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Design, Development and Performance Evaluation of Eddy Current Displacement Sensor Based Pressure Sensor with Target Temperature Compensation

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ABSTRACT

In Aerospace applications, pressure measurement plays a vital role as it serves as one of the input to onboard controller to aid decision- making on initiating or terminating some of the critical events. In this paper, the design aspects of pressure sensor using linear eddy current displacement sensor (ECDS) are presented along with its performance evaluation. The static calibration is carried out to select the best position of ECDS in the proposed pressure sensor. The effect of target temperature on sensor output is presented with test results to aid compensation. A compensation algorithm is developed to minimise the error due to target temperature. The developed compensation algorithm is validated using thermal calibration. The designed pressure sensor is calibrated using Arson dynamic pressure calibrator to evaluate its bandwidth. The calibration results are analysed to aid future sensor design towards improvement of accuracy, bandwidth and miniaturisation.

Keywords: Eddy current principle; Non-contact transduction; Piecewise linearisation; Calibration; Harsh environment

1. INTRODUCTION

In Aerospace applications, strain gauge type pressure sensors play a vital role in pressure measurement due to their excellent repeatability and reliability[1-3]. In strain gauge type pressure sensor, diaphragm converts applied pressure into proportional strain. Four strain gauges connected with wheat stone bridge act as transduction element which converts the strain into proportional output voltage. But, these sensors have the following limitations.

(a) Service temperature of strain gauge is limited
(b) Requires compensation beyond compensating temperature
(c) Compensation is limited only up to operating temperature

Mostly, long tubes are used to solve the temperature problem of strain gauge type pressure sensor in static test environment. But, the tubing method reduces the bandwidth of the sensor due to resonance cavity[4,5] formed by tube and the cavity of sensor. The temperature problems acquainted with the strain gauge type pressure sensors are mainly due to strain gauges[6] and contact transduction method. Hence, the non-contact transduction principles like optical, capacitive, inductive and magnetic[7-9] shall be employed to overcome the temperature problems. The applications of capacitive method and optical method are limited to static measurements and laboratory environment respectively. The magnet based pressure sensor is not preferred in harsh environment as it requires frequent calibration to meet the specified accuracy.

In chamber pressure measurement during static testing of aero space engines, harsh environment means the diaphragm temperature and the transient pressure generated by combustion gases. From the data base, the maximum diaphragm temperature is 340 °C at 20 s and the minimum rise time of the transient pressure is about 4 ms. The maximum vibration and shock levels experienced by the pressure sensor are 5 g_{rms} (20-2000Hz) and 20 g half sine wave for 11 ms duration, respectively.

In pressure sensor using linear eddy current displacement sensor (ECDS) shown in Fig. 1, when the pressure is applied on the sensing diaphragm, it moves towards ECDS. This increases the eddy current induced on the target surface and reduces the inductance of the ECDS coil. The conditioner circuit available in ECDS converts the change in inductance of the coil in to the corresponding output voltage. Aluminium is used as target material due to its high conductivity and light weight. The target diameter of 1.5 times the diameter of the shielded ECDS is required to achieve better resolution. The diameter of ECDS is 12 mm. Hence, the diameter of the target is 18 mm. The skin depth of the Aluminium target is 82 µm. The thickness of the target more than three times the skin depth is preferred for precision measurement. Further, the target thickness recommended for Aluminium is 250 µm[10]. The dimensions of circular Aluminium target are 18 mm x 250 µm. The pressure sensor using ECDS with Aluminium target is not preferred due to loading effect, bonding problem and compensation.

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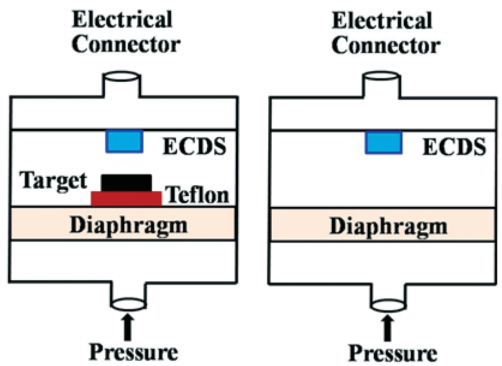


Figure 1. Pressure sensor using ECDS with and without target.

The diaphragm meets the dimensional requirement of the target and suits the harsh environment applications. In case of pressure sensor without target, diaphragm acts as the target and the primary sensing element. The major issues associated with pressure sensor using ECDS are

(i) Selection of best position of ECDS and
(ii) Target temperature compensation

Any one of the following two compensation schemes can be employed to compensate the effect of target temperature on pressure sensor output.

(a) Dual ECDS scheme and
(b) Temperature sensor scheme

In dual ECDS scheme, ECDS (A) senses the diaphragm deflection corresponding to the applied pressure due to high temperature gas and ECDS (B) senses mainly the diaphragm temperature as it is positioned near periphery of diaphragm. Hence, the differential output of ECDS (A) and ECDS (B) provides the minimum error due to target temperature. In temperature sensor scheme, ECDS measures the deflection of diaphragm against the applied pressure and its output contains components related to pressure and target temperature. Temperature sensor measures diaphragm temperature and aids target temperature compensation.

Researchers analysed the temperature compensation of ECDS[11,12] but rarely pointed out the target temperature compensation[13]. In this paper, selection of ECDS, design of pressure sensor using ECDS, selection of best position of ECDS and the performance evaluation of developed pressure sensor are presented with experimental results. A target temperature compensation algorithm is developed to achieve the measured value of accuracy ± 1% FS and stability ± 0.1% FS against target temperature variation up to 120 °C.

2. PROPOSED PRESSURE SENSOR WITH TARGET TEMPERATURE COMPENSATION

In the proposed pressure sensor as shown in Fig. 2, ECDS senses the deflection of the diaphragm and provides the output proportional to the applied pressure. A surface mount thermocouple is used to measure diaphragm temperature . The compensation algorithm uses ECDS output and thermocouple output as input and provides pressure value close to true pressure.

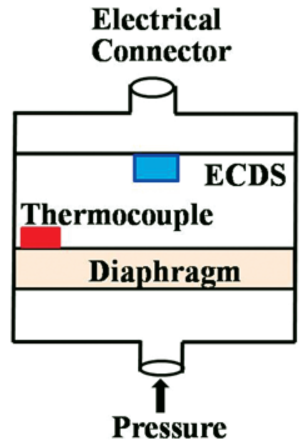


Figure 2. Scheme of proposed pressure sensor.

3. DESIGN ASPECTS OF PRESSURE SENSOR USING ECDS

The design of pressure sensor using ECDS with target temperature compensation is divided into four major parts.

(a) Diaphragm
(b) ECDS
(c) Target temperature compensation scheme and
(d) Compensation algorithm

3.1 Design of Sensing Diaphragm

In the proposed pressure sensor, the transduction requirement is displacement. The circular diaphragm yields more deflection than rectangular diaphragm for the given pressure[14]. Hence, circular diaphragm is selected. The corrugated diaphragm has advantages over flat diaphragm like better sensitivity and natural frequency[15]. Due to ease of design and fabrication, flat diaphragm is selected.

Diaphragm material 17-4 PH has high yield strength (1000 MPa) with young modulus 197 GPa and medium corrosion resistance than other diaphragm materials. Hence, 17-4 PH is selected as diaphragm material. The effective diaphragm diameter is taken as 24 mm to evaluate the proposed pressure sensor. The rated and safe overload pressure of the sensor are taken as 6.89 MPa and 10.34 MPa, respectively. In case of diaphragm design, finite element analysis (FEA) is more accurate than analytical solution[15]. Hence, FEA is carried out using ANSYS software version R17.1 and thickness of the diaphragm is selected as 1.0 mm. The natural frequency of the diaphragm (f_n) is calculated as 16847 Hz.

3.2 Selection of Eddy Current Displacement Sensor

The maximum deflection of the designed diaphragm under safe load is 0.17 mm. The minimum gap of 1 mm between the diaphragm and ECDS is required for non-contact transduction. Hence, the range of ECDS is selected as 1.0 mm to 1.5 mm. Shielded ECDS is selected as it requires smaller target than unshielded ECDS[10]. Since the diameter of diaphragm is 24 mm, diameter of ECDS cannot be more than 12 mm. The linear eddy current displacement sensor (Make : Omega, Model : LD 701-1/2) is selected as it meets the requirements.

3.3 Selection of Target Temperature Compensation Scheme

When the target temperature increases, the resistance of the target material increases and the eddy current flows on the target surface decreases. In response, inductance of the coil increases, which increases the sensor output voltage. This leads to measurement error beyond the specified limits. Hence, target temperature compensation is required to minimise the error due to target temperature. The dual ECDS scheme is not considered due to the following limitations.

(a) Error due to two sensors
(b) Mutual inductance
(c) Difficulties in positioning of two ECDS
(d) High cost, and
(e) Diaphragm temperature is not uniform

Temperature sensor scheme is selected as it is economical, flexible and easy to configure. Since cement-on thermocouple (Make: Omega, Model : CO1K-StyleI) is compact, flexible, surface mountable and meeting the requirements of target temperature measurement, it is selected.

3.4 Target Temperature Compensation Algorithm

The calibration results of pressure sensor using ECDS vary from one target temperature to another one. Hence, the target temperature compensation algorithm is developed using the logic illustrated in Fig. 3 to minimise the error due to target temperature. Piece wise compensation technique is used to achieve the measured value close to true pressure. The developed target temperature compensation algorithm serves better to extract true pressure value from the recorded test data.

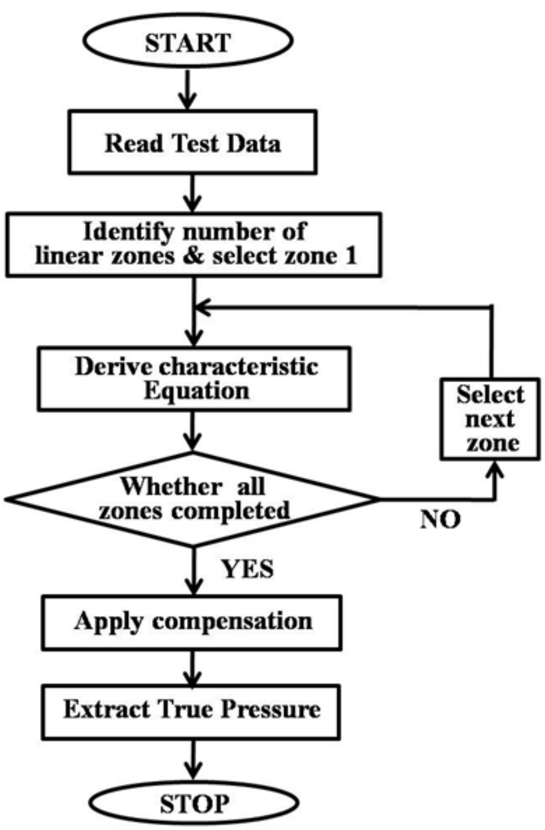


Figure 3. Flowchart illustration of target temperature compensation algorithm.

4. TEST RESULTS AND DISCUSSIONS

The pressure sensor using ECDS is designed, fabricated and calibrated to evaluate its performance. FEA is carried out and the results are as given in Table 1.

Table 1. Finite element analysis simulation results

Diaphragm thickness (t) mm	Pressure @ 6.89 MPa		Pressure @ 10.34 MPa	
	D_{max} (mm)	σ_{max} (MPa)	D_{max} (mm)	σ_{max} (MPa)
1.4	0.042	328	0.063	492
1.3	0.052	365	0.078	547
1.2	0.065	466	0.098	699
1.1	0.085	517	0.128	776
1.0	0.113	609	0.170	914

Figures 4 shows the deflection and stress profile of the designed diaphragm under rated pressure. The thickness of the diaphragm is selected as 1.0 mm as it yields maximum deflection under safe over load with the stress less than yield strength.

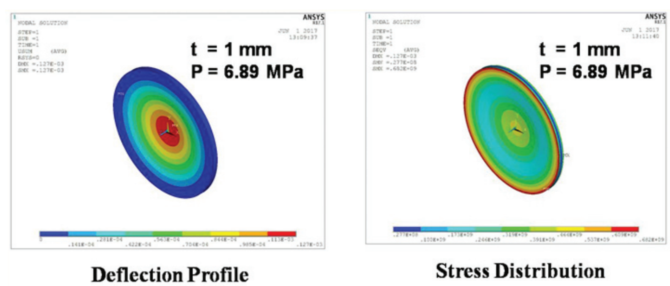


Figure 4. Deflection profile and stress distribution of diaphragm under rated load.

The selected ECDS is calibrated using micrometer as displacement standard[16] to ascertain the useful range of ECDS for the selected diaphragm material. The calibration results of ECDS with diaphragm and Aluminium target are as given in Table 2.

Figure 5 shows the calibration curves of ECDS with representative diaphragm and Aluminium target. From the displacement calibration results, the useful range of ECDS with diaphragm and Aluminum target are 1 mm to 1.5 mm and 0 mm to 0.4 mm, respectively. Aluminum target is not selected due to its limited range and zero near gap.

The selected ECDS is assembled with diaphragm to realise the designed pressure sensor. Static pressure calibration is carried out using dead weight tester. ECDS is fixed at 1.5 mm from the diaphragm surface. Eleven point calibration is carried out at 23 ºC ± 2°C and the results are as given in Table 3. The similar procedure is repeated for ECDS positions 1.4 mm, 1.3 mm, 1.2 mm, and 1.1 mm to select the best position of ECDS.

The calibration constants like differential full scale output (FSO), linearity (L), repeatability (R), hysteresis (H) and

Table 2. Calibration results of ECDS

Distance (mm)	ECDS output voltage with diaphragm (V_{DC})		Distance (mm)	ECDS output voltage with aluminium target (V_{DC})	
	Run 1	Run 2		Run1	Run2
1.0	1.082	1.081	0	1.026	1.028
1.1	2.761	2.763	0.1	2.634	2.648
1.2	4.042	4.044	0.2	4.603	4.602
1.3	5.274	5.272	0.3	6.702	6.713
1.4	6.946	6.942	0.4	8.767	8.776
1.5	8.772	8.778	0.5	9.532	9.532
1.4	6.962	6.964	0.4	8.758	8.768
1.3	5.263	5.257	0.3	6.697	6.696
1.2	4.036	4.032	0.2	4.573	4.573
1.1	2.763	2.768	0.1	2.621	2.634
1.0	1.085	1.088	0	1.024	1.025
Calibration constants	ECDS with diaphragm			ECDS with Aluminium target	
Sensitivity (V/mm)	14.93			18.01	
Linearity (± %FS)	3.73			6.20	
Hysteresis (± %FS)	0.29			0.35	
Repeatability (± %FS)	0.08			0.17	
Accuracy (± %FS)	3.74			6.21	
Near gap (mm)	1			0	
Useful range (mm)	1 - 1.5			0 - 0.4	

accuracy (A) are calculated and given in Table 3. The calibration curves of pressure sensor with ECDS at different positions are as shown in Fig. 6. The best position of ECDS is selected as 1.4 mm as it is better than other positions.

The thermocouple is bonded on the diaphragm to evaluate the performance of the designed pressure sensor against target temperature. Hot blower is used to conduct target temperature test. The test results are as given in Table 4. The following design changes are implemented to reduce the target temperature.

(a) Ventilation holes and

(b) Thermal isolation washers

The target temperature test is conducted on the pressure sensor with modified design shown in Fig. 7 and the results are as given in Table 4.

Figure 8 shows that the performance of modified pressure sensor is better. The ECDS temperature test is conducted using an additional thermocouple bonded on ECDS to measure ECDS temperature.

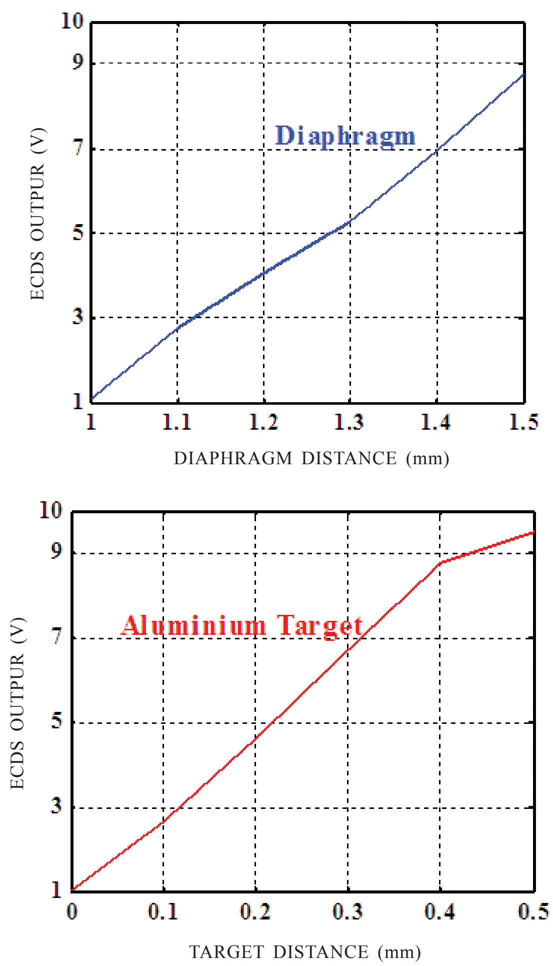


Figure 5. Calibration curves of ECDS with diaphragm and Aluminium target.

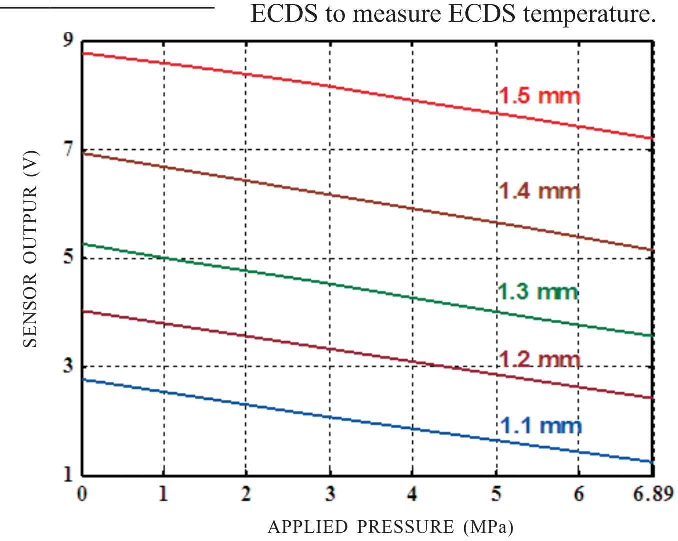


Figure 6. Calibration curves of the pressure sensor at different positions of ECDS from the diaphragm.

Figure 7. Various stages of assembly of pressure sensor with modified design against target temperature.

Table 3. Calibration results of pressure sensor with different positions of ECDS

Applied pressure (MPa)	Pressure sensor output voltage (V) position of ECDS from the diaphragm									
	1.1 (mm)		1.2 (mm)		1.3 (mm)		1.4 (mm)		1.5 (mm)	
	R 1	R 2	R 1	R 2	R 1	R 2	R 1	R 2	R 1	R 2
0	2.760	2.764	4.043	4.041	5.278	5.279	6.939	6.936	8.770	8.772
1.378	2.442	2.452	3.708	3.714	4.921	4.928	6.583	6.581	8.509	8.514
2.756	2.142	2.149	3.386	3.392	4.589	4.597	6.235	6.232	8.209	8.213
4.134	1.840	1.846	3.058	3.072	4.246	4.254	5.875	5.880	7.877	7.885
5.512	1.552	1.538	2.735	2.742	3.901	3.912	5.514	5.518	7.562	7.568
6.8947	1.242	1.242	2.412	2.410	3.560	3.563	5.153	5.159	7.197	7.199
5.512	1.542	1.529	2.721	2.732	3.889	3.899	5.502	5.506	7.574	7.578
4.134	1.834	1.839	3.052	3.061	4.239	4.244	5.869	5.872	7.860	7.869
2.756	2.143	2.143	3.384	3.381	4.589	4.593	6.233	6.236	8.196	8.199
1.378	2.453	2.451	3.712	3.710	4.935	4.931	6.585	6.588	8.498	8.498
0	2.762	2.762	4.046	4.044	5.281	5.282	6.940	6.939	8.767	8.768
FSO (V)	1.520		1.631		1.717		1.782		1.573	
L (± % FS)	0.59		0.37		0.50		0.38		2.61	
H (± % FS)	0.73		0.86		0.82		0.68		1.08	
R (± % FS)	0.92		0.86		0.64		0.34		0.57	
A (±%FS)	1.31		1.27		1.15		0.85		2.88	

Table 4. Target temperature test results of pressure sensor

Target temp. (ºC)	Pressure sensor output (V)	
	Without modified design	With modified design
30	6.946	6.943
35	6.952	6.948
40	6.959	6.954
45	6.966	6.959
50	6.974	6.965
55	6.982	6.973
60	6.991	6.981
65	7.006	6.989
70	7.014	6.997
75	7.010	7.011
80	7.002	7.025
85	6.994	7.043
90	6.969	7.065
95	6.926	7.023
100	6.812	6.909
105	6.608	6.699
110	6.296	6.391
115	5.868	5.961
120	5.384	5.473

The compensated temperature of ECDS is 60 °C. From the ECDS temperature profile as shown in Fig. 9, the temperature of ECDS is 50 °C even when the diaphragm temperature is 120 °C for the short period. The developed target temperature compensation algorithm has been verified using the calibration data at 50 ºC. The verification test results are as given in Table 5.

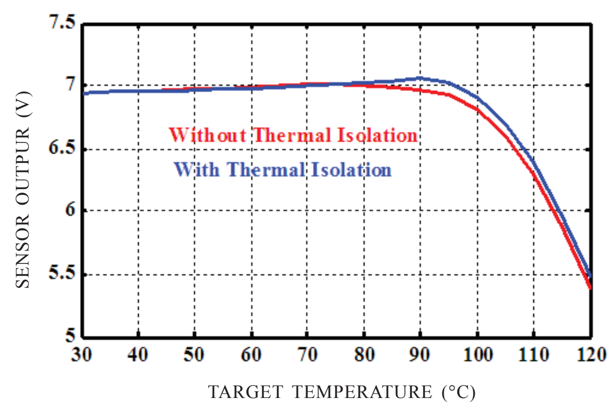


Figure 8. Comparison of target temperature effect on pressure sensor output with and without modified design.

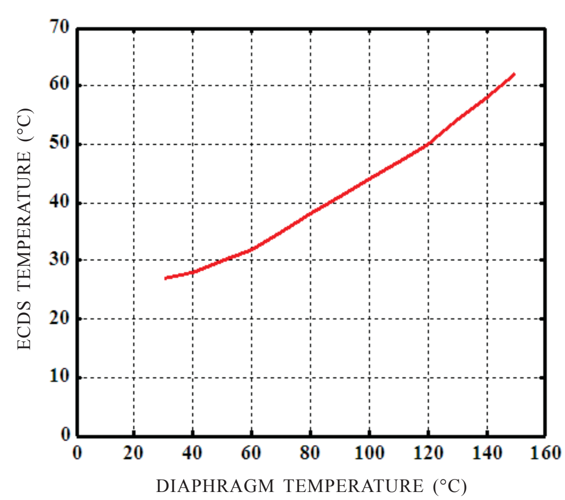


Figure 9. ECDS temperature profile.

Table 5. Target temperature compensation algorithm verification results

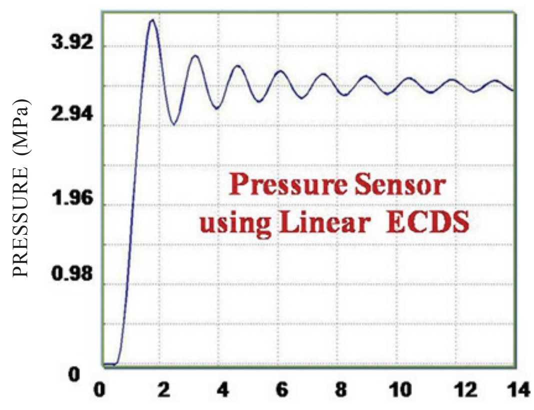
Calibration @ 50 ºC			Without compensation				With compensation			
Applied pressure (MPa)	Sensor output (V)		Calculated pressure (MPa)		Error ± % FS		Calculated pressure (MPa)		Error ± % FS	
	Run 1	Run 2	Run1	Run 2	Run 1	Run 2	Run 1	Run 2	Run 1	Run 2
0	6.959	6.958	0.066	0.062	0.95	0.90	0.012	0.015	0.17	0.22
1.378	6.604	6.603	1.305	1.309	1.06	1.00	1.382	1.386	0.05	0.11
2.756	6.257	6.253	2.645	2.660	1.61	1.39	2.721	2.736	0.51	0.28
4.134	5.889	5.887	4.066	4.073	0.99	0.88	4.141	4.149	0.11	0.22
5.512	5.534	5.532	5.436	5.444	1.10	0.99	5.511	5.519	0.01	0.10
6.89	5.174	5.173	6.826	6.830	0.99	0.94	6.901	6.905	0.09	0.14
5.512	5.531	5.532	5.448	5.444	0.93	0.99	5.523	5.519	0.16	0.10
4.134	5.889	5.882	4.066	4.093	0.99	0.60	4.141	4.168	0.11	0.50
2.756	6.255	6.254	2.653	2.656	1.50	1.45	2.729	2.733	0.40	0.34
1.378	6.606	6.604	1.297	1.305	1.17	1.06	1.374	1.382	0.06	0.05
0	6.960	6.958	0.069	0.062	1.01	0.90	0.008	0.015	0.11	0.22

The sensitivity of pressure sensor at 23 °C is used to convert the sensor output in to the corresponding pressure value during the static testing of aerospace engines. But, the diaphragm temperature increases as the burn time of engine increases. The developed compensation algorithm reads the diaphragm temperature and selects the characteristic equation corresponding to the diaphragm temperature zone. The characteristic equation is used to get the measured pressure value with minimum error due to target temperature. From Table 5, the accuracy of pressure sensor with and without compensation are ± 0.51% FS and ± 1.61% FS, respectively. Hence, it is shown that the developed compensation algorithm improves the performance of the pressure sensor against target temperature variations up to 120 °C. The thermal stability is calculated as 0.0015 %FS/°C.

The designed pressure sensor is calibrated using the Arson dynamic calibrator (Make : TMS, Model: 9907C) to evaluate its bandwidth. The strain gauge type pressure sensor of the same range and diaphragm dimensions is also calibrated for comparison. Figure 10 shows the step responses of the designed pressure sensor and the strain gauge type pressure sensor. From the calibration results, the rise time and bandwidth of these two sensors are the same and calculated as 0.45 ms and 777 Hz respectively. Hence, the non-contact transduction does not affect the bandwidth of the pressure sensor.

The following design changes aid the pressure sensor to serve better in harsh environment.

(a) ECDS with compensated temperature up to 200 ºC
(b) Non-contact temperature sensor.



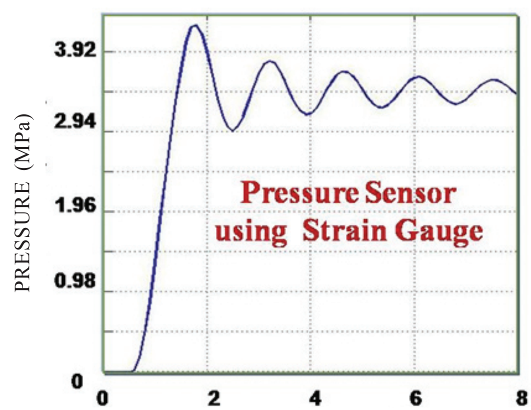


Figure 10. Step responses of pressure sensor.

5. CONCLUSIONS

In this paper, the design, fabrication and evaluation of pressure sensor using ECDS have been presented with analysis of test results. The best position of ECDS has been selected through experimental results. The accuracy of the developed pressure sensor is ± 1 % FS. In the designed pressure sensor, temperature of ECDS is below its compensated temperature even when the diaphragm temperature is 120 °C. The developed compensation algorithm serves better up to 120ºC with accuracy ± 0.6 % FS. From the dynamic calibration results, it is shown that the bandwidth of the designed pressure sensor is not affected by the non-contact transduction. From the analysis of calibration and target temperature test results, it is evident that the designed pressure sensor helps to overcome the temperature limitations of the strain gauge type pressure sensor without compromising the accuracy and bandwidth .

REFERENCES

1. Zarfl, C.; Schmid, P. & Schmid, U. A novel miniaturized sensor for combined static and dynamic pressure measurements in harsh environments. *Procedia Eng.,* 2016, **168**, 782-785. doi: 10.1016/j.proeng.2016.11.255
2. Cullinane, W. & Strange, R. Gas turbine engine validation instrumentation, measurement, sensors and needs. *In* SPIE Conference on Harsh Environment Sensors, 1999, **3852**, 36-42. doi: 10.1117/12.372833
3. Kim, J.; Kim, K.; Ham, S.W.; Bae, N.H.; Park, M.K. & Min, N.K. A hydrogen pressure sensor based on bulk-micro machined silicon strain gauges. *Procedia Eng.,* 2016, **168**, 790-793. doi: 10.1016/j.proeng.2016.11.260
4. Zakrzewski, J. & Wróbel, K. Dynamic calibration of low-range silicon pressure sensors. *IEEE Trans. Inst. Meas. J.,* 2002, **51**(6), 1358-1362. doi: 10.1109/TIM.2002.808030
5. Henryk, U. & Zakrzewski, J. Experimental verification of pressure sensors dynamic models. 2003. https://www.researchgate.net/publication/260060574 (Accessed on 25 May 2017)
6. Maeder, T.; Jacq, C. & Ryser, P. Thick-film load-sensing bridges - effect of temperature and mechanical boundary conditions. *Procedia Eng.*, 2014, **87**, 180-183. doi: 10.1016/j.proeng.2014.11.613
7 Nihtianov, S. Measuring in the sub-nanometer range: Capacitive and eddy current nano-displacement sensor. *IEEE Industrial Electro. Mag.*, 2014, **8**, 6-15. doi: 10.1109/MIE.2013.2285240
8. Karl, W.J.; Powell, A.L.; Gibbs, M.R.J. & Whitehouse, C.R. A micromachined magnetostrictive pressure sensor using magneto-optical interrogation. *Sensors Actuators A Phys.*, 2000, **81**, 137-141. doi:10.1016/S0924-4247(99)00154-5
9. Potdar, A.A.; Fletcher, S. & Longstaff, A.P. Performance characterization of a new photo-microsensor based sensing head for displacement measurement. *Sensors Actuators A Phys.,* 2016, **238**, 60-70. doi: 10.1016/j.sna.2015.12.007.
10. Kaman Aerospace Division. Kaman inductive technology application guide. www.kamansensors.com/html_pages/Applications Handbook.html. (Accessed on 18 June 2017).
11. Wang, H. & Feng, Z. Ultrastable and highly sensitive eddy current displacement sensor using self temperature compensation. *Sensors Actuators A Phys.*, 2013, **203**, 362-368. doi: 10.1016/j.sna.2013.09.016.
12. Li, Q. & Ding, F. Novel displacement eddy current sensor with temperature compensation for electrohydraulic valves. *Sensors Actuators A Phys.,* 2005, **122** , 83-87. doi: 10.1016/j.sna.2005.04.008.
13. Vyroubal, D. & Lackovic, I. Target temperature effect on eddy current displacement sensing. *IEEE Sensors Application symposium,* 2015, 305-309. doi: 10.1109/SAS.2015.7133621.
14. Mohapatra, A.G. Design and implementation of diaphragm type pressure sensor in a direct tire pressure monitoring system for automotive safety applications. *Int. J. Eng. Sci. Tech*., 2011, **3**(8), 6514-6524.
15. Gawade, S.S. & Chavan, D.S. Load deflection analysis of flat and corrugated stainless steel diaphragms by theoretical and finite element method. *Int. J. Eng. Res. Appl.,* 2013, **3**(4), 799-802.
16. Raghunathan, P. & Logashanmugam, E. Design and fabrication of low cost eddy current sensor for position control applications. *Indian J. Sci. Tech.,* 2016, **9**(42). doi: 10.17485/ijst/2016/v9i42/104645.

CONTRIBUTORS

Mr K. Gobi received the BTech (Electronics Engineering) and ME (Instrumentation Engineering) from Madras Institute of Technology, Anna University, Chennai, India, in 1991 and 1997, respectively. Presently he is working as a Scientist in DRDO-Defence Research Development Laboratory, Hyderabad, India. His current research interests include : Development of non-contact transduction based pressure sensors and non-intrusive type temperature sensors for harsh environment to meet the aerospace applications.
In the present work, he is instrumental in the design, development and performance evaluation of pressure sensor with analysis of experimental results.

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In the current work, he has reviewed the design of pressure sensor and involved in the bandwidth analysis to meet static test requirements.

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