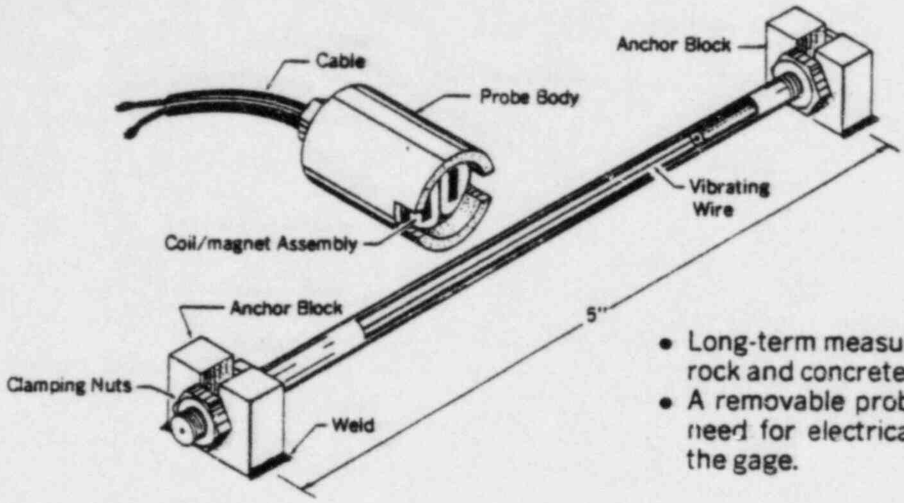
Optional Extras

Thermistors.
Model MT-1 Thermistor Readout.
Gage Cover.
Flex Conduit.

Ordering Information - Model SM-5

Specify: 1. Cable Length.
2. End Block Type. (Weldable or Bolted).

Vibrating Wire Strain Gage, Type SP



- Long-term measurements on steel, rock and concrete surfaces.
- A removable probe eliminates the need for electrical connections to the gage.

The IRAD GAGE Type SP Vibrating Wire Strain Gage is a low cost unit designed to monitor strain changes in steelwork as well as on rock and concrete structures where easy access to the gage is possible. The gage is unique in having no permanent connections between the electronic readout and the mechanical strain-sensing components; the readings are taken by holding a removable probe against the casing of the gage.

The basic unit consists of two end pieces, a spacing tube and a length of high tensile steel wire that is clamped between the end pieces. The gages are installed by rigidly clamping them between anchor blocks which are welded or bolted to the structure at a predetermined spacing using a special jig. The initial wire tension is set to the required value by rotating the clamping nuts using a standard wrench. The wire is vibrated and the vibrations are picked up by holding a removable probe, containing a coil/magnet assembly, against the spacing tube. The magnetic field radiating from the coil penetrates the tube walls and both drives and responds to the wire motions. The probe is used in conjunction with the IRAD GAGE Model MB-6 Digital Readout.

The coefficient of expansion of the wire is closely matched to that of structural steel eliminating the need for temperature corrections. Calibration data are supplied to allow for easy conversion of the vibration period readings to strains.

Specifications

Model No.		SP-1	SP-5
Active Gage Length (anchor block spacing)	inches (mm.)	1 (25.4)	5 (127)
Maximum Strange Range	μ in./in.	2000	2000 .002
Sensitivity (average)	μ in./in.	0.5	1
Temperature Range	°F	-40° to 150°F	-40° to 150°F
Overall Length	Inches (mm.)	1¼ (32)	6 (152)
Tube Diameter	inches (mm.)	0.09 (2.3)	¼ (6.4)
End Block Dimensions	inches	1 x 3/8 x 3/8	1 x ½ x 3/8

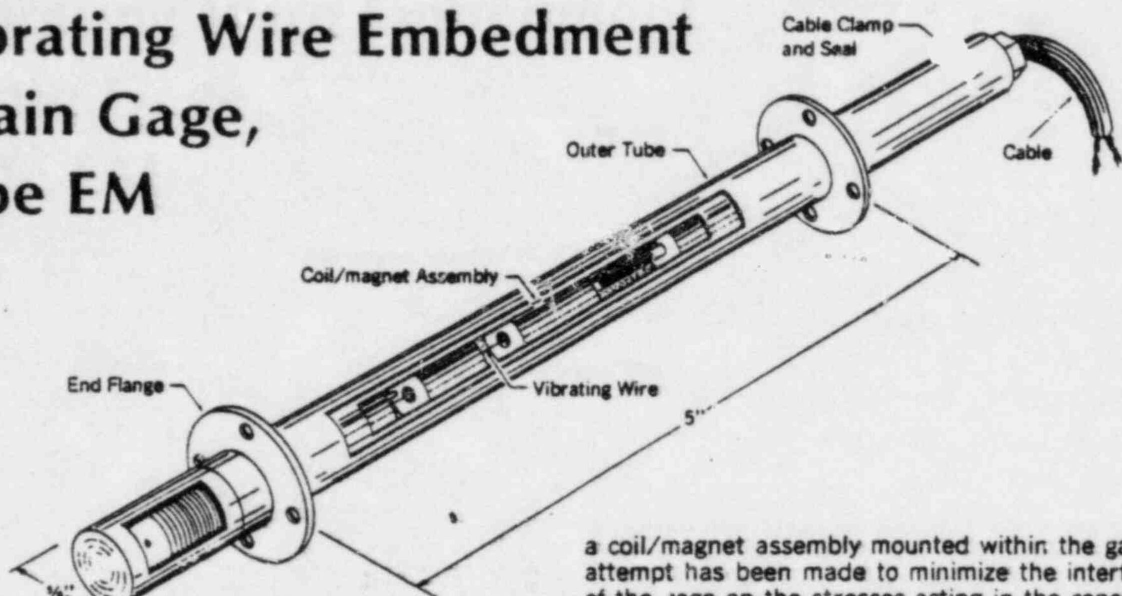
Accessories

Setting Jig (bolting type).
Setting Jig (weldable type).
Wrench.
Model MB-6 Readout Box.
Type SP Probe.

Ordering Information

Specify: 1. Model Number.
2. Weldable or Bolted End Blocks.

Vibrating Wire Embedment Strain Gage, Type EM



The IRAD GAGE Type EM Vibrating Wire Embedment Strain Gage has been designed to measure strains within concrete constructions. Typical applications would be buildings, foundations, dams, nuclear power stations, tunnels and bridges.

The Type EM Strain Gage embodies all the features of the Type SM Gage with the addition of an outer tube and end plates that become anchored in the concrete. Strains between the end plated cause the outer tube to be correspondingly strained and the wire tension to be changed. As with the conventional Type SM Gage the strains are measured in terms of the vibration period by a coil/magnet assembly mounted within the gage. An attempt has been made to minimize the interference of the gage on the stresses acting in the concrete by matching the equivalent modulus of the tube to the average value for concrete, 3.8×10^6 psi (26×10^3 MPa), and by bringing the electrical cables out the end of the gage.

The gage is installed by embedding directly into the concrete. Holes in the end plates permit the gage to be attached to rebars. An alternative method of encapsulating the gages in concrete briquettes prior to embedment is recommended where the gages may be damaged by concrete placement. Two gage lengths (5 and 10 inches) are offered to cover use with medium and large concrete aggregate. Thermistors can be provided if temperature measurements are required.

Specifications

Model No.		EM-5	EM-10
Active Gage Length	inches (mm.)	5 (127)	10 (254)
Maximum Strain Range	μ in./in.	2000	1000
Sensitivity	μ in./in.	1	½
Temperature Range	°F	−40° to 150°F	−40° to 150°F
Overall Length	inches (mm.)	8 (203)	13 (330)
Tube Diameter	inches (mm.)	⅝ (16)	⅝ (16)

Essential Accessories

Model MB-3 or Model MB-6 Readout Box.

Optional Extras

Thermistor
Model MT-1 Thermistor Readout Box

Ordering Information

Specify: 1. Model Number.
2. Cable Length.

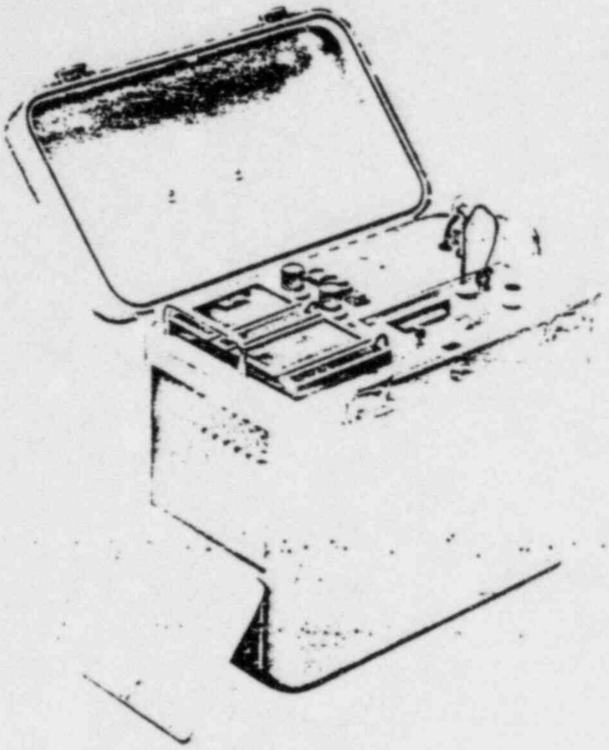
for further information write: IRAD GAGE, 14 Parkhurst Street
Lebanon, New Hampshire 03766, U.S.A.
Telephone: 603-448-4445

DATA SHEET

IRAD GAGE

MODEL MA-1

Rock Mechanics Instrumentation



Datalogger

The IRAD GAGE Datalogger is designed to automatically record data from vibrating wire transducers.

- Packaged for field use.
- Printed paper tape output.
- Compact solid state circuitry.

The IRAD GAGE Datalogger is a multi-channel digital data recorder used in conjunction with the Model MB-3 Readout Box. Automatically and at preset intervals it records data from vibrating wire transducers, a function it can perform accurately for long periods of time. The Datalogger may also be operated in a manual mode to record on command.

In automatic mode, data from stressmeters and strainmeters etc. are printed on paper (i.e. adding machine) tape along with the day, the time and the channel identification. Preselectable scan intervals on the standard configuration range from 15 minutes to one week. Up to 6,000 lines of data can be printed on a single roll of the paper tape.

In the manual mode each channel may be checked in turn. In addition a test scan can be initiated for a status check on all channels.

The Datalogger is sealed and splashproof. It operates with the cover closed to protect the printer and the paper tape from dirt and moisture.

The Model MB-3 Readout Box, which is used in conjunction with the Datalogger, is removable for local readout use.

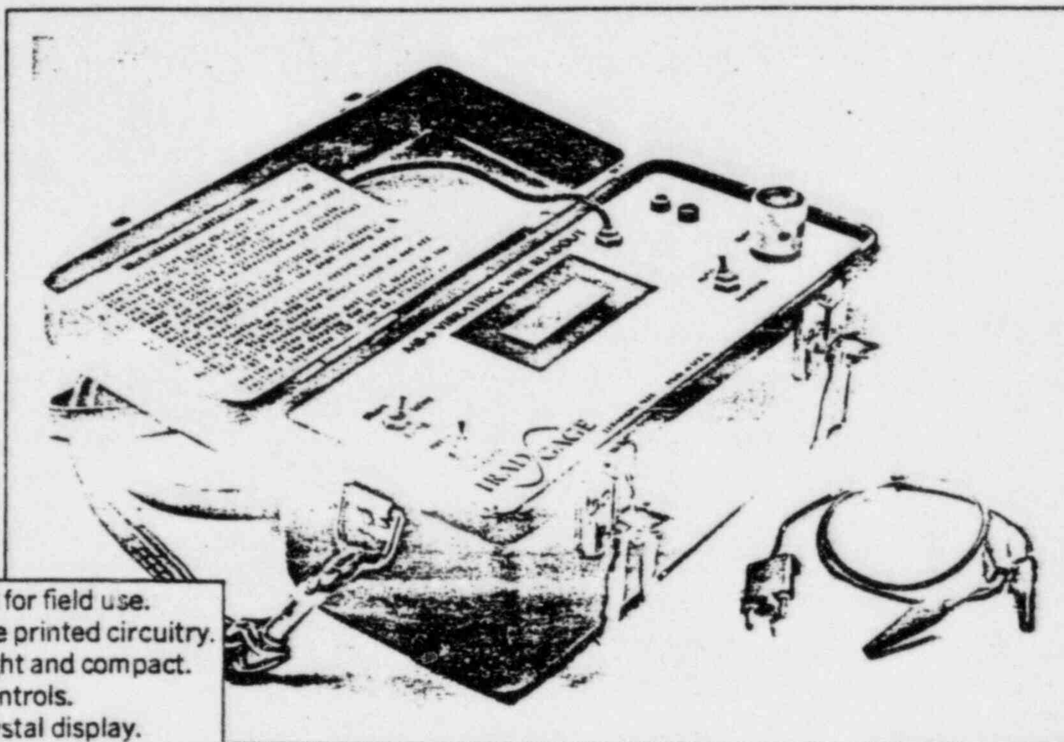
DATA SHEET

Geotechnical Instrumentation IRAD GAGE

MODEL MB-6

Vibrating Wire Readout Box

The IRAD GAGE Model MB-6 Readout Box is designed to provide a digital display for IRAD GAGE Vibrating Wire Gages.



- Packaged for field use.
- Solid state printed circuitry.
- Lightweight and compact.
- Simple controls.
- Liquid crystal display.

The IRAD GAGE Model MB-6 Vibrating Wire Readout is a lightweight, compact and simple to operate digital readout for IRAD GAGE Vibrating Wire Gages.

The readout operates by initially generating a voltage pulse containing a spectrum of frequencies spanning the natural frequency range of the wire in the gage being read. When the signal reaches the coil/magnet assembly mounted inside the gage (or probe), adjacent to the wire, it changes the magnetic field around the wire at a frequency corresponding to that of the input signal. When one of the frequencies in the input signal coincides with that of the wire, the wire vibrates and continues to vibrate after the input signal has ceased. A voltage is then generated in the coil at a frequency corresponding to that of the wire as it vibrates in the field of the coil/magnet assembly. This constant frequency signal generated by the gage is amplified by the readout meter and conditioned to eliminate electrical noise. Then, one hundred cycles of wire vibration are timed by a precise quartz clock and the time is displayed digitally.

To obtain readings, the operator: connects the gage, sets a switch to one of two positions corresponding to gage type, and depresses the 'read' button. The reading appears in the display window and flashes on and off as the readout constantly checks the reading.

The automatic readout mode can be manually overriden to extend the range of the unit and increase the possibility of obtaining readings from damaged gages. In this mode the multiple frequency signal is replaced by a pulse containing a single frequency. The operator sets the frequency to coincide with that of the vibrating wire by turning a tuning control. Once the wire is set in motion the technique of obtaining and displaying the vibration period is the same as described above.

Considerable attention has been given to produce a highly reliable readout for use under adverse environmental conditions. With the lid open the metal case is splash proof and the liquid crystal display is easily read even under bright sunlight. The solid state circuitry is mounted on printed circuit boards and the controls are sealed. Universally obtainable type AA batteries are in a pack mounted in the lid for easy access. A low voltage indicator is provided in the display. Rechargeable batteries are offered as an option.

The Model MB-6 Readout can be adapted for use with the IRAD Datalogger (See Data Sheet).

1/22/82
CPC Handout
Underground Piping Meeting

1. CODE CRITERIA COMPARISON

1.1. CODE ALLOWABLE - $3S_C$

1 COLLAPSE is a YIELD STRENGTH BASED PHENOMENON

$$3S_C = 2S_y$$

2. Sy for 36" PIPE AT MIDLAND - 38,000 PSI

3. Using STRAIN-OVALITY RELATIONSHIP FROM J.D. WOOD, CODE ALLOWABLE OVALITY IS 2.7%

1.2. STAFF POSITION is 1.5% OVALITY

1.3. STAFF POSITION is a FACTOR OF SAFETY OF 1.8 on CODE ALLOWABLE.

1.4. MIDLAND would be SUBJECTED TO A DESIGN CRITERIA MORE RESTRICTIVE THAN REMAINDER OF INDUSTRY.

2. AVAILABLE DATA

2.1 NUREG/CR-0261 -- SUMMARIZES BATTELLE-COLUMBUS DATA FOR LARGE SCALE TESTS AS FOLLOWS

D/t	%
20	4
100	11

2.2 B. D. REDDY

SIGNIFICANT NUMBER OF DATA POINTS FOR MIDLAND 36" BURIED PIPE

D/t	% OVALITY
96	8

2.3 OTC PAPER NO. 1569

PRIVIDES 4 DATA POINTS

D/t	% OVALITY
30.7	NO FAILURE PT.
46	8
61.5	8
78.4	3

2.4 NUREG/CR-0261 -- Regarding ELBOW OVALITY indicates that OVALITY at MID PLANE of ELBOW are Higher than End So that ELBOW ALLOWABLE OVALITY will be larger than STRAIGHT PIPE at COLLAPSE POINT. This DATA indicates OVALITIES at MID PLANE Ranging from 7.6% to 14.5%. It Should Be NOTED that COLLAPSE DID NOT OCCUR and the 14.5% OVALITY REDUCED FLOW AREA BY 2%.

Conference Call - Underground Piping Thursday - Jan. 7, 1982

CPC

R. Ramanujam
D. Budzik
J. Mooney
Jim Meisenheimer

R. Bosnak | Can not accept monitoring of flow as criteria for acceptance

M. Hartsman | Screening procedure to determine portion of pipes WHERE monitoring (for functionality capability) is required

1. Perform complete calculation of pipe stresses when subjected to all loadings (sustained & occassional) — stress intensification factors as listed in NC

Sustained) Pressure, thermal expansion, overb. wt & max. expected settlement
Do on basis of smoothing pipe geometry

Occasional) Do seismic analysis (including soil displacement under seismic loading)

$2S_y$ = max stress on elastic basis & pt. of limit moment
$2/3 \times 2S_y \sim 4/3$ to account for this max

For screening criteria

Use formulas (Eqs in N.C.) Set equal to 4/3 yield stress

Purpose - Identify problem pipe sections

~~If below 4/3 yield stress put above ovality - require monitoring~~

Wherever criteria is not exceeded - pipe accepted

Where exceeded - Compare w/ allowable ovality (ovality @ local buckling)

If ovality is exceeded - rebedding required

John Brammer - If non-cat. I pipe were to fail and erode overburden over Cat I pipe - would this loss of overburden cause Cat. I pipes to be overstressed

Pg. 5, Computer model

1/20/82
Rec'd from
N. Swanberg
@ Design Audit

055930

UNDERGROUND DIESEL FUEL TANKS

Sand Settlement Due to Ground Shaking by the Earthquake

The matter pertaining to the settlement of the diesel fuel oil tanks and the pipes connected to the tanks due to seismic shakedown was discussed in the meeting of May 5, 6, and 7, 1981 between Consumers Power Company and the NRC staff. In accordance with the agreement reached in this meeting, an estimate of settlement was made for the loose sand layer indicated in boring DF-5 (See 10 CFR 50.54 (f) Response to NRC Request Regarding Plant Fll, Question 33, Figure 33-1). The estimate is based on the procedures suggested by M. Silver and H. B. Seed in their publication entitled, "Behavior of Sands Under Seismic Loading Conditions", published in report number 69-16 of College of Engineering, Uiversity of California at Berkley, December 1969; and further modified procedure by R. Pike, H. B. Seed and C. K. Chan in their publiccation entitled, "Settlement of Sands Under Multidirectional Shaking", published in Journal of Geotechnical Engineering Division of American Society of Civil Engineers, April 1975. The procedures involve using the relative density of sand as determined from standard penetration tests (SPT) and the relationships between shearing strain and vertical strain published by Silver and Seed, 1969. In this calculation a ground surface acceleration of 0.12g was used. The vertical displacement calculated from this procedure is then multiplied by three to account for multidirectional earthquake ground shaking as proposed by R. Pike, H. B. Seed and C. K. Chan, 1975.

Based on this evaluation, the estimated shakedown settlement of layer of loose sand, as indicated in the boring DF-5 is on the order of 0.04 inch which is insignificant. It is concluded that the settlement of such a small magnitude will not cause any difficulty during the operation life of the plant.