UNIVERSITAS
GADJAH MADA
Warning System Kebocoran Pipa dengan Prinsip Differential Pressure menggunakan Sensor MPX5050Dp
Muhammad Haekal Faiq, Dr. Trias Prima Satya, S.Si., M.Sc.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

DAFTAR PUSTAKA

[1] S. Ahmed, F. L. Mouël, N. S. Gislain, and L. Kouyi, "Development and analysis of a distributed leak detection and localisation system for crude oil pipelines," *Sensors*, vol. 23, no. 9, p. 4298, 2023. [Online]. Available: https://doi.org/10.3390/s23094298

[2] M. A. Adegboye, W.-K. Fung, and A. Karnik, "Recent advances in pipeline monitoring and oil leakage detection technologies: Principles and approaches," *Sensors*, vol. 19, no. 11, p. 2548, 2019. [Online]. Available: https://doi.org/10.3390/s19112548

[3] S. S. Shantanu Datta, "A review on different pipeline fault detection methods," *Measurement*, vol. 41, p. 97, 2016. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S0950423016300651

[4] American Petroleum Institute (API), "Pipeline safety excellence performance report and 2020–2022 strategic plan," 2020, accessed: 2026-06-11. [Online]. Available: https://www.api.org/-/media/apiwebsite/oil-and-natural-gas/primers/2020-api-aopl-pipeline-safety-excellence-performance-report-and-20202022-strategic-plan.pdf

[5] Kementerian Energi dan Sumber Daya Mineral, "Statistik minyak dan gas bumi tahun 2022," Direktorat Jenderal Minyak dan Gas Bumi, Tech. Rep., 2022, diakses pada 11 Juni 2026. [Online]. Available: https://migas.esdm.go.id/cms/uploads/informasi-publik/Stat_tahunan/Statistik-Migas-2022.pdf

[6] S. Nešić, "Key issues related to modelling of internal corrosion of oil and gas pipelines – a review," *Corrosion Science*, vol. 49, no. 12, pp. 4308–4338, 2007. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S0010938X07001539

[7] X. Hu and A. Neville, "Co2 erosion–corrosion of pipeline steel (api x65) in oil and gas conditions—a systematic approach," *Talanta*, vol. 267, no. 11, p. 2027, 2009. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S0043164809004773

[8] Y. Shi, J. Chang, Y. Wang, X. Zhao, Q. Zhang, and L. Yang, "Gas leakage detection and pressure difference identification by asymmetric differential pressure method," *Chinese Journal of Mechanical Engineering*, vol. 35, no. 1, p. 44, 2022. [Online]. Available: https://doi.org/10.1186/s10033-022-00697-1

[9] P. Ostapkowicz, "Leak detection in liquid transmission pipelines using simplified pressure analysis techniques employing a minimum of standard and non-standard

UNIVERSITAS
GADJAH MADA
Warning System Kebocoran Pipa dengan Prinsip Differential Pressure menggunakan Sensor MPX5050Dp
Muhammad Haekal Faiq, Dr. Trias Prima Satya, S.Si., M.Sc.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

measuring devices," *Engineering and Computational Mechanics*, vol. 113, p. 194, 2016. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S0141029616000560

[10] A. Rebassa, L. Bhatnagar, and G. Paniagua, "Parametric evaluation of compact truncated venturi flow meters," *Flow Measurement and Instrumentation*, vol. 94, p. 102475, 2023. [Online]. Available: https://doi.org/10.1016/j.flowmeasinst.2023.102475

[11] Engineering ToolBox. (2026) Orifice, nozzle and venturi flow meters. Accessed: 2026-05-10. [Online]. Available: https://www.engineeringtoolbox.com/orifice-nozzle-venturi-d_590.html

[12] MSTN International Technologies. (2023) How does the edge condition of an orifice plate affect flow measurement? Accessed: 2026-05-10. [Online]. Available: https://www.flanges-fittings.com/blog/how-does-the-edge-condition-of-an-orifice-plate-affect-flow-measurement-1661236.html

[13] M. kamal, D. bimo Aji, B. cahaya pratiwi *et al.*, *Mekanika Fluida*. Get Press Indonesia, 2024, diakses melalui Google Books. [Online]. Available: https://www.google.co.id/books/edition/MEKANIKA_FLUIDA/vqzFEQAAQBAJ

[14] W. Li, Q. Fu, and H. Gao, "Pipeline leak detection and localization based on the flow balance and negative pressure wave methods," *AIP Advances*, vol. 14, no. 11, p. 115203, November 2024. [Online]. Available: https://doi.org/10.1063/5.0235483

[15] S. Wang, D. Xu, G. Liu, T. Xue, and Y. Liu, "Application of distributed acoustic sensing technology in pipeline leakage monitoring," *Journal of Energy and Natural Resources*, vol. 13, no. 2, pp. 81–89, 2024. [Online]. Available: https://doi.org/10.11648/j.jenr.20241302.14

[16] A. Devanesan *et al.*, "Review and analysis of pipeline leak detection methods," *Journal of Petroleum Science and Engineering*, vol. 208, p. 100074, 2022.

[17] R. Kemahyanto Exaudi, Rossi Passarella and R. Zulfahmi, "Using pressure sensors towards pipeline leakage," in *2018 International Conference on Electrical Engineering and Computer Science (ICECOS)*. IEEE, 2018, pp. 89–92.

[18] R. Jafari, S. Razvarz, C. Vargas-Jarillo, A. Gegov, and F. Arabikhan, "Pipeline leak detection and estimation using fuzzy pid observer," *Electronics*, vol. 11, no. 1, p. 152, 2022. [Online]. Available: https://doi.org/10.3390/electronics11010152

UNIVERSITAS
GADJAH MADA
Warning System Kebocoran Pipa dengan Prinsip Differential Pressure menggunakan Sensor MPX5050Dp
Muhammad Haekal Faiq, Dr. Trias Prima Satya, S.Si., M.Sc.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

[19] A. Messilem, A. Azzi, A. Zeghloul, F. Saidj, H. Bouyahiaoui, and A.-S. Abdelsalam, "Single- and two-phase pressure drop through vertical venturis," *Proceedings of the Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science*, vol. 234, no. 12, pp. 2349–2359, 2020. [Online]. Available: https://doi.org/10.1177/0954406220906424

[20] G. G. Barnos *et al.*, "Determinação e análise de coeficiente de descarga de um tubo de venturi com auxílio de um sensor de diferença de pressão mpx5050," ResearchGate, 2018, accessed: 2026-05-12. [Online]. Available: https://www.researchgate.net/publication/326307616_DETERMINACAO_E_ANALISE_DE_COEFICIENTE_DE_DESCARGA_DE_UM_TUBO_DE_VENTURI_COM_AUXILIO_DE_UM_SENSOR_DE_DIFERENCA_DE_PRESSAO_MPX5050

[21] Ruang Belajar Channel. (2025) Pengertian, jenis, dan sifat-sifat fluida. Diakses pada 14 Mei 2026. [Online]. Available: https://www.ruangbelajarchannel.com/2025/06/pengertian-jenis-dan-sifat-sifat-fluida.html

[22] R. A. Serway and J. W. J. Jr., *Physics for Scientists and Engineers with Modern Physics*, 7th ed. Thomson Brooks/Cole, 2006. [Online]. Available: https://salmanisaleh.wordpress.com/wp-content/uploads/2019/02/physics-for-scientists-7th-ed.pdf

[23] D. Pratama, K. Hadiningrum, and R. F. Muldiani, "Studi awal pengaruh temperatur terhadap karakteristik aliran fluida pada belokan pipa 90° melalui simulasi," *Jurnal MIPA*, vol. 11, no. 2, pp. 68–71, 2022. [Online]. Available: https://ejournal.unsrat.ac.id/v3/index.php/jmuo/article/view/41826

[24] F. M. White, *Fluid Mechanics*, 4th ed. Boston: McGraw-Hill, 1999. [Online]. Available: https://warwick.ac.uk/fac/sci/eng/staff/ymc/members/former/azimi/project/references/white_frank_m._-_fluid_mechanics_4th_ed_mcgraw_hill.pdf

[25] B. G. Liptak, Ed., *Instrument Engineers' Handbook: Process Measurement and Analysis*, 4th ed. Boca Raton, Florida: CRC Press, 2003, vol. 1. [Online]. Available: https://nivelco.com.ua/documents/technical%20publications%20docs/Instrument%20Engineers%20Handbook%2C%20Volume%201%20Process%20Measurement%20and%20Analysis%2C%20Fourth%20Edition%20%28Volume%201%29.pdf

[26] A. Abdulshaheed, F. Mustapha, and A. Ghavamian, "A pressure-based method for monitoring leaks in a pipe distribution system: A review," *Renewable and Sustainable Energy Reviews*, vol. 69, pp. 902–911, 2017. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S1364032116304373

UNIVERSITAS
GADJAH MADA
Warning System Kebocoran Pipa dengan Prinsip Differential Pressure menggunakan Sensor MPX5050Dp
Muhammad Haekal Faiq, Dr. Trias Prima Satya, S.Si., M.Sc.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

[27] Q. Hou, "An fbg strain sensor-based npw method for natural gas pipeline leakage detection," *Mathematical Problems in Engineering*, vol. 2021, pp. 1–8, 2021. [Online]. Available: https://www.researchgate.net/publication/350083313_An_FBG_Strain_Sensor-Based_NPW_Method_for_Natural_Gas_Pipeline_Leakage_Detection

[28] P. Ostapkowicz and A. Bratek, "Accuracy and uncertainty of gradient based leak localization procedure for liquid transmission pipelines," *Sensors*, vol. 21, no. 15, p. 5080, 2021. [Online]. Available: https://doi.org/10.3390/s21155080

[29] W. Li, Q. Fu, and H. Gao, "Pipeline leak detection and localization based on the flow balance and negative pressure wave methods," *AIP Advances*, vol. 14, no. 11, p. 115203, 2024. [Online]. Available: https://www.researchgate.net/publication/385471831_Pipeline_leak_detection_and_localization_based_on_the_flow_balance_and_negative_pressure_wave_methods

[30] T. L. Stewart, "Pipeline leak detection," Patent US4 280 356A, 1981. [Online]. Available: https://patents.google.com/patent/US4280356A/en

[31] C. D. Johnson, *Process Control Instrumentation Technology*, 8th ed. Harlow, England: Pearson Education, 2014. [Online]. Available: https://dokumen.pub/process-control-instrumentation-technology-eighth-new-international-edition-1292026014-9781292 html

[32] Formulas.today. (2025) Panduan komprehensif untuk persamaan bernoulli dalam mekanika cairan. Diakses pada 21 Mei 2026. [Online]. Available: https://www.formulas.today/id/rumus/persamaan-bernoulli-dalam-mekanika-cairan/

[33] A. S. Morris and R. Langari, *Measurement and Instrumentation: Theory and Application*, 1st ed. Oxford: Academic Press, 2011. [Online]. Available: https://archive.org/details/measurementinstr0000morr

[34] R. W. Miller, *Flow Measurement Engineering Handbook*. New York: McGraw-Hill, 1983. [Online]. Available: https://archive.org/details/flowmeasuremente0000mill

[35] Instrumentation Tools. (2023) Comparison of venturi and orifice flow meter. Diakses pada 21 Mei 2026. [Online]. Available: https://instrumentationtools.com/comparison-venturi-orifice-flow-meter/

[36] X. T. Xinghao Tian, Wenling Jiao, "Intelligent leak detection method for low-pressure gas pipeline inside buildings based on pressure fluctuation identification," *Journal of Civil Structural Health Monitoring*, vol. 12, p. 1191, 2022. [Online]. Available: https://link.springer.com/article/10.1007/s13349-022-00607-y

UNIVERSITAS
GADJAH MADA
Warning System Kebocoran Pipa dengan Prinsip Differential Pressure menggunakan Sensor MPX5050Dp
Muhammad Haekal Faiq, Dr. Trias Prima Satya, S.Si., M.Sc.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

[37] M. T. Abdu, W. Khalifa, and M. S. Abdelrahman, "Investigation of erosion-corrosion failure of api x52 carbon steel pipeline," *Scientific Reports*, vol. 13, p. 20494, 2023. [Online]. Available: https://www.nature.com/articles/s41598-023-42556-6

[38] P. Li, F. Wang, J. Gao, D. Lin, J. Gao, J. Lu, E. Qiu, and C. Liu, "Failure mode and the prevention and control technology of buried pe pipeline in service: State of the art and perspectives," *Advances in Civil Engineering*, vol. 2022, p. 2228690, 2022. [Online]. Available: https://onlinelibrary.wiley.com/doi/10.1155/2022/2228690

[39] United Nations Environment Programme, "Early warning systems: A state of the art analysis and future directions," 2012, accessed: 2026-05-21. [Online]. Available: https://capacity4dev.europa.eu/library/early-warning-systems-state-art-analysis-and-future-directions_en

[40] ScienceDirect Topics. (2025) Early warning system. Diakses pada 21 Mei 2026. [Online]. Available: https://www.sciencedirect.com/topics/social-sciences/early-warning-system

[41] A. Takey and M. A. Takey, "Pipeline monitoring system by using plc control and scada," *International Journal of Creative Research Thoughts (IJCRT)*, vol. 13, no. 6, pp. d547–d552, 2025. [Online]. Available: https://www.ijcrt.org/papers/IJCRT2506409.pdf

[42] M. F. M. Yusoff, N. Yahya, and A. Mohamed, "Gas pipeline leak detection using differential pressure analysis method," in *2016 IEEE Symposium on Computers & Informatics*. IEEE, 2016, pp. 256–261. [Online]. Available: https://utpedia.utp.edu.my/id/eprint/10485/1/2011%20-%20Gas%20Pipeline%20Leak%20Detection%20using%20Differential%20Pressure%20Analysis%20Method.pdf

[43] M. Esposito, L. Palma, A. Belli, L. Sabbatini, and P. Pierleoni, "Recent advances in internet of things solutions for early warning systems: A review," *Sensors*, vol. 22, no. 6, p. 2124, 2022. [Online]. Available: https://www.mdpi.com/1424-8220/22/6/2124

[44] X. Cai, J. Wang, Y. Ye, and L. Zhang, "An early warning method of pipeline leakage monitoring with limited leakage samples," *Measurement*, vol. 245, p. 116013, 2024. [Online]. Available: https://doi.org/10.1016/j.measurement.2024.116013

[45] Motorola Semiconductor, *MPX5050 Integrated Silicon Pressure Sensor Datasheet*, Motorola Inc., 1997, 0 to 50 kPa differential pressure sensor datasheet. [Online]. Available: https://www.alldatasheet.com/datasheet-pdf/pdf/5184/MOTOROLA/MPX5050.html

UNIVERSITAS
GADJAH MADA
Warning System Kebocoran Pipa dengan Prinsip Differential Pressure menggunakan Sensor MPX5050Dp
Muhammad Haekal Faiq, Dr. Trias Prima Satya, S.Si., M.Sc.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

[46] ScienceDirect Topics. (2025) Semiconductor strain gauge. Diakses pada 21 Mei 2026. [Online]. Available: https://www.sciencedirect.com/topics/engineering/semiconductor-strain-gauge

[47] The Engineering Projects. (2025) Mpx5010dp pressure sensor. Diakses pada 21 Mei 2026. [Online]. Available: https://www.theengineeringprojects.com/2025/02/mpx5010dp-pressure-sensor.html

[48] Freescale Semiconductor, *MPX5050 Series: Integrated Silicon Pressure Sensor On-Chip Signal Conditioned, Temperature Compensated and Calibrated*, rev. 11 ed., Freescale Semiconductor, Oct. 2012, datasheet, accessed July 12, 2026. [Online]. Available: https://www.nxp.com/docs/en/data-sheet/MPX5050.pdf

[49] B. Choi, S. Kim, and H. Kim, "A high-temperature piezoresistive pressure sensor with an integrated signal-conditioning circuit," *Sensors*, vol. 16, no. 6, p. 820, 2016. [Online]. Available: https://www.researchgate.net/publication/304192393_A_High-Temperature_Piezoresistive_Pressure_Sensor_with_an_Integrated_Signal-Conditioning_Circuit

[50] Espressif Systems, *ESP32-WROOM-32D & ESP32-WROOM-32U Datasheet*, Espressif Systems, 2025. [Online]. Available: https://www.espressif.com/sites/default/files/documentation/esp32-wroom-32d_esp32-wroom-32u_datasheet_en.pdf

[51] ——, *ESP32-DevKitC V4 Getting Started Guide*, Espressif Systems, 2023, accessed: July 12, 2026. [Online]. Available: https://docs.espressif.com/projects/esp-idf/en/latest/esp32/hw-reference/esp32/get-started-devkitc.html

[52] Jogja Robotika, "Esp32 devkitc v4 esp32-wroom-32u wireless bluetooth iot," https://jogjarobotika.com/wireless-gps-xbee-module/5530-esp32-devkitc-v4-esp32-wroom-32u-wireless-bluetooth-iot-wroom-esp-32u.html, 2026, accessed: July 12, 2026.

[53] Songle Relay, *SRD-05VDC-SL-C Relay Datasheet*, Songle Electronics, 2023. [Online]. Available: https://www.datasheetcafe.com/srd-05vdc-sl-c-datasheet-pdf/

[54] ScienceDirect Topics. (2025) Relay contact. Diakses pada 8 Juni 2026. [Online]. Available: https://www.sciencedirect.com/topics/engineering/relay-contact

[55] Digiware Store, "Relay module 1 channel 5v active high or low trigger," https://digiwarestore.com/en/relay/relay-module-1-channel-5v-active-high-or-low-trigger-263130.html, 2026, accessed: July 12, 2026.

UNIVERSITAS
GADJAH MADA
Warning System Kebocoran Pipa dengan Prinsip Differential Pressure menggunakan Sensor MPX5050Dp
Muhammad Haekal Faiq, Dr. Trias Prima Satya, S.Si., M.Sc.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

[56] B. Wang, B. Su, W. Zheng, Z. Ke, M. Lin, and Q. Wang, "Experimental study on flow rate and pressure drop characteristics in t-junction pipes under rolling conditions," *Physics of Fluids*, vol. 36, no. 4, p. 045111, April 2024. [Online]. Available: https://doi.org/10.1063/5.0199933

[57] A. Khalifa, R. Ben-Mansour, K. Youcef-Toumi, M. A. Habib, and D. Chatzigeorgiou, "In-pipe leak detection based on pressure gradient," Patent US9 335 233B2, 2016. [Online]. Available: https://patents.google.com/patent/US9335233B2/en

[58] I. Ali, M. Asif, K. Shehzad, M. R. U. Rehman, D. G. Kim, B. S. Rikan, Y. Pu, S. S. Yoo, and K.-Y. Lee, "A highly accurate, polynomial-based digital temperature compensation for piezoresistive pressure sensor in 180 nm cmos technology," *Sensors*, vol. 20, no. 18, p. 5256, 2020. [Online]. Available: https://www.mdpi.com/1424-8220/20/18/5256

[59] A. Vissière, G. Bratu, and A. Brasseur, "Experimental study of pressure sensors used in medical devices," *International Journal of Metrology and Quality Engineering*, vol. 8, p. 17, 2017. [Online]. Available: https://www.metrology-journal.org/articles/ijmqe/full_html/2017/01/ijmqe170028/ijmqe170028.html

[60] Y. Zhang, M. Li, and Q. Wang, "Pipeline safety monitoring and leak detection technology based on intelligent sensors," *Wireless Communications and Mobile Computing*, vol. 2022, p. 9973299, 2022. [Online]. Available: https://onlinelibrary.wiley.com/doi/10.1155/2022/9973299

[61] Robotistan. (2025) Esp32-wroom-32d devkit v4. Diakses pada 8 Juni 2026. [Online]. Available: https://www.robotistan.com/esp32-wroom-2d-devkitv4-en

[62] J. Fraden, *Handbook of Modern Sensors: Physics, Designs, and Applications*, 5th ed. Cham, Switzerland: Springer International Publishing, 2016. [Online]. Available: https://doi.org/10.1007/978-3-319-19303-8