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 Mechanics and Mechanical Engineering [Open Access](#)  
 Volume 22, Issue 4, 2018, Pages 1077-1097

## Base pressure behaviour in a suddenly expanded duct at supersonic Mach number regimes using taguchi design of experiments (Article)

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### Abstract

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Experimental investigations are carried out to study the control of base pressure without and with the use of micro-jets through suddenly expanded axi-symmetric passage in the supersonic regime. Four micro jets having an orifice diameter of 1mm were located at 90° intervals. In the base area, active controls jets have been placed on a pitch of a circle diameter that is 1.3 times the exit diameter of the nozzle. The jets were dispensed abruptly into the axi-symmetric tube maintained at a cross-sectional area of 4.84 times the exit nozzle area. The variation of base pressure as a function of flow control parameters namely Mach number, nozzle pressure ratio (NPR) and length to diameter ratio (L/D) are evaluated experimentally. This study also assesses the impact of flow control variables on base pressure for two cases viz. with control and without control respectively. An L<sub>9</sub> orthogonal array of Taguchi and the analysis of variance were employed to investigate the percentage of contribution of these parameters and their interactions affecting the base pressure. The correlations between the various factors affecting the base pressure were obtained by using multiple linear regression equations. Confirmation tests were conducted in order to test the developed linear regression equations for their practical significance. Both the regression models were found to be significant and reliable with a percentage deviation lying in the range of -6.12% to 10.26% for base pressure without control and -13.92% to 6.58% for base pressure with control. Analysis of variance was also performed in order to determine the statistical significance of each parameter on the total variability of base pressure. The study concluded that Mach number is the most influential parameter affecting base pressure followed by NPR and L/D. © Technical University of Lodz.

### SciVal Topic Prominence [📄](#)

Topic: Nozzles | Mach number | Suddenly expanded

 Prominence percentile: 63.870 [📄](#)

### Author keywords

[Length to diameter ratio](#) [Mach number](#) [Micro-jets](#) [Nozzle pressure ratio \(NPR\)](#) [Taguchi](#)

 ISSN: 14281511  
 Source Type: Journal  
 Original language: English

 Document Type: Article  
 Publisher: Wydawnictwo Politechniki Lodzkiej

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 sudden expansion for mach 3.0  
 using CFD

 Quadros, J.D. , Khan, S.A. ,  
 Antony, A.J.

- 1 Wick, R.S.  
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- 2 Anderson, J.S., Williams, T.J.  
Base pressure and noise produced by the abrupt expansion of air in a cylindrical duct (1968) *Journal of Mechanical Engineering Science*, 10 (3), pp. 262-268. Cited 37 times.

- 3 Viswanath, P.R., Patil, S.R.  
Effectiveness of passive devices for axisymmetric base drag Reduction at Mach 2  
(1990) *Journal of Spacecraft and Rockets*, 27 (3), pp. 234-237. Cited 33 times.  
doi: 10.2514/3.26130

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- 4 Badrinarayanan, M.A.  
Experimental investigation of base flows at supersonic speeds  
(1961) *Journal of Royal Aeronautical Society*, 65 (607), pp. 475-482. Cited 35 times.

- 5 Khan, S.A., Rathakrishnan, E.  
Active control of suddenly expanded flows from overexpanded nozzles  
(2002) *International Journal of Turbo and Jet Engines*, 19 (1-2), pp. 119-126. Cited 29 times.  
<http://www.degruyter.com/view/j/tjj.2012.29.issue-2/issue-files/tjj.2012.29.issue-2.xml>  
doi: 10.1515/TJJ.2002.19.1-2.119

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- 6 Khan, S.A., Rathakrishnan, E.  
Control of Suddenly Expanded Flows with Micro-Jets  
(2003) *International Journal of Turbo and Jet Engines*, 20 (1), pp. 63-81. Cited 29 times.  
<http://www.degruyter.com/view/j/tjj.2012.29.issue-2/issue-files/tjj.2012.29.issue-2.xml>  
doi: 10.1515/TJJ.2003.20.1.63

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- 7 Khan, S.A., Rathakrishnan, E.  
Active control of suddenly expanded flows from underexpanded nozzles  
(2004) *International Journal of Turbo and Jet Engines*, 21 (4), pp. 233-253. Cited 24 times.  
<http://www.degruyter.com/view/j/tjj.2012.29.issue-2/issue-files/tjj.2012.29.issue-2.xml>  
doi: 10.1515/TJJ.2004.21.4.233

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- 8 Khan, S.A., Rathakrishnan, E.  
Control of suddenly expanded flows from correctly expanded nozzles  
(2004) *International Journal of Turbo and Jet Engines*, 21 (4), pp. 255-278. Cited 22 times.  
<http://www.degruyter.com/view/j/tjj.2012.29.issue-2/issue-files/tjj.2012.29.issue-2.xml>  
doi: 10.1515/TJJ.2004.21.4.255

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