Journal of Science Technology (JoSTec)
Published by: Inovasi Pratama Internasional. Ltd
Journal homepage: https://ejournal.ipinternasional.com/index.php/jostec
DOI: https://doi.org/10.55299/jostec.v5i1.337

Effect of Cessna 172S Aircraft Engine Vibration on the ground on Aviator Academy Pilots

Hadi Prayitno[1], Dimas Endrawan Putra[2], M. Khoirul Anam[3], Wisnu Kuncoro[4], M. Nur Cahyo Hidayat[5]
[1,2,5]Indonesian Aviator Academy – Banyuwangi, Indonesia
[3]Department of Mechanical Engineering, PGRI Banyuwangi University, Indonesia

ARTICLE INFO

Article history:

Received March 16, 2023
Revised March 28, 2023
Accepted June 07, 2023

Keywords:

Vibration
Cadets
Cessna 172 S

ABSTRACT

There are various problems experienced by cadets at the Indonesian Aviator Academy (API) Banyuwangi, one of which is the effect of engine vibrations on the pilot of the cessna 172s aircraft. Vibration is a physical factor in the workplace that comes from the work equipment used. The impact of vibration on humans mainly occurs in certain parts of organs such as: chest, head, jaw, nerves and other joints. In general, exposure to mechanical vibrations in the body can cause disturbances in comfort at work, accelerate the occurrence of work fatigue and the emergence of disturbances to occupational health. The discomfort that affects the cadets at the Indonesian Aviator Academy (API) Banyuwangi affects the causes of fatigue that can cause plane crashes. This study aims to determine the effect of engine vibration on the performance of the pilot of the cessna 172s aircraft. The results of this study were based on questionnaire data obtained from cadets, 50% of 25 respondents answered that they had felt numbness in the hands when holding the steering lever of the aircraft and felt anxious when there was excessive vibration. The condition experienced can be a safety risk for pilots and cadets if the existing problem is not quickly given a solution to the solution.

Corresponding Author:

Hadi Prayitno,
Department of Aviation,
Banyuwangi Aviator Academy,
Banyuwangi International Airport complex, Jl. Blimbingsari Beach, Krajan Hamlet, Blimbingsari, Rogojampi District, Banyuwangi Regency, East Java 68462
Email: ha_pray@yahoo.co.id

1. INTRODUCTION

Indonesian Aviator Academy (API) Banyuwangi is an official school under the Ministry of Transportation and is one of the STPI (Indonesian Aviator College) which aims to produce cadet graduates who are ready to work in the aviator world, especially the pilot profession and air transportation safety (Asy'ar et al., 2022). There are various problems experienced by cadets at the Indonesian Aviator Academy (API) Banyuwangi, one of which is the effect of engine vibrations on the pilot of the cessna 172s aircraft. Vibration is a physical factor in the workplace that comes from the work equipment used (Ulfah & Bina Husada Palembang, 2018). Vibrations produced by machines when exposed to humans or workers can have detrimental effects on health (Cindyastira et al., 2014)(Hussein et al., 2019). The impact of vibration on humans mainly occurs in certain parts of organs such as: chest (Góra et al., 2020; Katarzyna et al., 2022), head(Lucas et al., 2020), jaw(Alikhani et al., 2019), nerve(Gerhardsson et al., 2020) and other joints (Bellver et al., 2021; Rajapakse et al., 2021). In addition to the sense of discomfort caused to the organs already mentioned, according to several studies, it has been reported long-term effects to the point of causing osteoarthritis of the

spine (Meita Wulandari et al., 2017). In general, exposure to mechanical vibrations in the body can cause disturbances in comfort at work, accelerate the occurrence of work fatigue and the emergence of disturbances to occupational health. Low-frequency vibrations can result in hangover, instability, numbness and fatigue (Manuputty, 2019).

In Indonesia, the threshold value of vibration exposure for health and comfort is regulated by the Decree of the Minister of Manpower Number PER.13/MEN/X/2011 concerning the Threshold Value of Physical and Chemical Factors in the Workplace. The Threshold value of vibration both directly and indirectly in contact throughout the body is set at 0.5 meters per second squared (m/s^2) (Ikhssani, 2019). The discomfort that affects the cadets at the Indonesian Aviator Academy (API) Banyuwangi affects the causes of fatigue that can cause plane crashes. Fatigue is the biggest contributor that affects pilot performance, especially in commercial airline operations (Finahari & Soebiyakto, 2022). The pilot's mental state will be burdened if the pilot is faced with a situation when the plane is about to make a landing (Saputra et al., 2016). This study aims to determine the effect of engine vibration on the performance of the pilot of the cessna 172s aircraft.

2. RESEARCH METHOD

2.1. Thinking Framework

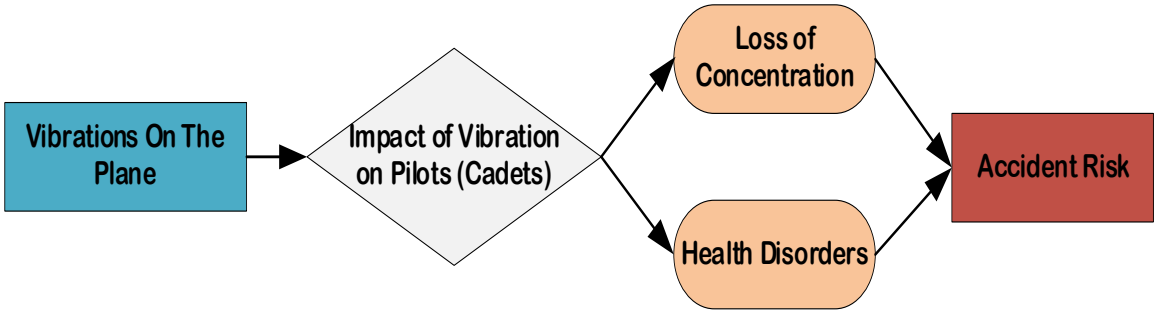

Figure 1. Thinking Framework

Vibrations caused by aircraft, especially cessna 172s aircraft operated by pilots (cadets) can cause loss of concentration (Boryaev et al., 2020), The loss of concentration is very fatal in the operation of aircraft. In addition to the loss of vibration concentration found in the cessna 172s aircraft can interfere with the health of the pilot (cadet). When these various things are not handled, unwanted things will occur such as the risk of accidents during aircraft operation.

2.2. Data Retrieval Methods

The method used in data collection is to use a device in the form of a vibration meter where the vibration meter is used to measure vibrations in the cockpit of the aircraft. Measurements were made on the steering column in the cockpit of the cessna 172s aircraft where the designated measurement point is designated in figure 3.

2.3. Data Collection Techniques

The data obtained in this study in addition to direct data collection of the specified vibration point, also used a questionnaire system with several questions asked to the pilot (cadet). In the data obtained, it will be identified what impacts are felt by pilots (cadets) caused by vibrations on the cessna 172s aircraft. The results of the questionnaire and vibration measurements obtained can be a reference for pilots (cadets) to find out the impact caused by vibrations in the ceesna 172s aircraft, besides that the reference can be used as a reference for cessna 172s aircraft technicians to carry out maintenance to reduce the occurrence of vibrations on the aircraft so that the pilot (cadet) feels comfortable and the negative effects that may arise on the pilot (cadets) due to the impact of vibrations can be reduced.

2.4. Sample Determination Techniques

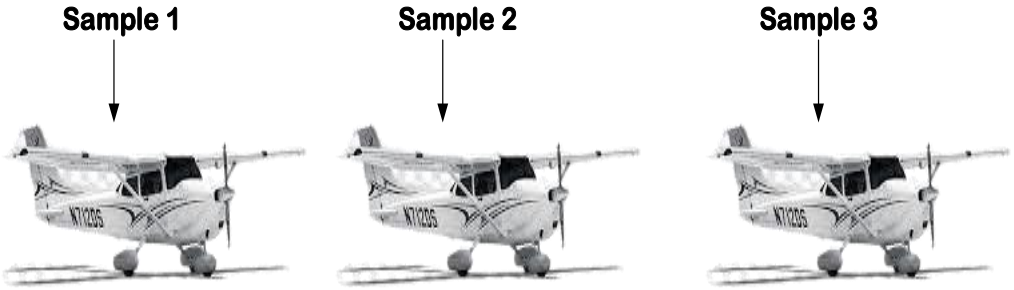

Figure 2. Sample Determination Techniques

This study used 3 samples of aircraft with differences in year of manufacture and number of landings.

Table 1. Plane Sample

Aircraft Type	Aircraft Registration Mark	Year of Manufacture	Total of Landing	Information
Cessna 172 S	PK-APA	2018	3.119	OH Engine
Cessna 172 S	PK-APF	2018	3.002	-
Cessna 172 S	PK-BYJ	2015	3.724	-

The data collection carried out will produce an output in the form of vibration result data which later the data will be used as technical reporting related to the vibration threshold that has been determined by the Decree of the Minister of Manpower Number PER.13 / MEN / X / 2011 and as a reference to technicians for repairs to engines, engine mounting, dumpers and inspections of airframes to reduce vibration. The technicality of taking vibration data on the aircraft can be seen in figure 3.

2.5. Data Retrieval Techniques

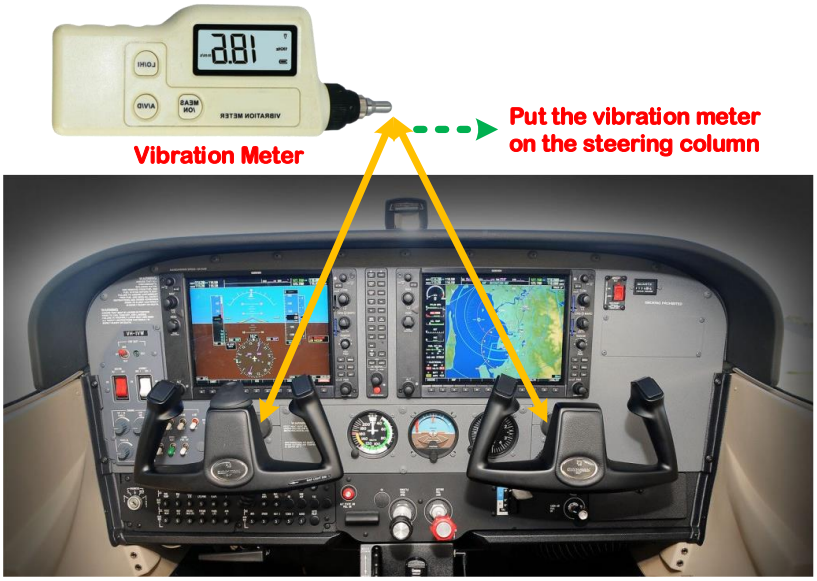

Figure 3. Data Retrieval

Vibration data retrieval on the cockpit when on ground with an engine speed of 2,300 RPM using a vibration meter tool and data retrieval points are carried out on the steering column. The steering column is alleged to have a fairly strong vibration because its position is directly related to the airframe. Data collection is carried out for 2 minutes with the aim of first aligning the engine vibration to the airframe so that it is stable and a constant vibration value is obtained.

3. RESULTS AND DISCUSSIONS

Through research that has been carried out, results were obtained in the form of vibration values and questionnaire results that have been filled in by pilots (cadets).

3.1. Vibration Research Data

Table 2. Cessna PK-APA 2018 - OH

Time (Sec)	Engine Revs (RPM)	Vibration (m/s²)
0	First Start	6.2
0.5	800	5.7
1	1000	4.4
1.5	1500	3.9
2	2300	3.1

Table 3. Cessna PK-APF 2018

Time (Sec)	Engine Revs (RPM)	Vibration (m/s²)
0	First Start	5.8
0.5	800	5.2
1	1000	4
1.5	1500	3.3
2	2300	2.9

Table 4. Cessna PK-BYJ 2015

Time (Sec)	Engine Revs (RPM)	Vibration (m/s²)
0	First Start	6
0.5	800	5.5
1	1000	4.1
1.5	1500	3.4
2	2300	3

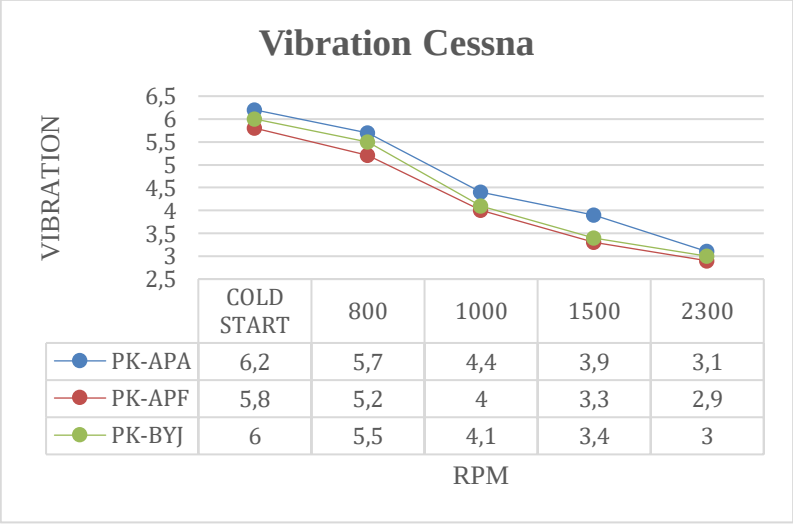

Figure 4. Grafik Compare Vibration of Cessna 172

3.2. Questionnaire Research Data

The questionnaire data collection was carried out using a google form with a total of 25 cadet respondents. The questionnaire data will be displayed in Table 5.

Table 5. Questionnaire Research Data

No.	Question	Ever	Never
1	Have you ever felt excessive vibration on the engine?	15 People	10 People
No.	**Question**	**Yes**	**No**
2	Do you feel anxious during this over-tremor?	13 People	12 People
No.	**Question**	**Yes**	**No**
3	As long as you feel anxious do your hands feel sweaty?	14 People	11 People
No.	**Question**	**Yes**	**No**
4	Have you ever felt numbness or tingling in your hands when holding the steering lever of an aircraft that has abnormal vibrations?	16 People	9 People

3.3. Discussion

Based on the data obtained in Table 2, Table 3 and Table 4 of the cessna aircraft with registration number PK-APA 2018 with the condition of the aircraft has been overhauled to the engine and has made a total landing of 3,118 having the highest vibration level of 3.1 m/s^2. High vibration levels can occur due to several factors including engine age and condition, age and airframe conditions, engine mounting and several other factors that support the transmission of vibration resonance to the cockpit chamber.

4. CONCLUSION

Some supporting data from the research results have been collected and processed. Conclusions of the study is a cessna aircraft with registration number PK-APA Year 2018 with the status of having been carried out Overhaul Engine has the largest level of vibration resonance in the cockpit room or rather in the steering column position of 3.1 m/s^2. The vibration value is relatively large when compared to the Decree of the Minister of Manpower Number PER.13 / MEN / X / 2011 concerning the Threshold Value of Physical and Chemical Factors in the Workplace. The Threshold value of vibration both directly and indirectly in contact throughout the body is set at 0.5 meters per second squared (m/s^2) Some of the factors supporting the occurrence of considerable vibration resonance in the cockpit space are the age and condition of the engine, the age and condition of the airframe, engine mounting and several other factors.

Based on questionnaire data obtained from cadets, 50% of the 25 respondents answered that they had felt numbness in the hands when holding the steering lever of the aircraft and felt anxious when there was excessive vibration. The condition experienced can be a safety risk for pilots and cadets if the existing problem is not quickly given a solution to the solution.

ACKNOWLEDGEMENTS

Thank you to the Banyuwangi Indonesian Aviator Academy and PGRI Banyuwangi University for providing this research facility.

REFERENCES

Alikhani, M., Alikhani, M., Alansari, S., Almansour, A., Hamidaddin, M. A., Khoo, E., Lopez, J. A., Nervina, J. M., Nho, J. Y., Oliveira, S. M., Sangsuwon, C., & Teixeira, C. C. (2019). Therapeutic Effect Of Localized Vibration On Alveolar Bone Of Osteoporotic Rats. *Plos One*, *14*(1), E0211004.

Asy'ar, S., Setiabudi, Moh. A., & Setiawan, W. (2022). Analisis Perbedaan Tingkat Vo2max Taruna Akademi Penerbang Indonesia (Api) Banyuwangi Dan Atlet Karate Puslatkab Lumajang. *Sprinter: Jurnal Ilmu Olahraga*, *3*(1), 6–15.

Bellver, M., Drobnic, F., Jovell, E., Ferrer-Roca, V., Abalos, X., Del Rio, L., & Trilla, A. (2021). Jumping Rope And Whole-Body Vibration Program Effects On Bone Values In Olympic Artistic Swimmers. *Journal Of Bone And Mineral Metabolism*, *39*(5), 858–867.

Boryaev, A., Malygin, I., & Marusin, A. (2020). Areas Of Focus In Ensuring The Environmental Safety Of Motor Transport. *Transportation Research Procedia*, *50*, 68–76.

Cindyastira, D., Russeng, S. S., Wahyuni, A., Kesehatan, B., Kerja, K., Kesehatan, F., & Unhas, M. (2014). Intensitas Getaran Dengan Keluhan Muskuloskeletal Disorders (Msds). *Media Kesehatan Masyarakat Indonesia*, *10*(4), 234–240.

Finahari, N., & Soebiyakto, G. (2022). Review Hasil Penelitian Ergonomi Kokpit Sebagai Perbaikan Lingkungan Kerja Pilot. *Skyhawk : Jurnal Aviasi Indonesia*, *2*(1), 1–5.

Gerhardsson, L., Ahlstrand, C., Ersson, P., & Gustafsson, E. (2020). Vibration-Induced Injuries In Workers Exposed To Transient And High Frequency Vibrations. *Journal Of Occupational Medicine And Toxicology*, *15*(1), 1–9.

Góra, G., Iwaniec, M., Kulinowski, P., & Gac, K. (2020). Vibration Impact On People Transported By Mining Belt Conveyors. *Vibrations In Physical Systems*, *Vol. 31*(Nr 1), 2020109.

Hussein, N. I. S., Shukur, A., Kamat, S. R., & Yuniawan, D. (2019). The Impact Of Worker Experience And Health Level To Vibration Absorbed By Hand. *Journal Of Advanced Manufacturing Technology (Jamt)*, *13*(2(1)).

Ikhssani, A. (2019). Physical Potential Hazards On The Palm Oil Processing Of Pt.Perkebunan Nusantara Vii 2019. *Preventif : Jurnal Kesehatan Masyarakat*, *10*(2), 95–103.

Katarzyna, M., Marta, L., Aleksandra, K., Katarzyna, J., Dołomisiewicz, D., Mielniczek, K., Lipiec, M., Kowalska, A., & Jóźwik, K. (2022). Impact Of Neurological Disorders Occurring In Neurodegenerative Diseases On The Conversation Process And Patients' Quality Of Life. *Journal Of Education, Health And Sport*, *12*(7), 957–967.

Lucas, G., Kemeny, A., Paillot, D., & Colombet, F. (2020). A Simulation Sickness Study On A Driving Simulator Equipped With A Vibration Platform. *Transportation Research Part F: Traffic Psychology And Behaviour*, *68*, 15–22.

Manuputty, M. (2019). Pengaruh Getaran Dan Kebisingan Terhadap Kelelahan Kerja Pada Awak Kapal Ikan Tipe Pole And Line. *Ale Proceeding*, *2*, 39–44.

Meita Wulandari, D., Lady, L., Umyati, A., & Teknik Untirta Jljendsudirman Km, F. (2017). Pengaruh Getaran Mekanik Dan Kebisingan Terhadap Tekanan Darah Pada Laki-Laki Dan Perempuan. *Jurnal Teknik Industri Untirta*, *0*(0).

Rajapakse, C. S., Johncola, A. J., Batzdorf, A. S., Jones, B. C., Al Mukaddam, M., Sexton, K., Shults, J., Leonard, M. B., Snyder, P. J., & Wehrli, F. W. (2021). Effect Of Low-Intensity Vibration On Bone Strength, Microstructure, And Adiposity In Pre-Osteoporotic Postmenopausal Women: A Randomized Placebo-Controlled Trial. *Journal Of Bone And Mineral Research*, *36*(4), 673–684. Https://Doi.Org/10.1002/Jbmr.4229

Saputra, A. D., Program, M., Jurusan, D., Sipil, T., & Lingkungan, D. (2016). Beban Kerja Mental Dalam Operasional Penerbangan Dilihat Dari Karakteristik Pilot. *Prosiding Forum Studi Transportasi Antar Perguruan Tinggi*, *6*, 979–95721.

Ulfah, M., & Bina Husada Palembang, S. (2018). Analisis Faktor Lingkungan Fisik Terhadap Risiko Stress Kerja Di Cv Natural Palembang Tahun 2017. *Jurnal Formil (Forum Ilmiah) Kesmas Respati*, *3*(2), 111–116.