

# CHARACTERISTICS RELATIONSHIP OF WORKERS AND INTENSITY OF WORK ENVIRONMENT NOISE WITH TINNITUS COMPLAINTS IN GAS INDUSTRIAL WORKERS IN SIDOARJO

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## ABSTRACT

**Introduction:** Industrial progress is characterized by the increasing use of machinery in factory which has a negative impact on workers' health, one of which is tinnitus symptoms. Tinnitus is a hearing loss due to exposure to noise. The purpose of this study was to determine the relationship of worker characteristics and intensity of work environment noise with tinnitus symptoms in gas industry workers in Sidoarjo. **Methods:** Based on the study design, this study used analytic research, in terms of time including cross-sectional research. Research variables include age, years of service, noise intensity and tinnitus symptoms. Data are from observation, measurement, questionnaire filling and interview. **Result:** The results showed that there was a relationship between noise intensity and tinnitus symptoms ( $p = 0.033$ ). There was no relationship between the age of workers and tinnitus symptoms ( $p = 1.000$ ). There was no significant relationship between years of work ( $p = 0.505$ ) with tinnitus symptoms suffered by workers at PT. X Sidoarjo Gas Industry. There was no association between exposure pattern and complaints of tinnitus ( $p=0.165$ ). **Conclusion:** So as to reduce the risk of tinnitus complaints the company can apply the use of ear protector for workers and install silencers that can absorb sound with high noise intensity such as glasswool, rockwool, foam, cellulose fiber and acourete fiber carpets to reduce noise.

**Keywords:** Worker characteristics, intensity of work environment noise, tinnitus

## INTRODUCTION

Exposure to noise at work increases with technological advancements, especially in the industrial sector that cannot be separated from the use of machinery. The noise source is generated from engine noise in the work environment with dBA values exceeding the specified threshold value or NAV, especially in the factory environment. The NAV of noise based on the specified time is 1 to 8 hours per day for noise intensities between 85 dBA and 94 dBA. The regulation stipulates that NAVs from 94 dBA to 112 dBA can only be heard for 30 minutes per day (PER.13/MEN/X/2011).

A person's hearing in the work environment will correlate with the time and severity received by the worker. When the assessment time exceeds a predetermined limit, then it will aggravate

hearing changes in someone. If there is noise that persists over a long time, it results in damage to the inner ear, so that the ability to hear sounds with high or low frequencies disappears (Septiana & Widowati, 2016).

Noise caused by sound is caused by the sound source that produces vibrations and makes molecules in the air become trembling. According to the longitudinal wave pattern, the vibration of this source also causes mechanical energy propagation waves in the air. Wave propagation or commonly known as voices or sound can disrupt comfort and health if it is too loud. Hearing loss is one of the effects that can be caused by excess noise, and progressive deafness is also caused by noise that exceeds specified limits (Dewanty & Sudarmadji, 2015).

According to research in India, of 50 workers exposed to noise, 80% had hearing loss at a frequency of 4000 Hz (Tekriwal,

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Parmar, & Saxena, 2011). One impact due to noise exposure in the workplace is a decrease in hearing function (Primadona, 2012). Tinnitus is a hearing loss caused by exposure to high-intensity noise continuously. Symptoms experienced by sufferers are ringing ears (Occupational Safety and Health Administration, 2011). Risk factors for tinnitus include individual factors, namely age, sex, and the use of ear protection equipment (EPE); activity pattern factors namely length of work, years of service, exposure patterns; and noise intensity factors (Kurniawati, 2016).

According to a study conducted in 2011, there was an impact on the level of noise intensity with someone's hearing threshold, in which 65% of the respondents were found to have mild disturbance in the left and right ears (Listyaningrum, 2011). In research conducted at PT. Japfa Comfeed Indonesia Tbk. the Makassar Unit in 2014 showed a relationship between the length of service of the worker, the age of the worker, and the use of ear protection equipment by workers with hearing loss complaints (Hamzah, 2014). This is in line with research that worker's age is significantly related to the incidence of hearing loss (Primadona, 2012).

As many as 35 million people experience the incidence of hearing loss at the age of 18 years and becomes worse as you get older; this happens in many American countries (Choi, 2011). Noise is felt to interfere with work concentration, accelerate fatigue, and reduce work efficiency and also affect one's behavior. Noise also causes interrupted speech communication. Such incidence, of course, greatly affects the work, it can even cause mistakes in doing work. A form or model in which an organism is exposed to exposure can be in a matter of hours, days, months or years is called a pattern of exposure. The nature of the pattern of exposure includes continuous, intermittent and impulsive (repetitive) (Djafri, 2014).

Sidoarjo City has an industry that produces a variety of gases. One of the units

in the PT X industrial area has a work process and the presence of machinery used can cause a high risk of noise. The work environment in PT X Industri Gas Sidoarjo has a noise level above 85 dBA or arguably exceeds the threshold value. Measurements made during the field survey showed the noise level of 90-110 dBA in the ASP Unit Engine Room so that the room has a noise threshold value that exceeds the limit. A noise that occurs in the ASP Engine Unit is continuous because the engine in this unit is working continuously or never turned off.

Workers in the ASP engine unit at PT X have an average working time of eight hours per day. There are three shifts in the division of working time in the room, namely the morning shift to evening, evening to night and night to the morning with several shifts of 2-3 workers each on duty. ASP machine maintenance activities are carried out once every hour in the ASP Engine Unit Room with noise between 90-110 dBA, so that, when maintaining, workers are face to face with machines that are a source of noise, so that workers get greater exposure from these machines. This is done alternately for workers who work on this shift once every hour.

The results of the review in the Ministry of Manpower and Transmigration Regulation NO.PER.13 / MEN / X / 2011 stated that if the noise level exceeds values above 85 dBA (90-110 dBA) it is only allowed to work for less than eight hours. This still requires further research to examine the relationship between the intensity of the noise exposure of the engine room of the ASP unit and the complaints of tinnitus in the gas industry workers in Sidoarjo.

## METHODS

This study examines the risks associated with noise intensity in the work environment due to complaints of tinnitus in gas industry workers in Sidoarjo. This study uses analytic research with a quantitative approach. This research is a cross-sectional

study by way of data collection at the same time (point time approach).

The measurement in this study uses two variables, the dependent variable, and the independent variable. The independent variables in this study are age, years of service, noise exposure patterns, and noise intensity, while the dependent variable studied is complaints of tinnitus. Researchers conducted interviews and observations without intervening or giving treatment to respondents. Data were collected by observation, measurement, filling questionnaires and interviews to determine risk factors in the form of worker characteristics that influence complaints felt by workers due to noise in the work environment. When the measurement was completed, a bivariate analysis was carried out on each variable.

The research location is the engine room of the ASP unit because it has a fairly high noise level between 90-110 dBA compared to other rooms such as the liquid nitrogen filling room and water filtration where workers at PT X do their daily work. This research was conducted in October 2018 to retrieve secondary data and continued until April 2019 to collect primary data by distributing questionnaires to workers, measuring noise with sound level meters and documentation during the study. When researching, work was carried out simultaneously on the same day.

The study population was all PT X gas industry workers in Sidoarjo, totaling 14 people consisting of ASP Unit Engineers and Outdoor Environment workers. The sampling technique in this study was total sampling so that the samples taken from this study were 14 people. Research data were processed using Chi-square test to see the relationship between the independent variable and the dependent variable. The basis of hypothesis decision-making is based on a significance level ( $\alpha$  value) of 95%.

This research has passed the ethical test by Universitas Airlangga, Faculty of Dental Medicine - Health Research Ethical

Clearance Commission with number 237 / HRECC.FODM / V / 2019.

## RESULTS

Table 1 shows the results that most respondents had age less than 40 years with a percentage of 78.6%. In this table, it is known that the majority of respondents have a tenure less than equal to 10 years with a percentage of 64.3% and the majority of respondents have a continuous exposure pattern with a percentage of 57.2%.

**Table 1.** Characteristics of Respondents PT. X Sidoarjo Industri Gas in March 2019

Characteristics of Respondents	The number of workers	
	N	%
<b>Age :</b>		
>40 years	3	21,4
≤40 years	11	78,6
<b>Works Period :</b>		
≤10 years	9	64,3
>10 years	5	35,7
<b>Exposure Pattern :</b>		
Continuous	8	57,2
Intermittent	3	21,4
<b>Impulsive</b>	3	21,4

**Table 2.** Noise Intensity Measurement Results at PT X Industri Gas Sidoarjo in March 2019

Measurement Location	Average of Noise Leq 8 hours (dBA)
<b>Point 1</b>	109.74
<b>Point 2</b>	81.76
<b>Point 3</b>	92.21
<b>Average of Noise</b>	94.57

Table 2 shows the results that the measurement of the greatest noise intensity is at point 1 of the measurement that is equal to 109.74 dBA. Then, the results of the calculation of the average noise at PT X Industri Gas Sidoarjo show a figure of 94.57 dBA. When compared with the NAV

determined by Permenaker Number 13 of 2011, the average results of noise measurements at PT X have exceeded the specified quality standards.

**Table 3.** The Relationship between Age and Tinnitus Complaints PT. X Sidoarjo Industri Gas in March 2019

Tinnitus Complaint	Age of Respondents (years)				p Value
	> 40 years		≤ 40 years		
	N	%	N	%	
Yes	3	100	9	81,8	1,000
No	0	0	2	18,2	
Total	3	100	11	100	

Table 3 shows the results that the majority of respondents who experienced Tinnitus complaints were aged less than 40 years with a total of nine respondents from a total of 14 respondents. Meanwhile, those who have more than 40 years of age and suffer from complaints of tinnitus are three respondents out of a total of 14 respondents. Fisher Exact Test results showed a value of  $p = 1,000$  which means that there is no relationship between the age characteristics of respondents with complaints of tinnitus. This clearly shows that tinnitus complaints that occur in workers in the Sidoarjo gas industry are not caused by age.

Table 4 shows the results that the majority of respondents who suffered from tinnitus complaints were with a work period of less than 10 years, as many as seven respondents from a total of 14 respondents. Then, the Fisher Exact test results showed a value of  $p = 0.005$ , which means that there is no relationship between tenure and tinnitus complaints.

Table 5 shows that the majority of respondents suffering from tinnitus complaints were respondents who had a continuous noise exposure pattern with a total of eight respondents out of a total of 14 respondents. Fisher Exact test results showed a value of  $p = 0.165$ , which concluded that there was no relationship

between exposure patterns with tinnitus complaints.

**Table 4.** The Relationship between Work Period and Tinnitus Complaints PT. X Sidoarjo Industri Gas in March 2019

Tinnitus Complaint	Works Period (Years)				p Value
	< 10 years		>10 years		
	N	%	N	%	
Yes	7	77,8	5	100	0,505
No	2	22,2	0	0	
Total	9	100	5	100	

**Table 5.** The Relationship between Pattern of Exposure and Complaints of Tinnitus of PT. X Sidoarjo Industri Gas in March 2019

Tinnitus Complaint	Pattern of Exposure				p Value
	Continuous		Intermittent & Impulsive		
	N	%	N	%	
Yes	8	100	4	66.7	0.165
No	0	0	2	33.3	
Total	8	100	6	100	

**Table 6.** The Relationship between Environmental Noise Intensity with Tinnitus Complaints PT. X Sidoarjo Industri Gas in March 2019

Tinnitus Complaint	Noise Intensity (dBA)				P Value
	High (>85 dBA)		Normal (≤85 dBA)		
	N	%	N	%	
Yes	11	100	1	66.7	0.033
No	0	0	2	33.3	
Total	11	100	3	100	

Table 6 shows that the majority of respondents suffering from tinnitus complaints were those with high noise intensity (> 85dBA), as many as 11

respondents out of a total of 14 respondents. Then, the Fisher Exact test results showed a value of  $p = 0.003$ , which means that there is a relationship between noise intensity with tinnitus complaints.

## DISCUSSION

### Characteristics of Respondents

This research was conducted at PT X Industri Gas Surabaya with a total of 14 respondents. Workers taken as respondents of this study came from workers who were at three different noise measurement points, namely eight workers from point 1 measurement, three workers from point 2 measurement, and three workers from point 3 measurement. Point 1 noise is an ASP engine unit where workers carry out machine production activities, point 2 noise is water filtration near ASP where workers carry out filtration activities and water pumps near ASP units, and point 3 noise is liquid filling where workers carry out liquid filling production activities, then passing tanker trucks, and channeling gas to the tank.

The majority age of respondents in this study were workers who were less than 40 years old. This proves that there are still many respondents who are young and still have good health conditions. Then, in terms of tenure, there are many less than 10 years. This proves that many new people become workers in this company, so there is a possibility of employee turnover. Furthermore, many respondents have a pattern of continuous exposure and cause most of the respondents to get exposure to noise that occurs for a long time and continuously. As a result, this can be a causative agent and risk factor for the occurrence of complaints of tinnitus in workers' hearing. Not only that, other factors such as the amount of noise intensity can also be a major determinant in the occurrence of complaints of tinnitus. Another study conducted by Al-Swiahb (2016) in several age groups who experienced complaints of tinnitus and

treatment at Mary Hospital, Korea, also found it has nothing to do with age. A similar study conducted by Steinmetz (2009) in Brazil on workers who experienced exposure to noise in the workplace also showed no relationship between age and complaints of tinnitus suffered by someone.

### Noise Intensity Measurement Results

According to Prabu (cited in Dewanty & Sudarmadji, 2015), the intensity of noise in a workplace gives impacts such as physiological, psychological, communication and effects on internal organs. Research conducted by Dewanty (2015) on laundry unit officers states that there is a relationship between noise intensity with hearing loss in the unit officer. Besides, if a person is exposed continuously for a long period and the intensity of noise exceeds the threshold value that has been determined, the risk of a worker being affected by hearing loss is higher. The risk of the hearing will be higher in old age than at a young age (Stranks, 2003).

In the measurement of noise, intensity carried out at three measurement points in the PT X work environment, namely in the ASP engine unit, water filtration section, and liquid filling section. Based on the results of measurements at these three points, it is found that there are two measurement points with noise intensity that exceeds the threshold value of 85 dBA for eight hours. The two measurement points are located in the ASP engine unit and liquid filling work section. Noise in the work environment at PT X Industri Gas is measured using a noise level meter, the SLM, to determine the intensity of noise at the site.

Workers who work on the ASP engine unit certainly have a high noise intensity, because, in this section, there are several production activities of machines such as RNC Sergas, refrigeration units, coller engines, nitrogen compressors, and

turbine expander. The machine at the measurement point 1 operates 24 hours a day, so workers who work at this point are divided into three shifts or three times, 7 am to 3 pm or morning shift, 3 pm to 11 pm or afternoon shift, and 11 am night until 7 am or night shift. Furthermore, workers who are at the third point of filling liquid oxygen and nitrogen also have the risk of getting noise exposure that exceeds the threshold value or high intensity because there is the liquid filling production activity itself, as well as the number of tank trucks passing on duty to channel gas into the tank.

After measuring and calculating the average related to noise intensity at PT X Industri Gas, the results obtained that the average noise is 94.57 dBA in eight hours/day. These results prove that the noise intensity at this company has exceeded the quality standard set by Permenaker No. 13 of 2011, namely noise exposure that exceeds 85 dBA may not be exposed to workers for more than eight hours. This study shows that 11 out of 14 respondents or around 78.57% of respondents experienced noise exposure with noise intensity reaching more than 85 dB in the work environment. One-way research conducted by Septi (2016) on the meat grinder business in Jember Market with noise intensity of 108.58 - 109.38 dBA and Putri (2016) on the machine shop workers of PT. Surabaya Dock and Shipping obtained significant results regarding the relationship of noise intensity with complaints of tinnitus experienced by workers.

### **The Relationship between Worker Characteristics and Tinnitus Complaints**

Tinnitus is a form of sound perception perceived by a person without any sound stimulus coming from outside the ear. Tinnitus itself can be objective or subjective for the listener. Subjective tinnitus is tinnitus that is heard only by the patient himself without being able to be heard by others (Nugroho & Naftali, 2015). Complaints of tinnitus experienced are

humming, hissing, roaring, or various other variations of sounds (Dewi Purwita Agustini, 2016).

The characteristics of respondents who have been investigated during this study are age, years of service, and exposure patterns. Research conducted on workers in the gas industry in Sidoarjo found that there is no significant relationship between age factors with complaints of tinnitus. This means that complaints of tinnitus that have been experienced by workers are not caused by age, but can be caused by other factors such as noise intensity. Table 1 shows many workers with complaints of tinnitus at the age of less than 40 years. If age can affect tinnitus complaints, then the older a person should be, the more he suffers from tinnitus complaints.

Tinnitus complaints can indeed be experienced by all age groups. But complaints of tinnitus generally appear with age, whereas in children it is usually caused by the use of earphones with a loud volume for hours. Generally, this complaint is experienced by someone who is in the age group of 40 years or more because every year the hearing threshold will increase by 0.5 dB.

Supporting research is that conducted by Al-Swiahb. J., & Park, SN., (2016) that some age groups experience complaints of tinnitus and treatment at Mary Hospital, South Korea, there is no significant relationship between age and complaints of tinnitus. Then, other supportive research is that conducted by Steinmetz (2009) in Brazil which shows that there is no relationship between age and complaints of tinnitus. A study conducted by Purintyas (2006) mentioned the lack of significance in the relationship between age and tinnitus complaints.

Putri (2016) states that one of the factors that determine the magnitude of the decrease in hearing and hearing loss and can produce a large influence on the condition of Temporary Threshold Shift (TTS) experienced by workers is the work period. Complaints of tinnitus due to noise

exposure can arise directly or chronically until it can cause disruption of daily activities and sleep quality. This study shows that there is no significant relationship between tenure and complaints of tinnitus. That is because there are workers with tenure less than 10 years who experience tinnitus complaints.

Previous research conducted by Putri (2016) on PT Dok and Shipping Surabaya workers also showed that there was no significant effect between tenure and complaints of tinnitus. However, it is different from Purintyas' research (2006) which shows that complaints of tinnitus are related to the length of service received by workers. Other research that is in line with this research is a study conducted by Putri (2016) on a meat-grinding worker in Jember District which shows that there is also a significant relationship regarding tinnitus complaints with the length of service of workers.

Work period can affect hearing complaints such as tinnitus because the hearing organ is only able to receive noise at certain limits. If the noise level received by the worker exceeds the appropriate limit with long-term exposure and continuous or recurring events, this can have an impact on workers' hearing complaints. Decreased hearing ability can occur in a person due to the noise that has occurred over a long time, about five years or more.

However, in this study, workers who had a working period of fewer than 10 years experienced greater tinnitus complaints, while workers who were more than 10 years experienced lower tinnitus complaints. What causes this to happen is the frequency of noise exposure to the workers themselves. For example, it is possible for workers who have more than 10 years of service to have less frequency of noise exposure compared to workers who have less than 10 years of service. As a result, workers with more than 10 years of service experience no complaints from tinnitus. Another possibility that causes work period to not not affect tinnitus

complaints is the worker's employment history. For example, workers with tenure less than 10 years have had jobs with higher noise levels compared to the current workplace, so that this can also affect workers' complaints of tinnitus.

This study found that there was no relationship between exposure patterns with significant tinnitus complaints. This shows that the noise that is heard by workers continuously does not have a big influence on the occurrence of complaints of tinnitus. Similar study was previously conducted by Kurniawati (2016) and showed that there was no significant relationship between exposure time and hearing loss. Other studies that are in line with this study are those conducted by Steinmetz (2009) in Brazil on workers who experience noise exposure in the workplace. It found that there is no significant relationship between exposure patterns with complaints of tinnitus suffered by someone.

Exposure can occur due to risk agents from the work environment inhaled into the air, absorbed through human skin or in direct contact with body parts for physical hazards such as radiation, swallowed together with water and hot food, noise, or vibration (Djafri, 2014). This pattern of exposure is a form or model in which an organism is exposed to exposure, it can be in a matter of hours, days, months, or years. The pattern of exposure, in this case, can be continuous (continuous), intermittent (intermittent), and impulsive (repetitive) (Djafri, 2014).

The pattern of exposure may not have a relationship with tinnitus complaints because it is caused by several other major factors that can affect tinnitus complaints, such as noise intensity. A very high noise intensity that exceeds > 85 dBA can cause some hearing loss, one of which is a complaint of tinnitus.

A person with a continuous exposure pattern may not be affected by tinnitus complaints because the worker is in a position of workers exposed to low noise intensity. Meanwhile, workers who have

interrupted or repeated exposure patterns are in a position of workers exposed to high noise intensity. As a result, although the worker has a pattern of exposure that is not frequent or rarely experiences noise exposure, workers can experience tinnitus complaints due to exposure to noise intensity that is too high and exceeds a predetermined threshold value, which affects the organ function of the workers' hearing.

### **The Relationship between the Noise Intensity of the Work Environment and the Complaints of Tinnitus**

Hearing loss due to noise such as complaints of tinnitus can be caused by several factors including the duration of noise exposure, ototoxic treatment, and the high frequency (Soetirto & Hendarmin, 2009). Noise with an intensity of 85 dBA or more can cause damage to Corti's auditory receptors for frequencies of 3000 Hz to 6000 Hz at sound receptors, and heavy damage to the Corti device for sound resets at frequencies of 4000 Hz (Soetirto & Hendarmin, 2009).

In this study, tinnitus complaints were experienced by 12 respondents from a total of 14 respondents, which is about 85.7% of respondents experienced tinnitus complaints. In line with the research conducted by Silitonga et al. (n.d.) is the relationship between noise and workers' hearing who stated that some workers experienced the most complaints of tinnitus with a percentage of 70.9%.

Other measurement results about the intensity of work environment noise at PT X Industri Gas Sidoarjo showed that there were only three workers who were not exposed to noise more than 85 dBA, namely workers who were at point 2 namely the water filtration section. Based on the results of research and calculations, it was found that there is a significant relationship between noise intensity with the occurrence of complaints of tinnitus. This means that if there is a change in noise intensity, it will also affect the occurrence of complaints of

tinnitus. The higher the intensity of noise received by a person, the higher the risk that a person will experience complaints of tinnitus.

Complaints of tinnitus can be grouped into five scoring severity, i.e. very mild, mild, medium and heavy. very heavy. Based on the results of the study it was also found that of the 12 respondents experiencing complaints of tinnitus, five respondents were found to have a very mild degree of tinnitus, five respondents had a mild degree of tinnitus, and the remaining two respondents had a moderate degree of tinnitus.

Research conducted by Silitonga et al. (2015) found similar results, namely the relationship between noise intensity and hearing loss by workers. This is in line with findings in the Purintyas (2006) study which showed a relationship between noise exposure and tinnitus complaints in respondents who were exposed to noise had a risk of 28.3 times greater. This means that respondents who are exposed to noise exposure have a 28.3 times greater risk of developing tinnitus complaints compared to respondents who are not exposed. Thus, the greater the value of the noise intensity we receive, the greater the risk of tinnitus complaints that will be suffered.

Other research is Putri's (2016) finding that there is a relationship between noise exposure and tinnitus complaints in PT Dok and Shipping Surabaya workers. Other studies conducted in the US on workers exposed to noise show the results of the prevalence of Tinnitus by 15% (Masterson, E A., Themann, C L., Luckhaupt, S E., Li, J & Calvert, G M, 2016) Besides, research conducted by Gananca (2011) also showed a prevalence of 37.8% experienced the occurrence of complaints of tinnitus due to noise exposure. Then, other studies conducted in the flour industry also showed a large prevalence of tinnitus complaints of 38.1% (Ibrahim, Aremu, Ajao, & Ojelabi, 2015).

The noise occurred at work has to be handled properly by the appropriate



authorities. This is because, in addition to the workers themselves, the leader of the workplace also has the authority to maintain occupational health and safety. The results of observations and interviews with PT X Industri Gas Sidoarjo showed that so far there have been several activities carried out related to noise control. Some noise controls that have been carried out include PT X Industri Gas Sidoarjo conducting supervision, cleaning, and repairing the production machines periodically, providing a separate area for machines that make high noise, providing ear protection equipment (APT) such as earplugs and earmuffs, and a medical check-up to all workers once a year.

PT X Industri Gas Sidoarjo also explained that the use of APT has been stipulated, namely for workers to always use PPE and APT while doing work. However, the use of APT depends on the awareness of the workers themselves. So, in this case, there are still workers who do not use APT while doing work that is exposed to noise. Because of that, many PT X Industri Gas Sidoarjo workers experienced complaints of tinnitus after doing the work.

## CONCLUSION

Based on the results of this research, it can be concluded that there is a relationship between the age characteristics of the respondents with complaints of tinnitus. Fisher Exact test results also showed that there was no relationship between the characteristics of the respondent's tenure and tinnitus complaints and there was no relationship between exposure patterns with tinnitus complaints. Furthermore, the test results also indicate that there is a relationship between the intensity of work environment noise with complaints.

The advice given by the author to PT X Industri Gas Sidoarjo is that the company can enforce the use of ear protection equipment (APT) for workers and install a silencer that can absorb sound with high-

intensity noise such as glasswool, rockwool, foam, cellulose fiber, and acoustic fiber carpet type to reduce noise. Thus, noise at work can be minimized and the intensity of work environment noise received by workers' hearing can also be smaller.

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