Safety Guidelines for Performing Risk Assessments

Prepared by the ASM-TSS Safety Guidelines Committee

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DISCLAIMER:

1. SCOPE

1.1 Introduction to the approach and concept of a Risk Assessment.
1.2 Steps that can be taken to improve workplace safety.
1.3 Examples of thermal spray hazards

2. REFERENCED DOCUMENTS

Where standards and other documents are referenced in this publication, they refer to the latest edition.

Publication	Pub. Edition	Available from:
TSSEA Code of Practice for the Safe Operation of Thermal Spraying Equipment		Mr. Ivor Hoff: Thermal.Sprayers@btinternet.com
Thermal Spraying: Practice, Theory and Application (Chapter 11)		American Welding Society 550 N.W. LeJeune Road Miami, Florida 331326 www.aws.org
Recommended Safe Practices for Thermal Spraying	Reprint No. 2, 1983	American Welding Society 550 N.W. LeJeune Road

		Miami, Florida 331326 www.aws.org
A guide to the Health and Safety at Work etc. Act		(UK) 1974, L1, ISBN 0 7176 044441 1
Free Risk Radar software download		www.spmn.com/products_software.html

3. TERMINOLOGY

3.1. *Definitions*

3.1.1. Risk Assessment – The steps involved in identifying, documenting and putting in place the necessary controls to minimize or eliminate the potential risk of an activity.

3.1.2. Frequency Rating – A measure of how often a particular activity with a potential risk is performed.

3.1.3. Severity Rating – A measure of the potential for injury of a particular activity.

3.2. ***Keywords***-- *Risk Assessment, Safety, Frequency Rating, Severity Rating, Engineering Controls, Administrative Controls, Confined Spaces, Hazard*

4. RISK ASSESSMENTS

Every activity that is carried out on a daily basis, from driving a car to work or flying on an airplane, poses a certain level of risk. It is the assessment of the risk (acceptable or unacceptable) and then putting in place a plan of action to control the unacceptably high risk, that can ultimately provide for a safer work environment.

The purpose of performing a risk assessment, or RA, is to make the workers and their management aware of the hazards in the work environment. With this knowledge, each risk can be identified in a methodical manner and a plan put in place to mitigate the hazard. More time and effort should be spent mitigating hazards that pose the highest risk, although no hazard should go unaddressed.

So, how does one perform a risk assessment? The information contained within this document provides a logical approach that can be taken to minimize risk and maximize safety. More formal descriptions of Risk Assessments are available and should also be consulted. The purpose of this document is to introduce the concept in enough detail that thermal spray practitioners can use it to improve safety in their work places.

Risk Assessments need to be customized to the specific workplace and to the actual work being performed. Therefore, no two Assessments will be the same.

There are basically four steps to improving operational safety by using a risk assessment. These are described in the sections below. Two case studies are given as examples to illustrate the concepts involved. Please note that the specific ratings that are used in this document are not as important as the methodology and approach that has been taken.

4.1 Identifying the Risks for Each Activity

The initial step of a RA is to **carefully** think about the **various risks** that are associated with **each activity** and to **document** the hazards posed by these risks. The level of hazard may be minimal or quite high, but anything that poses a real risk should be identified and written down. Trivial risks, or risks that are always present (such as walking into a wall or falling out of a chair) need not be addressed since they will only dilute the effectiveness of the RA.

When identifying risks, a systematic, methodical approach is always required so that all risks will be identified. This task can be quite complex and is sometimes overlooked.

Risk Assessments are recommended for use during the design stage for a new spray facility. In this way, safety can be incorporated up front and costly upgrades and modifications can be avoided. RA's are also useful for examining the safety of existing spray facilities. Flowcharting a process or operation can help in identifying risks associated with certain actions. RA's should be reviewed for completeness on a regular basis. Significant changes in personnel, operating procedures or equipment should trigger a review. At a minimum, annual reviews are recommended.

Some typical examples of activities performed in the thermal spray industry would be arc spraying, combustion spraying, plasma spraying, handling of gas cylinders, the use of cranes during lifting of parts to be sprayed, chemical cleaning, grit blasting, working in confined spaces, handling hazardous materials, working with robotic equipment, etc.

4.2 Rating the Risk, (R)

In order for a RA to be **practical** and **useful**, the identified risks listed in step one need to be rated. This will help to determine the most serious risks - those that need to be given priority of action. A Risk Assessment number (R) is calculated by multiplying the Frequency Rating (F), how often this risk is likely to occur, by the Severity Rating (S), when the risk occurs, how severe is it :

R = F x S.

The following guidelines may be used in the frequency and severity rating:

Frequency Rating (F):
1 = Highly unlikely occurrence
2 = Remotely possible occurrence
3 = An occassional occurrence
4 = A fairly frequent occurrence
5 = A frequent and regular occurrence
6 = Almost certain that the event will occur

Severity Rating (S):
1 = Negligible injuries (i.e. scratches, hole in the wall, no downtime)
2 = Minor injuries (i.e. cuts and bruises, 1-2 days of downtime)

3 = Major Injuries (i.e. concussion, broken bone(s), loss of limb or eye, major structural damage, 3 or more days of downtime)
4 = Possible/Probable death or total loss of building

Example: An activity where accidents are recognized as **a fairly frequent occurrence** has a Frequency Rating of 4. When the past records of these accidents are reviewed, it is determined that these injuries have been **minor**, so a Severity Rating of 2 is given. Therefore the Risk Rating (R) is calculated as (Frequency x Severity) 4 x 2 = 8.

When performing the Risk Rating, it is important to note what the initial assumptions may have been. Meaning, unskilled labor performing a skilled task would carry a higher risk than skilled labor performing the same task. Other assumptions may be that equipment is calibrated and working properly (i.e. has not been tampered with or modified), operators have received proper training, etc.

4.3 Putting in Place the Actions Required to Minimize Risk

Once all of the risks have been identified and prioritized for each activity, it is now important to identify the steps that are necessary to minimize or control each risk. It is the implementation of these steps that ultimately improves safety.

Risk mitigation can be accomplished by several different means. Employee awareness and training play a key role in mitigating work place hazards. Engineering controls that prevent unsafe conditions from occurring are also important. An example of an engineering control is the micro-switch that prevents the operation of a microwave oven when the door is opened. The other major risk mitigation tool is Administrative Control. These controls include such items as operational checklists, training, safe operating procedures, maintenance schedules, and so on. A judicious combination of engineering and administrative controls can often significantly reduce the risk of a potentially hazardous task without being too expensive to implement or too complex to work with on a daily basis. Ultimately, however, the successful reduction of risk relies on the willingness of management and employees to initiate and maintain safe working practices. Without the “buy-in” of operators, engineering staff and management, the safety improvements possible through engineering and administrative controls can be rendered useless.

It is highly recommended that all levels of employees participate in the risk assessment. Identification of a risk is greatly dependent upon the perspective of the person performing the task. What one person sees as a high level risk, another may see as being only a moderate risk. Many organizations have a “stop work” policy that enables any worker at any level to authorize a “stop work” if unsafe working conditions exist. Operations cannot be resumed until the hazard is corrected.

4.4 Review and Update the Risk Assessment on Regular Basis

Because change is inevitable and these changes may affect the validity of the actions/control measures that were put into place, it is very important that the Risk Assessment be reviewed and updated on a regular basis. The review process is also a helpful tool in determining how useful/practical a given control measure has been in minimizing the associated risk. Sometimes what seemed like a good idea at the time proves to be too costly or difficult to manage.

There is no set rule as to how often this needs to be done, but rather is left up to the discretion of the responsible party (company's Health and Safety Officer, manager in charge, etc). A good rule of thumb would be to review RA documents annually or whenever a significant change (i.e. new equipment installation, new employee hire) occurs.

In summary, an **effective Risk Assessment** should:

- Be systematic and logical in approach first looking at all of the activities / tasks that are necessary to accomplish a given task and then looking at the risks for each activity.
- Ensure that all relevant risks hazards have been addressed and identified.
- Focus on real risks and not obscure the RA with trivial risks or excess information.
- Prioritize the control measures / actions dealing with the highest, most significant risks first.
- Identify what assumptions were made (skilled or unskilled labor, calibration of equipment, etc.).
- Be regularly reviewed and updated / revised as necessary.
- Be signed off by the Manager responsible for the spray shop.

Appendix I: Some Typical Thermal Spray Risks to Consider When Performing a Risk Assessment

1. Explosion and suffocation/asphyxiation hazards from Compressed and Combustible Gases, which may be at high pressures.
2. Old, worn or cracked cables and hoses can cause gas leaks or electrical shocks.
3. UV/ infrared from plasma/arc torches can cause burns to face/skin/eyes.
4. High sound levels from equipment can cause hearing damage.
5. High voltage and high currents/improper grounding connections can cause electrical shocks that can be lethal.
6. Hot-sprayed parts or particles can cause burns and fires if directed at combustible materials (i.e. paper, rags, clothing, etc).
7. Chronic exposure to powder and spray process dust, fumes and mists can cause severe respiratory ailments.
8. Slippery floors from powder/water spills.
9. Mechanical pinch hazards from robots, turntables, automatic doors, etc.
10. Fire and explosions from fine metal powders and dust.
11. Handling Components: Manually or by crane, lifting or fork lift truck.
12. Risks associated with spraying of hazardous or toxic materials.

Appendix II: Typical Engineering Control Procedures that can be used In the Thermal Spray Process

1. Interlocks that: prevent walking into a spray booth that has robotic manipulation, allow exhaust systems to vent rooms in cases of gas leaks, etc.
2. Warning lights and audible sounds (sirens)s
3. Lockout/tag out stations.
4. Required use of respirators and other personal protection equipment (PPE).
5. Use of gas leak detectors and oxygen sensors.
6. Properly designed sound attenuation spray booths.
7. Properly designed ventilation and filtration equipment.
8. Proper assessment of, and compliance with all local, state and federal codes/norms/standards/regulations.
9. Selection of properly designed thermal spray equipment.
10. Properly designed part fixtures and tooling.
11. Maintaining and updating operator personnel records confirming safety and training approvals.
12. Properly reviewing Material Safety Data Sheets (MSDS).

Appendix III: Typical Administrative Control Procedures that can be used in the Thermal Spray Process

1. Written start-up and shutdown checklists.
2. Written and read standard operating procedures (SOPs).
3. Personnel safety training including respiratory/hearing training.
4. Equipment Maintenance/Calibration Schedules.
5. Scheduled thermal spray process and operation training.
6. Accident/incident procedures (reporting, investigation, corrective action, etc.).
7. Fire extinguisher training.
8. First-aid training, e.g., certified CPR training (required in some states).

Case Study #1: Risk Assessment of Working in a Confined Space

Step 1: Define Risks of Activity.

In the case of working in a confined space, the specific risks could be: limited access into and out of the booth, fumes, asphyxiation from gases, oxygen enrichment/deficiency, an explosive or combustible atmosphere, excessive noise or heat, etc.

Step 2: Rate the Risk (R).

Based upon the frequency (F) and severity (S) of each risk identified in Step 1, a table can be made up which would weight the risk (R) and identify the hazards.

Activity: **Working in a Confined Space**

No	HAZARD	RISK	F	S	R
1	Access / Exit	Difficulty in entering / exiting	2	3	6
2	Fumes	Inhalation causing illness	2	3	6
3	Asphyxiation (Oxygen Depletion)	Becoming unconscious / death	3	4	12
4	Oxygen Enrichment	Fire and/or explosion	2	4	8
5	Explosive atmosphere	Fire, explosion, death	3	4	12
6	Noise	Hearing Damage	2	3	6
7	Heat	Heat exhaustion	3	3	9

Step 3: Actions to Put in Place to Minimize/Reduce Risk:

For the activity of working in a confined space, the following steps would need to be put into place to minimize the risk:

No	Action / Control Measure
1	Test for explosive as well as breathable atmosphere (install gas detection system which is interlocked with gas and exhaust system; keep space well ventilated with clean and breathable air)
2	Install fire extinguishing equipment and alarms
3	Wear forced air breathing apparatus to minimize risk of oxygen depletion
4	All exits must be clear from blockage and identifiable even in the event of a power loss
5	Hearing protection must be worn when necessary
6	Employees must undergo training for gas handling / hearing protection / fire safety/respiratory protection
7	Use of a “buddy system” ensuring that someone else is always present

Step 4: Regularly Review and Update Process Risks and Actions to ensure that assessment is still valid and being implemented appropriately.

Case Study #2: Spraying a Bridge with Zn-Al Arc Sprayed Wire

Step 1: Define Risks of Activity.

In the case of performing this on-site arc spray job, some of the risks would be: shock/electrocution from the spray wires, falling off scaffolding, breathing spray fumes.

Step 2: Rate the Risk (R).

Based upon the frequency (F) and severity (S) of each risk identified in Step 1, a table can be made up which would weigh the risk (R) and identify the hazards.

Activity: **Working in a Confined Space.**

No	HAZARD	RISK	F	S	R
1	Touching Wires	Electric shock/Electrocution	2	3	6
2	Entanglement in Processes wires/cables	Falling off scaffolding/death	3	4	12
3	Fumes	Inhalation causing illness	2	3	6

Step 3: Actions to Put in Place to Minimize/Reduce Risk:

For the above activity, the following steps would need to be put into place to minimize the risk:

No	Action / Control Measure
1	Limit distance of exposed feed wires in set-up and provide protective barrier so that wires can not be touched
2	Personnel must wear protective harness equipment to prevent falls.
3	Wear appropriate and approved respirators to minimize inhalation of zinc and aluminum fumes. Note: Personnel must be “fit-tested” by a qualified industrial hygienist before the use of a respirator.
4	Comply with all local, state and federal codes relating to this type of “construction” related work as well as obtain all necessary permits.

Step 4: Regularly Review and Update Process Risks and Actions to ensure that assessment is still valid and being implemented appropriately.