

Safety Risk Assessment in CNC GAS Cutting Machine of Mechanical (Manufacturing) Industry

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Abstract— The aim of this risk assessment is highlighting the safety aspect in CNC gas cutting process .The gas cutting is one of the hazardous process in manufacturing industry which have multiple potential hazard so that we have applied risk assessment method to find out risk related to it and also given countermeasures to reduce or eliminate risk in order to make the working environmental safe for worker.

Keywords—Risk Matrix; Risk Rating; Computer Numeric Control; Gas Cutting; SRA etc.

I. INTRODUCTION

Manufacturing industry is one of the growing industry in an India and all over the world. These industries have involved various hazardous operation such as loading, unloading, hot work etc. hot work operation such as gas cutting is one of the common hazardous process which is being used in industries for last several decades. It has many minor and major hazard which may lead to the accidents. Every accident whether it is minor or major has effect on economy of industry due to loss of time (productive hours), men power, medication, compensation to victims. For avoiding these accident it is important to eliminate or reduce the risk up to tolerable limit by taking preventive and control measures. In order of this risk assessment method plays significant role. The purpose of risk assessment to identify potential hazard and risk associated in the working area in order to keep workplace safe. For this purpose we have given countermeasures for each risk so as to avoid near miss and accidents. We have also rated or scored risk so that we can categorized risk.

II. METHODOLOGY

This risk assessment method is careful examination which helps to find out the all potential hazard concern with work area so one can check whether countermeasures have been taken or not to avoid any unwanted event ergonomical hazard.

This analysis includes six step:

1. Select job.
2. Brake the job into task.
3. Describe risk.
4. Rating or score the risk (Before giving countermeasures).
5. Describe giving countermeasures.
6. Rating or score the risk again (After giving countermeasures).

In this method firstly risk is identified in work area than it is categorized before giving countermeasure and after giving countermeasure risk is again categorized (scored or rated). Which shows the difference between before and after risk rating. It also shows that the risk has been minimized up to what level. This analysis generate data which can use for comparatively analysis. Risk matrix can be developed to separate risk event into risk class.

In our work we have taken problem in computer numeric control gas cutting machine of fabrication area .there are basically six major task which are involved in gas cutting operation.

1. Plate loading:- In task heavy metallic component or sheets are loaded on the CNC gas cutting machine which have abrasion hazard, person may injured due to falling of component or he may die due to this.
2. Plate alignment:- Because this machine is computer numeric control machine so that plate alignment task is required. To perform this task tools are required so selection of improper tool lead to injury or accident
3. Gas cutting:- This part of operation have burning hazard,. This is also have particle projection hazard and hazardous fumes also generate during the operation.
4. Removal of profile:-During this operation there may be Hit/ Impact/Crush hazards from machine / tool / Part (to head or any exposed body parts).
5. Shifting of profile:- This task have involvement of tools, material & equipment which include ergonomical hazard.
6. Shifting scrap:- During the cutting operation scrap produce which is removed after the operation. This scraps are improper in shape and are heavy in weight which is having cut/abrasion/crush hazard.

TABLE I SIX TASK (CNC GAS CUTTING)

Sr.No.	Task
1	Plate loading
2	Plate alignment
3	Gas cutting
4	Removing of profile
5	Shifting of Profile
6	Shifting Scrap plate

SAFETY RISK ASSESSMENT WORKSHEET:

CNC GAS CUTTING MACHINE

TABLE : SRA (Safety Risk Assessment)													
Area.....		Workstation.....			Date.....			Auditor.....					
Hazards	Risk Description	Apply	Task # (s)	P	G	C	R	Describe Risk	Countermeasure Description	P	G	C	R
General / SS	Are there particle projection hazard ?	Y	3,4	2	3	3	18	3) Expose to Flame & Spatter 4) Expose to flying burrs during profile removal	3) Screen for operator 4) Goggle	1	2	2	4
	Are there any Abrasion hazards?	Y	4	1	1	3	3	During removal of sharp burrs of Edges hands may be abraded	Hand Gloves & Instruction Display for awareness	1	1	3	3
	Are there Hit/Crush hazards from machine / Part? r any exposed body parts)	Y	4	3	2	3	18	Chances of fingers to Get between cut profile & plate	Hand Gloves & Instruction Display for awareness	1	1	3	3
	Are there any Cut hazards?	NA											
	Are there any contact with hot items?	Y	4	2	2	3	12	Recent cut profiles are Hot which can cause burn	Hand Gloves	1	1	3	3
	Are there any risks associated with temporary or contractor work or visitors?	Y	1,2,4,5,6	2	2	3	12	Plates are lifted with hooks can slip down Untrained operator may lead to met with abrasion, burrs (flying)	Standard operation procedure Displayed of, For long term magnetic Lifter plan	1	2	3	6
	Are work surface providing good footing ?	NA											
	Are tools is in good condition	Y	2,4	1	2	2	4	Improper tools may Cause of accident	Check tool daily	1	2	2	4
Are material ,tool & equipment in designated location?	Y	1,2,4,5,6	2	2	3	12	In absence of proper location tool may fall on the feet	Location for the tool (tool stand)	1	2	3	6	
Vehicle Operation/Material Movement (internal or External)	Do cart wheels have guards to protect against rolling over?	NA											
	Are walkways/aisles in good condition and with free access?	Y	All	2	2	3	12	Sprading of weld spatter	The path with made clear/gurdindg	1	2	2	4
	Are Emergency communication signs posted (exits, evac, fire ext)?	Y	All	1	2	3	6	In absence of the emergency can not be Handled	The Emergency sign pasted with Exit path	1	1	3	3
	Are Hoists, cranes, ropes, hooks, chains in good condition?	Y	1,5,6	1	3	2	6	Bad condition of lifting device may lead to accident	The Ropes are checked every six monthly	1	3	2	6
	Are hoist & lifting devices marked with capacity?	Y	1,5,6	1	2	3	6	The person working can lift more wt than the capacity	The Hoist marks with SWL size	1	2	3	6
	Do parts drop from lifting devices(bails, manipulators, slings, etc)?	Y	1,5,6	1	3	2	6	The falling object may cause Injury	Slings are Tested on 6 monthly bails	1	3	2	6

	Risk Description	Apply	Task #s)	P	G	C	R	Describe Risk	Countermeasure Description	P	G	C	R
	Does a struck/hit by object or vehicle hazard exist? (between person & Vehicle)	NA											
	Could operator walk into object?	NA											
PPE	Are Visible instructions/signs for PPE in use at workstation?	Y	All	2	2	4	16	The person will not know what is to be used	Visual management	1	1	3	3
	Are PPEs inspected and in good condition?	Y	All	1	2	3	6	Bad PPE may not protect	Regular check done	1	1	3	3
	Is appropriate PPE being worn?	NA											
Fire/Hot Work	Are Fire extinguishers available & accessible?	Y	All	2	2	3	12	In case of fire no control will be available	Fire Ext. installed	1	1	3	3
	Do explosive or combustible atmospheres exist?	NA											
Hy- Chemical/Industrial/ giene/Environment	Is Sufficient ventilation/good general air quality? (Vapor, mist, fume, particulate)	Y	3	1	1	3	3	The Fumes may cause Respiratory problem	The windows are provided for ventilation & mask	1	1	3	3
	Is there sufficient lighting for job?	Y	All	1	1	2	2	Insufficient light can lead to Accident	Sufficient light	1	1	2	2
	Does optical radiation risk exist? (laser, welding, torching)	Y	3	1	1	3	3	The Exposer to Cutting flame can cause eye irritation	PPE	1	1	3	3
Machine Safety	Do gears, pulleys, sprockets, flywheels have guarding?	Y		2	2	4	16	Absence of Guarding may lead to contact with rotating part	Guarding provided	1	1	3	3
	Does guarding prevent flying objects/debris and access hazards?	Y		2	2	4	16	Improper Guard may lead to Accident	Guards prevents the hazard	1	1	3	3
	Are access points for guards interlocked or fixed requiring a tool?	Y		2	2	4	16	During maintenance or absence of Guard m/c operation may lead to accident	Yes fastened guards	1	1	3	3
Ergonomics	Is there reaching below waist?	Y	4,6	2	2	4	16	Back pain problem for remove of profile & scrap	Required scrap store trolley	1	1	2	2

TABLE II RISK RATING OF PROBABILITY

Score/Rating	Probability
1	No events occurred in the past
2	Event is possible but not probable
3	Probable Event (risk applies 50% of tasks)
4	Relevant risk/event will occur (risk exists throughout job)

TABLE III RISK RATING OF GRAVITY

Score/Rating	Gravity
1	Near-miss event has occurred or possible
2	First aid event has occurred or possible
3	Lost time incident less than 30 days has occurred or possible
4	Lost time incident more than 30 days or fatality incident has occurred or possible

TABLE IV RISK RATING OF CONTROL

Score/Rating	Control
1	Elimination or substitution that eliminates hazard
2	Engineering Controls takes place
3	Training/Procedures/PPEs in place to minimize risk
4	Either no controls to reduce risk or controls have failed

PROBABILITY × GRAVITY × CONTROL = RISK

Here;

Probability word indicates exposure opportunity.

Gravity means degree of harm.

Control word shows preventive and control measures.

This help us to calculate the risk in number and this calculation is performed two times 1st before giving countermeasures, 2nd after giving countermeasures which also provide us data for comparative analysis.

		Control →			
		18	32	48	64
		8	16	27	36
		3	6	12	24
		1	2	4	9
↑ Gravity	4				
	3				
	2				
	1				
	0				
		→ Probability			

Fig 1. Risk Matrix

TABLE V RISK CATEGORIES

Risk Levels	
Very high risk	This risk is intolerable. Immediate action of prevention and protection needed to be taken. Temporary countermeasures should be taken immediately and action plan for final solution should be started and take place within 1 month.
High risk	Preventive and Corrective action to reduce the risk are required. Temporary countermeasure should within 1 month and action plan for final solution within 3 months.
Medium risk	Regular Checks are required to ensure that the risk is under control. Continuous monitoring is also required to ensure that risk is not growing further. Preventive and corrective actions can be taken.
Low risk	This is green zone which shows that the risk is tolerable . In the area the risk is under control. risk management through PPEs utilization.

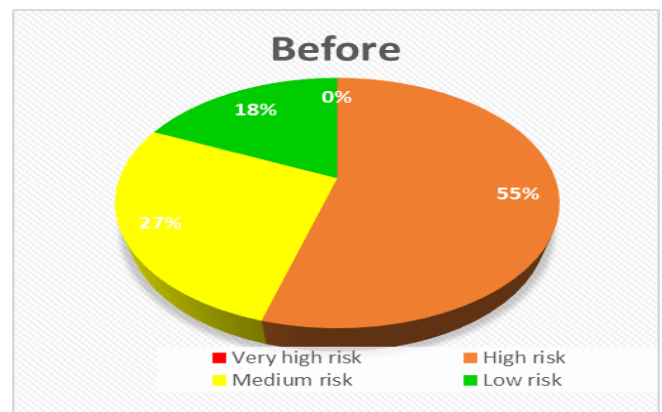


Fig 2. Risk Assessment (Before)

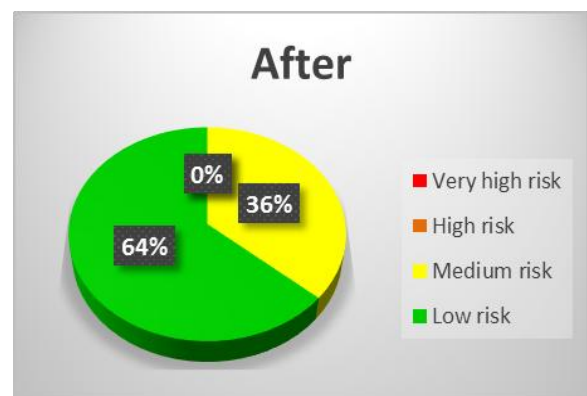


Fig 3. Risk Assessment (After)

III. RESULT & DISCUSSION

After risk calculation it is categorized and according to risk level counter measures are given to minimize risk/eliminate risk or reduce it to tolerable limit.

	Before	After
Very high risk	0	0
High risk	12	0
Medium risk	6	8
Low risk	4	14

IV. CONCLUSION

The use of risk assessment methodologies contributes to the prevent and control undesired event (near miss, accident). It also help to keep work place safe. Potential hazards associated to CNC gas cutting machine and its working area have been identified and proper control measures have been recommended by preparing risk assessment worksheet. Risk Rating is also calculated of the each work as per hazards identified and listed in risk assessment worksheet. which helps to understand whether risk is high or it has been reduced to tolerable limit. Risk matrix have also been formed to categories risk.

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