

Ergonomic assessment and implement controls in Automobile Closed room Testing by using 'Risk assessment Methodology'.

Jithin V¹,

¹BMW India Pvt Ltd, Mahindra World City, Chengalpet-603002

Abstract - Automobiles is an unavoidable portion of our life. As we know there are many automobile manufacturers exists in the world. Each automobile manufacturer, who is producing vehicle with IC engines always integrating the product with 100% or sampling testing processes, manufacturing processes with high noises, lights, dust, fumes. etc. to meet the customer requirements/expectations. This includes different types of testing like destructive, non-destructive...etc. However in product testing sometimes it is important to test the products in closed rooms as well. Since all the processes engaged with workers directly, which need to improve their processes to ensure the employee's health and satisfaction. Indirectly this will provide the best results in the engaged results and thereby the organization can strive in to the excellence. In this Paper, the Risk assessment controls of a closed room automobile testing is discussed with the help of a Risk assessment tool.

Key Words: Hazards, Risk Assessment, Simulation Tests, Risk reduction..etc

1. INTRODUCTION

This Closed room testing with Engine ignition on condition can leads to accumulation of exhaust gases in the chamber. When there is a Manual controlled machines used for these testing, the exhaust gas get inhaled by the associates and can create the health issues due to polluted air. Moreover, the exhaust gases can pollute the work environment. As a society committed organization the environment pollution shall be avoided and better work environment to be provided to the workers as well as the interested parties. However, the legal requirements already adhering and reports already submitted to the regulatory boards.

Pollution is the introduction of contaminants to the system or atmosphere that cause serious impacts. This can

be different forms. Sometimes is like chemical substances or energy as like noise, heat, light. etc. Automobile pollutions are basically a mixture of gases, which contains different substances and gases. Many of them are declared as air pollutants already and toxic as well. Because these gases included carcinogens, which can leads to cancer.

There are different standard available to review and measure the risk of cancer and the air quality in the different work environments. NIOSH is one of the standard in which the "Air quality "is getting reviewed and monitored. "National Institute for Occupational Safety and Health" normally known as NIOSH is agency situated in the Washington D.C, with research laboratories. This institute has released a standard, in which the different air quality limits has been included. As per NIOSH web "NIOSH is part of the U.S. Centers for Disease Control and Prevention, in the U.S. Department of Health and Human Services. It has the mandate to assure "every man and woman in the Nation safe and healthful working conditions and to preserve our human resources." NIOSH has more than 1,300 employees from a diverse set of fields including epidemiology, medicine, nursing, industrial hygiene, safety, psychology, chemistry, statistics, economics, and many branches of engineering. NIOSH works closely with the Occupational Safety and Health Administration (OSHA) and the Mine Safety and Health Administration in the U.S. Department of Labor to protect American workers and miners."

1.1 Literature Review

The overall goals of literature review to understand the different scholarly articles and journals, and to get a relevant inputs in this field, "ergonomics assessment and process design". To address these topics, there are lot of journals reviewed and the crisp information captured here for better clarity.

“Hazardous chemicals escape to the environment by a number of natural and/or anthropogenic activities and may cause adverse effects on human health and the environment. Increased combustion of fossil fuels in the last century is responsible for the progressive change in the atmospheric composition. Air pollutants, such as carbon monoxide (CO), sulfur dioxide (SO₂), nitrogen oxides (NO_x), volatile organic compounds (VOCs), ozone (O₃), heavy metals, and respirable particulate matter (PM_{2.5} and PM₁₀), differ in their chemical composition, reaction properties, emission, time of disintegration and ability to diffuse in long or short distances. Air pollution has both acute and chronic effects on human health, affecting a number of different systems and organs. It ranges from minor upper respiratory irritation to chronic respiratory and heart disease, lung cancer, acute respiratory infections in children and chronic bronchitis in adults, aggravating pre-existing heart and lung disease, or asthmatic attacks. In addition, short- and long-term exposures have also been linked with premature mortality and reduced life expectancy. These effects of air pollutants on human health and their mechanism of action are briefly discussed”. (Marilena Kampa, 2007).

The application of ergonomics in enterprises is gaining in importance. Nowadays ergonomics in enterprises is addressed in a more technical manner. Therefore it is necessary to try to adapt generally applicable ergonomic practices to a technical perception. (Elsevier, Procedia Engineering 100 (2015) 592 – 601). This study shows that “a search for approaches that can be used as a link between technical and ergonomic perspectives of problems in the workplace”.

These ergonomic studies have focused especially on those workplaces, which offered the worst working conditions. The use of this methodology has provided a step-by-step overall vision of the assembly process from the first concept (Elsevier, Procedia Engineering 132 (2015) 1077 – 1080).

2. Research Methodology

In this research there are different processes involved. Which includes process review, hazard identification, Risk assessment, identifying controls, and reassessment.

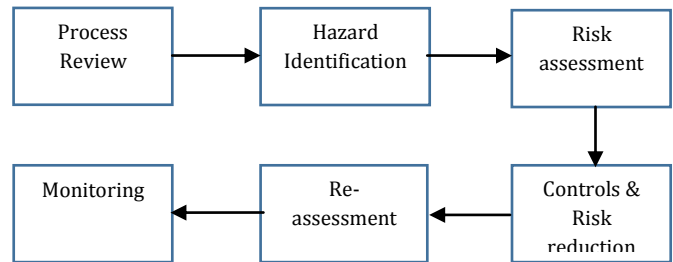


Fig -1: Process Flow

Process review is a step, in which the individual process steps and process flow to be assessed. For any risk assessment ‘process flow’ is one of the input. All the risk assessment to be done for individual processes and further actions to be reviewed.

Hazard Identification is a 2nd step, in which the individual process steps to be assessed to identify the Hazards and its severity. A hazard is a situation that poses a level of threat to life, health, property, or environment.

Risk Assessment is a process in which risk is assessing and the product of severity & probability to be compared. These products will be able to understand the level of risk and will be helpful to plan further actions.

$$\text{Risk} = \text{Severity} \times \text{Probability}$$

Controls & Risk Reduction is a 4th step, in which further process controls and the risk reduction methodologies to be identified. There are different types of methodologies can be used for risk reduction. As per British Standard OHSAS 18001: 2007 the risk reduction criteria are,

1. Elimination
2. Substitution
3. Engineering Controls
4. Administrative Controls
5. Personal Protective Equipment

Elimination is the first preferred criteria always. This category will eliminate the hazard and the risk occurrence can be avoided. The substitution is the criteria, is the second priority in risk reduction and the followed by other step criteria also.

Re-Assessment is a process in which effectiveness of risk reduction will be reviewed and the requirement of further actions will be reviewed. In the automobile testing the evaluation reassessment involves the testing of atmospheric conditions and evaluations included as a process of re-assessment

If the re-assessment shows that the drastic improvements in the system, then we can assume that the risk assessment process is it in the right direction.

As per OSHA guide lines, Sampling to be done for individual work sites to asses risk and its impacts. In sampling process basically two samplings types to be considered.

1. Personal Sampling
2. Work Place Sampling.

Personal Sampling is a process in which Individual personals and there inhalation to be assessed. As pe OSHA web, the personal sampling process “Sampling strategies should be planned for a meaningful evaluation of air contaminants and prudent use of limited resources.

Screening techniques and devices, such as detector tubes and direct reading meters, may provide valuable information when their use and their detection limits are appropriate (see Section II: Chapter 3 Technical Equipment: On-Site Measurements). Knowledge of sampling procedures, including sampling media, recommended air volumes,

and sample storage precautions, are essential in planning proper sampling strategies.

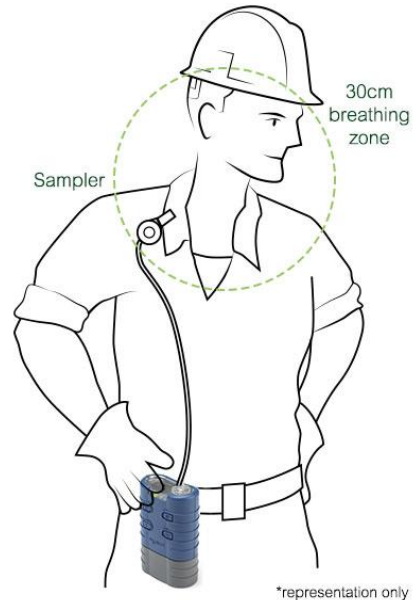


Fig -2: Personal Sampling

Bulk samples are sometimes necessary to support analyses of air samples, to document the source of air contaminants or to identify additional hazards. For example, in conjunction with air sampling for organic dusts, it may also be useful to collect bulk samples for analysis of explosibility and flash point to identify additional safety hazards. Or when air sampling for asbestos, it may also be useful to collect one or more bulk samples of suspect building materials to identify the source(s) of airborne fibers if this is not otherwise evident at the work site. Bulk samples are sometimes used in Hazard Communication inspections

Worksite sampling is another process step to collect the samples from worksite to assess the air quality. Samples can be collected from the sites with the help of below mentioned equipment. These samples to be tested with reference to the standards and the actions can be taken. All the results can be subjected to the assessments and decision can be made. In India, this is a requirements set by the pollution control boards to ensure the pollution free atmosphere.

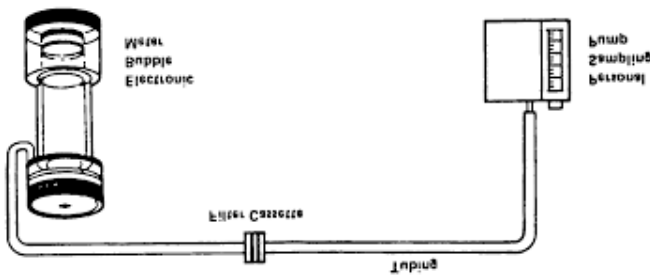


Fig -3: Worksite Sampling

In the Automobile Manufacturing process chain Closed Room testing is applicable in many process. The reason to have closed room testing is to ensure the best performances of the vehicle. Sometimes the vehicles to be tested in engine off status and with engine on status as well. Here the closed room testing process with engine in condition is selected and the assessment is started.

For better clarity, the closed room testing photo attached here.



Fig -4: Closed Room Testing (Sample: Road Simulation Test)

3. CONCLUSIONS

The real data collected from one automobile manufacturing unit to understand the air quality level.

3.1. Results and Discussions

In general the closed room testing of automobile, with engine start condition can generate the carbon monoxide. These carbon monoxide will pollute the air. In addition to that the Carbon Monoxide

will affect the worker health as well. Latest study shows that the as a worst case these polluted air can cause cancers to the persons. Roller test samples collected and compared to the NIOSH and OSHA standards. These results assessed and the primary review done in the processes. To protect the workers and to improve the health conditions, the improvements has been made in the testing processes. The major improvements has been listed here for better clarity.

Exhaust gas collection hoses is the first mechanism to the installed in the closed room testing. This will help to

- Collect the exhaust gases from vehicle
- Will send the exhaust gases in to the Chimney
- Ensure the closed room free from contaminants.
- Worker health can be improved.
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A sample of retraction type exhaust gas collection hose is attached here for better clarity.



Fig -5: Exhaust Gas collection Hose (Retraction type)

Process sequence improvement is the other methodology to be introduced in the closed room testing. After testing there should not be any review and assessment inside the room. Such processes to be eliminated in the process room and the same to shifted in to next stations.

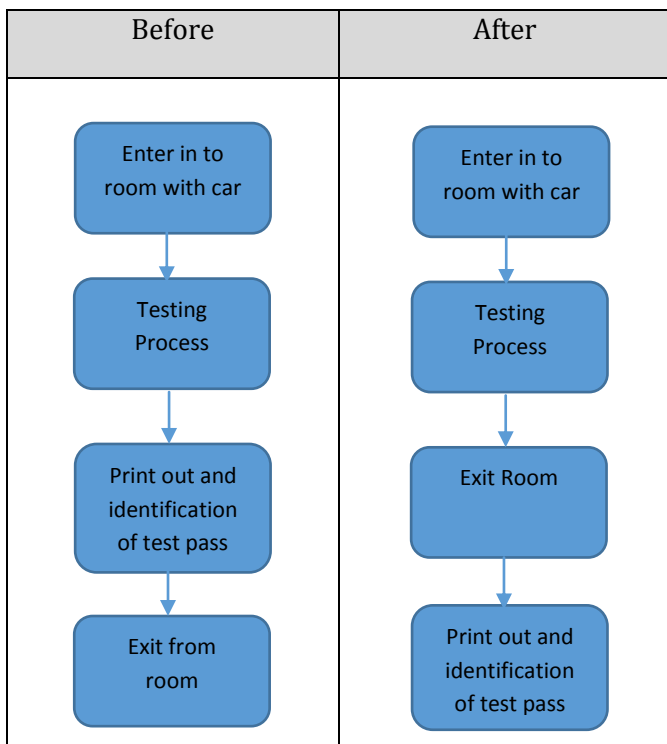


Table -1: Process flow before vs after correction.

These process steps review and changes will be helpful to avoid the exhaust gas inhalation within the processes. This is one of the process method which need to be ensured.

After implementing all these processes changes and improvements, the reassessment also done and the results given below.

Air Test report after improvements:

ROLLER TEST BOOTH AIR MONITORING ANALYSIS								
Sl. No.	Parameters	Unit	Test Method	Permissible exposure limits as per OSHA Standard	Sedan		XS	
					Personal Sampling	Work zone	Personal Sampling	Work zone
1	Carbon Monoxide	ppm	NOH-6604	50	<1	1.12	<1	1.62
2	Carbon dioxide	ppm	NSCH-6603	5000	780	2253	775	3110
3	Oxygen	%	NOH-6601	19.5% (V) Min.	21	20.8	21	20.6
4	Temperature	°C			24	35.1	22	31
5	RH	%	Wet & Dry Bulb Method	Not Specified	39	51.1	35	48
6	RSPM	mg/m ³	NOH-6600	5	BLO (LOQ0.1)	0.43	BLO (LOQ0.1)	0.83
7	Nitrogen dioxide	mg/m ³	NOH-6014	1.9	BLO (LOQ0.04)	0.22	BLO (LOQ0.04)	0.45
8	Sulphur dioxide	mg/m ³	NOH-6004	13.1	BLO (LOQ0.04)	1.71	BLO (LOQ0.04)	3.16
9	Benzene, Toluene, Xylene	ug/m ³	NSCH-1501	Not Specified	BLO (LOQ0.1)	BLO (LOQ0.1)	BLO (LOQ0.1)	BLO (LOQ0.1)
10	Aromatic Hydrocarbon	ug/m ³	NSCH-1501	Not Specified	BLO (LOQ0.1)	BLO (LOQ0.1)	BLO (LOQ0.1)	BLO (LOQ0.1)

Table -2: Air Sample inspection results

After improvements the air quality inside the rooms has been improved and well within the safe limit. (Ref: above table). Which shows that room air also like the natural air. Since the air doesn't contains the contaminated substances in higher level the worker risk also get reduced.

3.2. Conclusions

In this research we assessed the closed room automobile testing the following key conclusion made.

- No major worker risk involved in the processes after implementation of minimum requirements.
- Minimum requirements like exhaust gas collection hoses to be installed in the room with proper ventilation.
- Process to do inside the closed room to be eliminated and process balancing to be done with other processes.

In addition to the above conclusions, the other conclusion also made in this research. Whenever the closed room processes introduces in the automobile processes, the ventilation is identified as the key characteristic. Not only the ventilation, the vehicle condition also the important factor included in the consideration.

When the vehicles are not producing high level of emissions, the process controls itself is a negligible one. But this is not feasible in all the cases in the India.

These conclusions not only applicable to the automobile manufacturers, but also to can be followed in the service and mechanic showrooms. Wherever it may be, the worker health condition will get improved and the worker satisfaction will get improved.

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BIOGRAPHIES



Jithin. V, is an Industrial Engineer,
Working with BMW India Pvt Ltd
as an Asst. Manager. He is also a
certified lead auditor in

- ISO 14001: 2004
- BS OHSAS 18001:2007

And an internal Auditor in

- ISO/TS16949:2009