RST INSTRUMENTS LTD.

8x3 VW Jackout Earth Pressure Cell

Instruction Manual

RST Instruments Ltd.
200 – 2050 Hartley Avenue
Coquitlam, B.C. Canada V3K 6W5
Tel: (604) 540-1100
Fax: (604) 540-1005
e-mail: info@rstinstruments.com

8x3 VW Jackout Earth Pressure Cell Instruction Manual

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1 INTRODUCTION

The Jackout Earth Pressure Cell, as shown in Figure 1, measures the total stress at a face of a structural element. The instrument consists of a pressure cell and a hydraulic jack. The hydraulic jack is used to provide solid contact with the soil while the concrete is poured. The pressure cell is where the soil contact takes place. It is made entirely from stainless steel. The pressure transducer senses the pressure of the hydraulic fluid and outputs a proportional electrical signal.

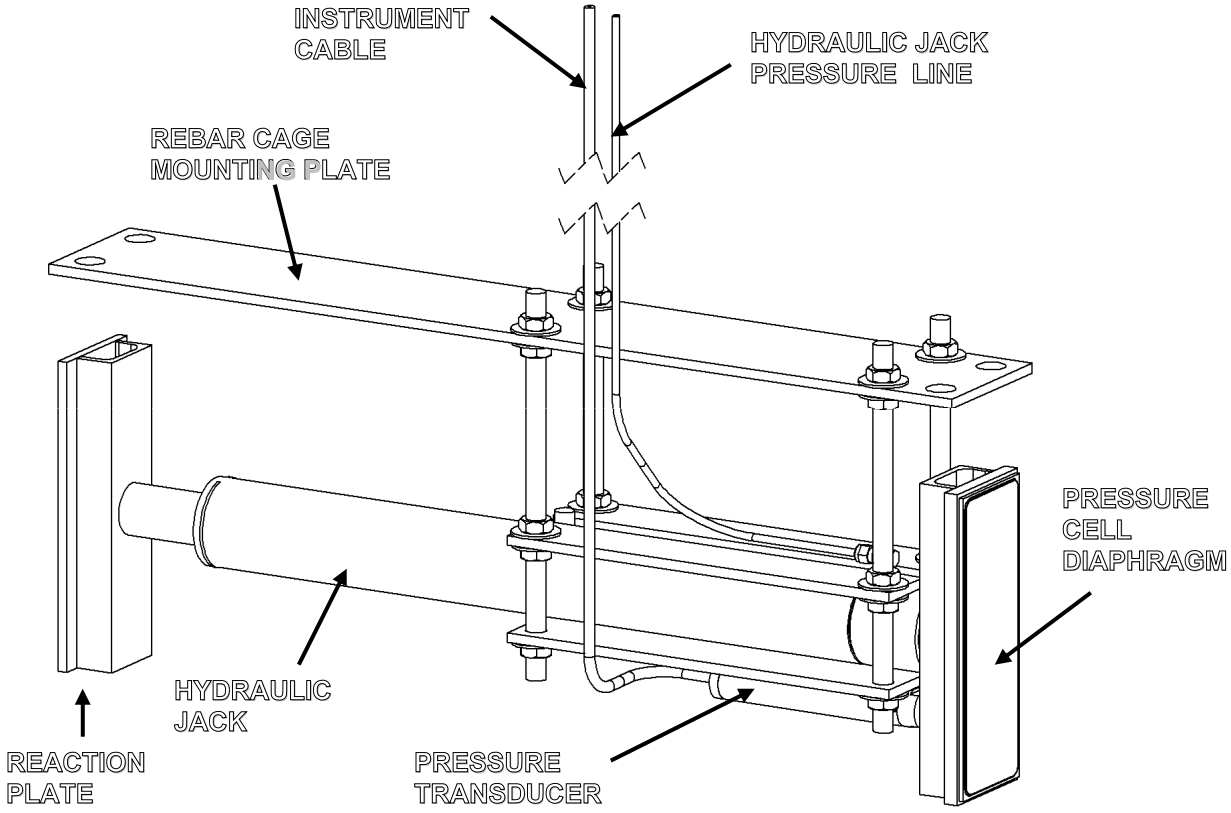

Figure 1: The Jackout Earth Pressure Cell

First, the instrument is mounted directly into the rebar cage or against another rigid structure. Then, the hydraulic jack is activated until the pressure cell makes solid contact with the soil. Finally, the concrete is poured and the instrument effectively measures the total stress of the soil (the effective stress due to the soil together with the pore water pressure in the voids between soil grains).

2 INSTALLATION

Before the site installation, the VW Pressure Transducer should be checked. The resistance between the gauge leads (Red and Black wires) should be approximately 180Ω. The resistance between the thermistor leads (Green and White wires) should be approximately 3kΩ at room temperature, and it should decrease with increasing temperature, i.e. when someone squeezes the instrument. Finally, there should be infinite resistance between the shield and the other leads.

The instrument comes fully calibrated, ready for installation, which generally includes these steps:

1. Mount the instrument in the rebar cage by using steel wire through the four mounting holes as shown in Figure 2. It may be easier to weld one side of the mounting plate directly to the rebar. The diaphragm plate must end up parallel to the soil before the hydraulic jack is deployed as shown in Figure 3, and thus the mounting plate should be level.

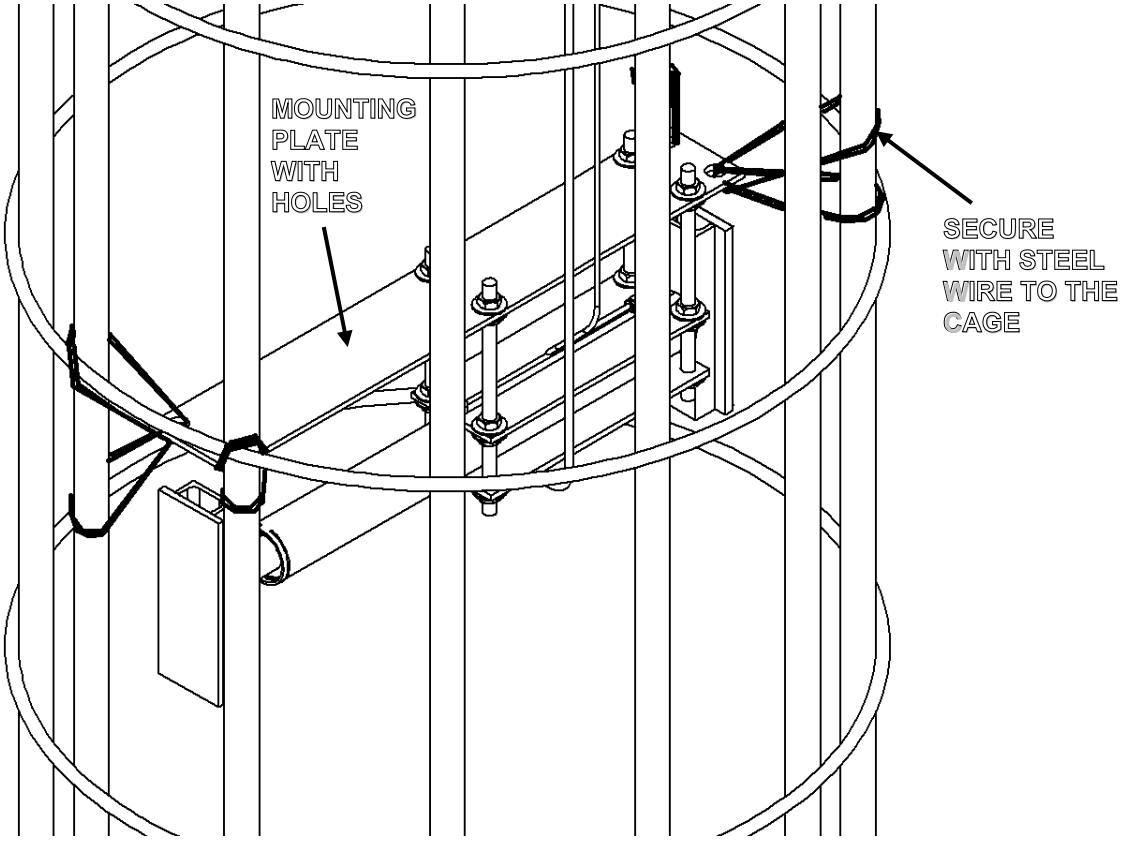

Figure 2: Mounting Into Rebar Cage

2. Install the rebar cage as shown in Figure 3.

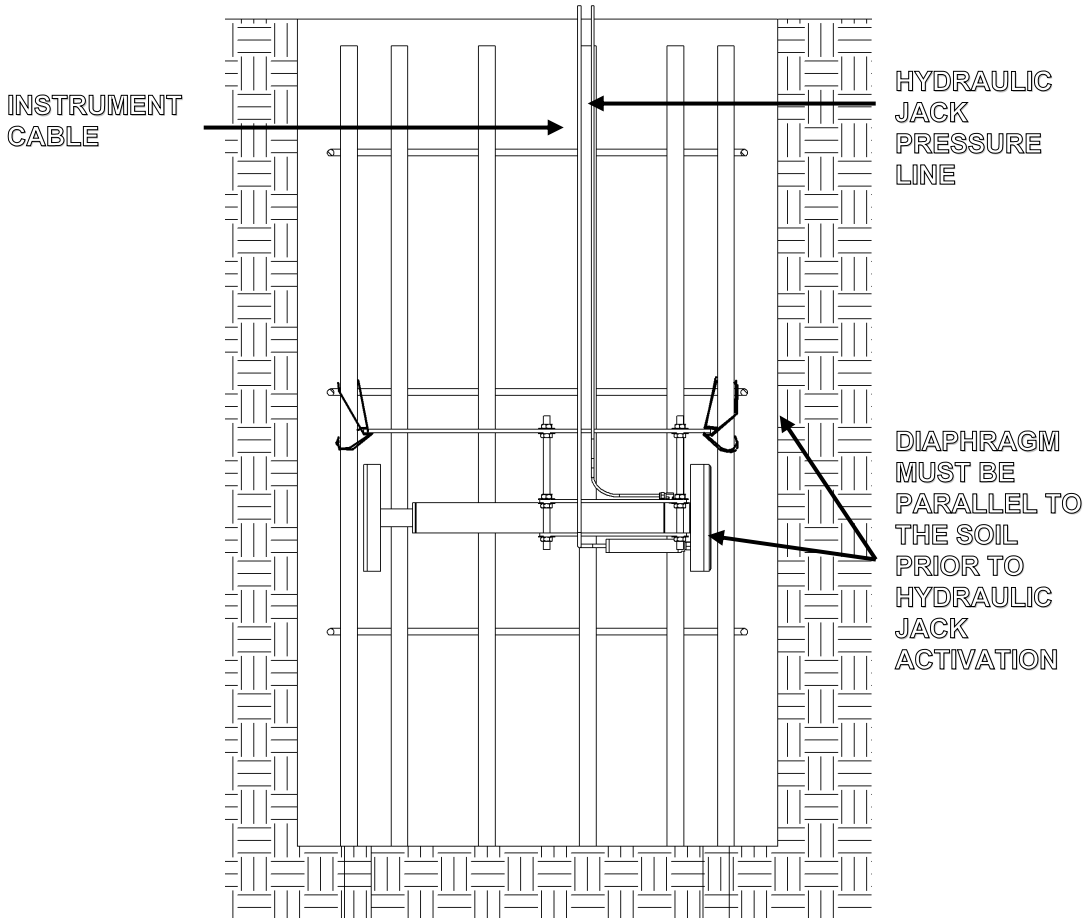

Figure 3: Installing the Rebar Cage

3. Hook up the instrument cable to the RST Vibrating Wire Readout by matching the five wire colors. The black and red wires carry the frequency signal that is proportional to the vibrating wire strain. The green and white wires are connected to the thermistor. The shield is the exposed wire made from the cable shield.
4. Connect the hydraulic jack pressure line to a hydraulic pump (a hand pump is sufficient) that is capable of approximately 150psi.

From this point on, always monitor the instrument pressure and make sure it does not exceed the pressure transducer's capacity (50psi). If that pressure is exceeded, immediately turn off the hydraulic pump and depressurize the hydraulic line until the preload pressure is at most 50% of capacity.

5. Start the hydraulic pump at approximately 15psi to get the jack moving. If possible, visually check that the jack is moving.
6. The reaction plate, as shown in Figure 1, will hit the soil first since it is connected to the hydraulic piston. Make sure that the instrument remains oriented after this happens. If the instrument changes orientation significantly then stop the pump immediately and try to make the diaphragm plate parallel to the soil by adjusting the mounting plate.
7. It may be necessary to increase the pump pressure past 15psi to make the diaphragm end move. Increase the pressure to 30psi if necessary. The deployed instrument is shown in Figure 4.

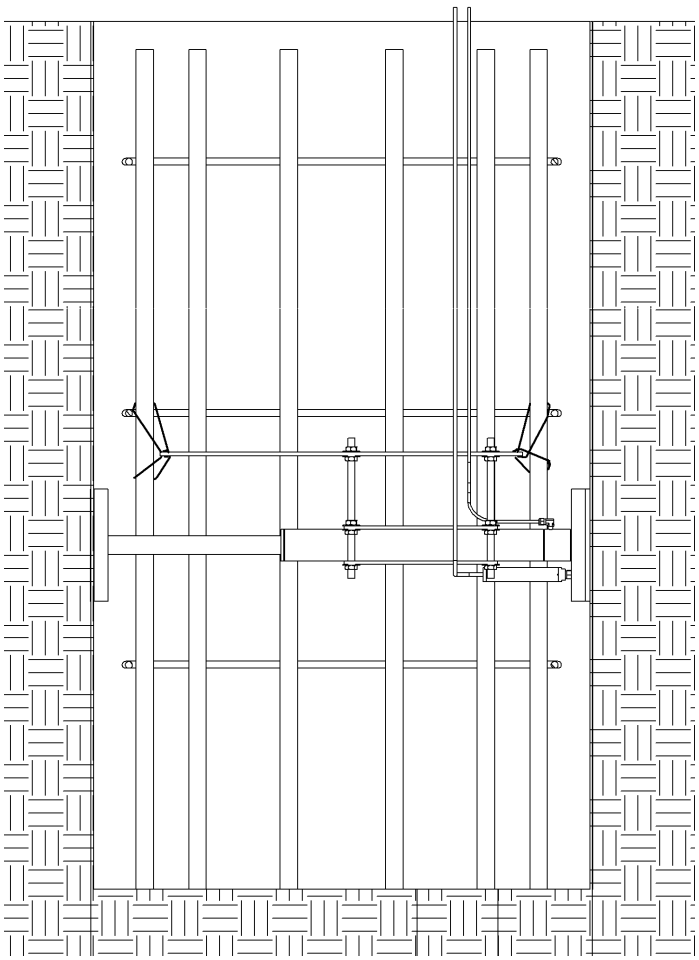

Figure 4: Deployed Jackout Earth Pressure Cell

8. There will be a sharp spike in cell pressure once the diaphragm side hits the soil (i.e. the instrument becomes fully extended). Carefully monitor the pressure at this point. The diaphragm must solidly contact the soil since otherwise the concrete may go in between that critical interface and adversely affect the measurements.

9. It is recommended to increase the cell preload to five psi above the concrete pressure. The concrete pressure is proportional to depth, and may be estimated to increase approximately one psi for each foot of depth. Thus, if the instrument will be installed six feet deep, then the preload pressure should be eleven psi:

   Cell Preload = 5psi + 1psi/ft * Cell Depth In Concrete = 5+1*6 = 11psi

10. Tremie the concrete. Do not pour directly on the instrument.
11. Wait until the concrete has set.
12. Record the total soil pressure.
13. Vent the hydraulic jack line.

3 OPERATION

After the installation, the measurements may be obtained by using RST Vibrating Wire Readouts or Data Loggers. Connect the five wires by matching the wire colors. The black and red wires carry the frequency signal that is proportional to the vibrating wire strain. The green and white wires are connected to the thermistor. The shield is the exposed wire made from the cable shield.

The readouts will output the pressure in Digits (Hz^2*10^-3) and the calibration factor (found on the particular calibration sheet) may be used to convert to pressure. The readouts will output the temperature in °C. If an Ohmmeter is used directly on the green and white wires, then use the equation or table in the appendix.

APPENDIX

The following equation may be used to convert the measured thermistor resistance R (Ω) to temperature T (°C).

$$T = \frac{1}{1.4051*10^{-3} + 2.369*10^{-4} * \ln(R) + 1.019*10^{-7} * (\ln(R))^3} - 273.2$$

The following table may be used as well:

Table 1: Thermistor Resistance (Ω) versus Temperature (°C)

Ohms	Temp	Ohms	Temp	Ohms	Temp	Ohms	Temp	Ohms	Temp
201.1K	-50	16.60K	-10	2417	+30	525.4	+70	153.2	+110
187.3K	-49	15.72K	-9	2317	31	507.8	71	149.0	111
174.5K	-48	14.90K	-8	2221	32	490.9	72	145.0	112
162.7K	-47	14.12K	-7	2130	33	474.7	73	141.11	113
151.7K	-46	13.39K	-6	2042	34	459.0	74	137.2	114
141.6K	-45	12.70K	-5	1959	35	444.0	75	133.6	115
132.2K	-44	12.05K	-4	1880	36	429.5	76	130.0	116
123.5K	-43	11.44K	-3	1805	37	415.6	77	126.5	117
115.4K	-42	10.86K	-2	1733	38	402.2	78	123.2	118
107.9K	-41	10.31K	-1	1664	39	389.3	79	119.9	119
101.0K	-40	9796	0	1598	40	376.9	80	116.8	120
94.48K	-39	9310	+1	1535	41	364.9	81	113.8	121
88.46K	-38	8851	2	1475	42	353.4	82	110.8	122
82.87K	-37	8417	3	1418	43	342..2	83	107.9	123
77.99K	-36	8006	4	1363	44	331.5	84	105.2	124
72.81K	-35	7618	5	1310	45	321.2	85	102.5	125
68.30K	-35	7252	6	1260	46	311.3	86	99.9	126
64.09K	-33	6905	7	1212	47	301.7	87	97.3	127
60.17K	-32	6576	8	1167	48	282.4	88	94.9	128
56.51K	-31	6265	9	1123	49	283.5	89	92.5	129
53.10K	-30	5971	10	1081	50	274.9	90	90.2	130
49.91K	-29	56.92	11	1040	51	266.6	91	87.9	131
46.94K	-28	5427	12	1002	52	258.6	92	85.7	132
44.16K	-27	5177	13	965.	53	250.9	93	83.6	134
39.13K	-25	4714	15	895.8	55	236.2	95	79.6	135
36.86K	-24	4500	16	863.3	56	229.3	96	77.6	136
34.73K	-23	4297	17	832.2	57	222.6	97	75.8	137
32.74K	-22	4105	18	802.3	58	216.1	98	73.9	138
30.87K	-21	3922	19	773.7	59	209.8	99	72.2	139
29.13K	-20	3748	20	746.3	60	203.8	100	70.4	140
27.49K	-19	3583	21	719.9	61	197.9	101	68.8	141
25.95K	-18	3426	22	694.7	62	192.2	102	67.1	142
24.51K	-17	3277	23	670.4	63	186.8	103	65.5	143
23.16K	-16	3135	24	647.1	64	181.5	104	64.0	144
21.89K	-15	3000	25	624.7	65	176.4	105	62.5	145
20.70K	-14	2872	26	603.3	66	171.4	106	61.1	146
19.58K	-13	2750	27	582.6	67	166.7	107	59.6	147
18.52K	-12	2633	28	562.8	68	162.0	108	58.3	148
17.53K	-11	2523	29	543.7	69	157.6	109	56.8	149
								55.6	150

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200 - 2050 Hartley Avenue, Coquitlam, British Columbia, Canada V3K 6W5

CALIBRATION DATA SHEET
Vibrating Wire TEPC 10pt Calibration

Customer:	[redacted]	
Work Order:	[redacted]	
Model:	JOPC-V	
Serial Number:	**TP0332**	
Mfg Number:	04-12833	
Range:	50	PSI
Date of Calibration	29-Nov-04	
Temperature:	16.3	°C
Cable Length	18.0	ft
Cable Colour Code:	red / black (coil)	green / white (thermistor)
Thermistor type:	3	Kohms

Average Pressure (psi)	Average Reading (B units)	Calculated pressure (psi)	Linearity F.S. Error (%)	Polynomial Fit (% FS)
5.0	8851.3	6.46	2.93	0.84
10.0	8637.2	10.28	0.56	-0.28
15.0	8397.7	14.55	-0.91	-0.63
20.0	8138.3	19.17	-1.66	-0.51
[illegible]	7[illegible]	24.0[illegible]	[illegible]	[illegible]
30	[illegible]	29.[illegible]	[illegible]	8
35.0	[illegible]	34[illegible]	[illegible]	14
[illegible]	7.6	39[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	4[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	5[illegible]	1	0.55
[illegible]	[illegible]	[illegible]ro	2	0.84

Linear Calibration factor: **C.F.=** **0.01782 psi / B unit**
Regression Zero: **At Calibration Bi =** **9214 B unit**

Polynomial Gage Factors **A: -1.30201E-06** **B: 0.0020249** **C: 89.501**

Pressure is calculated with the following equation:
Linear P(psi) = C.F. x (Li - Lc) - [Tk (Ti - Tc)] + [0.014504 (Bi - Bc)]
Polynomial, $P(psi)=A(Lc)^2+BLc+C+Tk(Tc-Ti)-[0.014504(Bc-Bi)]$

PRE-SHIPPING ZERO READINGS:	VW2104 Pos. B (Li)	TEMP °C (Ti)	BARO (Bi)
Date: 30-Nov-04	9002	17.5	1027.9

Li, Lc = initial (at installation) and current readings
Ti, Tc = initial (at installation) and current temperature, in°C
Bi, Bc = initial (at installation) and current barometric pressure, in millibars
0.014504 = constant for psi / millibar

Pressure Reference: Crystal Digital Gauge: M/N IS33-36/300PSI S/N 2535-919715 Calibrated Annually to National Standards
RST VW Reference Readout: M/N VW2104 S/N 1154 Calibrated Annually to National Standards

Applied Science Technologists and Technicians of British Columbia 22724 A. C. AL CULLEY ASCT

Calibrated by: Corey Christen CC Date: 30-Nov-04

This instrument has been calibrated using standards traceable to the NIST in compliance with ANSI Z540-1

Document Number.: LPL0031D

Tel: (604) 540-1100 Facsimile: (604) 540-1005 Toll Free: 1-800-665-5599 e-mail: info@rstinstruments.com www.rstinstruments.com

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