Attachment 4-8-1

Operational Report

This Section includes:

The Operational Report should describe the plant, methods, processes, ancillary processes, abatement, recovery and treatment systems, and operating procedures for the activity, to include a copy of such plans, drawings or maps, process flow diagrams, and such other, reports and supporting documentation as are necessary to describe all aspects of the activity.

The following information should be supplied:

- *A list of all unit operations to be carried out.*
- *A schematic or simple flow diagram of the activity and each unit operation, along with a brief description detailing its purpose.*
- *A description of the process control system indicating the control equipment.*
- *Information on all aspects of the unit operation that can cause emissions to the environment during normal operation and also in the event of a malfunction or interruption of services e.g. power loss.*
- *Details of internal capacity and throughput for each unit operation including the range of input and output materials.*
- *Brief details of the activities carried on in laboratory facilities associated with the activity.*
- *Detailed descriptions and schematics of all abatement systems.*
- *Detailed of the storage conditions, location within the site, segregation systems used and transport systems within the site for raw materials, intermediates and products.*
- *Details of sewerage and surface water drainage infrastructure, including location and sizes of pipes, outlets, invert details, treatment facilities, etc.*
- *For waste activities, details of waste quarantine and waste inspection areas, traffic control, (including location and detail of signs, barriers, parking, number of vehicles catered for, etc.) and delivery and reception of waste.*

Unit operations refers to processes as well as plant/ infrastructure be it a treatment plant, composting facility, or landfill, etc. All treatment and abatement systems to be employed should be detailed including information on the capacity and throughput.

Hours of Operation

Details of hours of operation for the installation/facility in the Section 9 'Environmental Management' template attachment. Summary details should be included in the operational report where relevant.

Any assessment of the potential impacts from the installation should have reference to the proposed hours of operation.

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1 INTRODUCTION

Dublin Aerospace Limited (hereinafter DAL) is proposing to operate an aircraft maintenance facility at their site located in Ashbourne Industrial Estate, Ashbourne, Co Meath. The proposed activities at this facility are currently being undertaken at their facility located at Hanger 1, Dublin Airport, Co. Dublin which is operating under EPA Licence Reference P0480-02.

The Applicant is applying to the EPA for an Industrial Emissions Licence in respect of the activities proposed at the Ashbourne facility which will involve the relocation of current operations taking place at Hanger 1, Dublin Airport to the facility located in Ashbourne.

1.1 Background and History

DAL have been operating at the site in Dublin Airport since March 2009. DAL had been operating under an Industrial Emissions Licence Reg. No. P0480-02 since 30 December 2010 as the IPPC licence which was transferred to DAL from SR Technics Ireland Limited (SRT). The original IPPC Licence was granted to SRT on 17th August 2006. The licence was amended under the Industrial Emissions Directive (IED) Section 82A (II) Amendment dated 18th December 2013 and is now referred to as an Industrial Emissions (IE) Licence.

DAL operations are undertaken in Hangar 1, 4 and 5 under the existing licence, P0480-02 and the following are the licensed activities;

12.3 The surface treatment of metals and plastic materials using an electrolytic or chemical process where the volume of the treatment vats exceed 30m^3 – Principal Activity

12.2.2 The manufacture or use of coating materials in processes with a capacity to make or use at least 10 tonnes per year of organic solvents, and powder coating manufacture with a capacity to produce at least 50 tonnes per year, not included in paragraph 12.2.1.

Dublin Aerospace Ltd. is proposing to relocate part of its operation from Hangar 1 to a new location at Ashbourne Industrial Estate, Ashbourne, Co Meath.

This site in Ashbourne Co. Meath was previously licenced by the EPA from 29th July 1998 under Integrated Pollution Control Licence P0237-01 which was surrendered on the 25th April 2008 under the name of Polyglass Ltd.

1.1.1 Proposed Facility

The proposed development, which was previously an EPA Licensed Facility (Polyglass Ltd.), consists of the re-fitting and refurbishment of the existing established industrial premises for industrial uses. The existing unit when redeveloped will be specifically an Aircraft landing gear overhaul facility. The principal activity consists of the surface treatment of metals and plastic materials using an electrolytic or chemical process (Class 12.3 of EPA Act 1992).

The classes and nature of the Industrial Emissions Directive activities in accordance with the First Schedule of the Act of 1992 are:

> *12.2.2. The manufacture or use of coating materials in processes with a capacity to make or use at least 10 tonnes per year of organic solvents, and powder coating manufacture with a capacity to produce at least 50 tonnes per year, not included in paragraph 12.2.1.*
>
> *12.3. The surface treatment of metals and plastic materials using an electrolytic or chemical process where the volume of the treatment vats exceeds 30 m3 (Principal Activity).*

Figure 1: Layout of the Proposed Development

Figure 2 outlines the site layout which identifies the facility boundary, facility entrance, cark park areas, pedestrian entrance and walkway route, loading bays, facility drainage and the facility building which houses the processing building, storage areas and the facility offices.

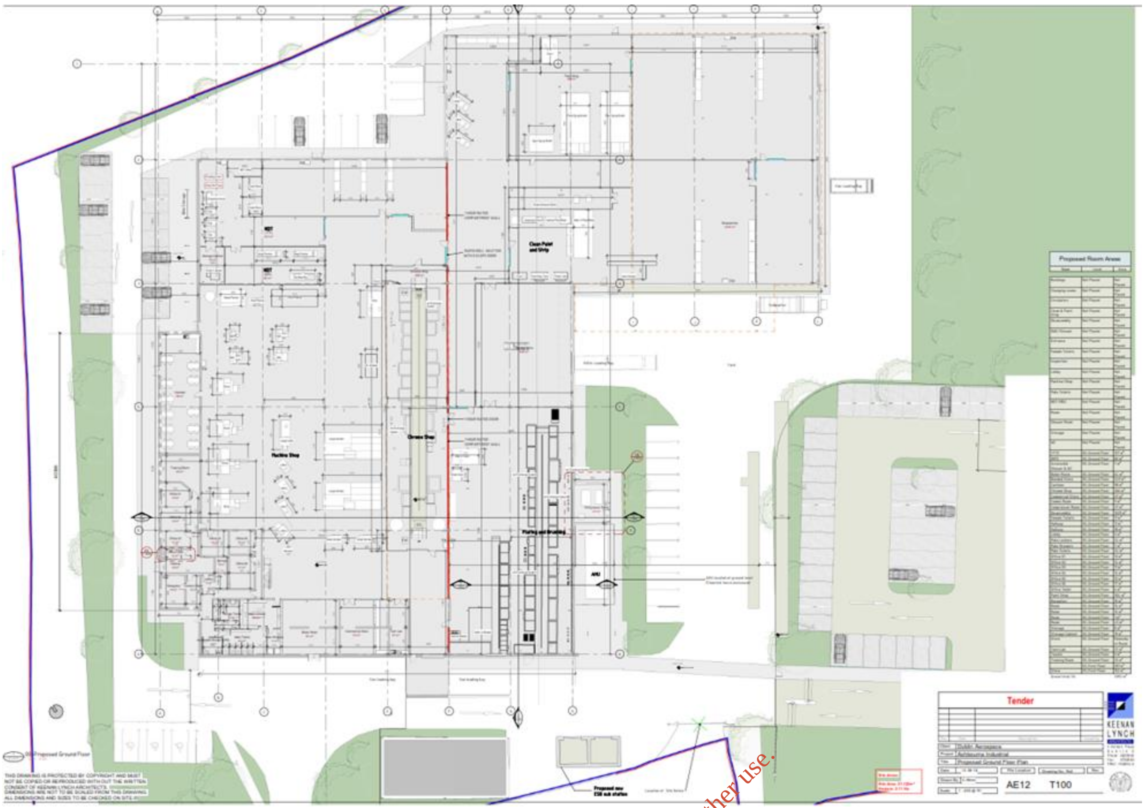


Figure 2: Detailed Site Layout Plan

The existing unit in Ashbourne Industrial Estate when redeveloped will be specifically an Aircraft landing gear overhaul facility. The operation of landing gear overhaul, consists of the renovation of used landing gear from various airlines, stripping the gear down to its components, removing existing finishes to leave bare metal, subsequent inspection of components for damage, such as metal fatigue, repairing any damage identified as required and finally, the reapplication of the protective and functional finishes. The individual refurbished components are then reassembled/certified and shipped back to the customer; thus, the facility is in summary for the service and maintenance of aircraft landing gear assemblies/components.

This application is for an industrial emissions licence for the new location to cover landing gear overhaul which is currently carried out at Hangar 1 at Dublin Airport under EPA Licence No. P0480-02. This is to enable future expansion of the services which DAL can provide.

An application for planning permission was submitted to Meath County Council and granted on the 23rd September 2019, reference number AA/19080

2 PROPOSED UNIT OPERATIONS

The proposed re-development of the industrial unit in Ashbourne will comprise of the following operations, specifically for landing gear maintenance and overhaul;

- Cleaning landing gear
- Painting landing gear;
- Machining landing gear;
- Blasting landing gear;
- Electroplating;
- Testing via NDT (Non-destructive testing); and
- Assembly and Disassembly.

2.1 Process Description

The following describes these unit operations. Process flow diagrams are included in Section 2.2.

2.1.1 Landing Gear Workshop

There will be three spray painting booths located in the landing gear workshop in addition to a bunded storage area. Chemicals used and stored in this area will consist of various solvents, paints, aerosols, detergents, gas cylinders and liquid nitrogen units. The paint preparation area of the workshop will also contain various pieces of equipment include mills, lathes and drills.

Each spray booth provides air extraction during the painting process. Each booth has a control panel located on entrance to the spray booth / If air extraction is insufficient due to the filtering processing a light will indicate that maintenance is required and that the filters may require change out. A daily check is carried out on this and the checks are located in situ at the spray booth. On average filters are changed out every three months in line with preventative maintenance schedule.

In the event of service interruption to the spray booth e.g. failure of standby air compressor to kick in then the spray booth is shut down and works cannot be carried out.

2.1.2 Landing Gear Strip Area

This area contains the chromic acid scrubbing units which removes chromic acid from the plating process. This area also contains work benches and some tools for examination of the landing gear and breaking down the gear into its component parts. The chromic acid scrubbing unit will be relocated to the proposed licenced facility as per engineers' specifications.

2.1.3 Inspection Area

This area will contain benches for examining parts.

2.1.4 Machining Landing Gear

2.1.4.1 Machine Shop

The machine shop will contain four grinders, two large grinders with reservoir storage tanks of coolant from the machine and two smaller grinder which will be fed by the machine shop coolant system. These units will all be self-contained, sealed and bunded.

Any parts going in the machine go through the various process below;

- Corrosion removal by machining or grinding using milling machines grinding machines lathes horizontal boring machine.
- Finish grinding of hard chrome plate using grinding machines.
- Bushing fabrication using laths
- Bushing installation using lathes, bench presses and hydraulic presses.
- Stress relieve using shot peening machines.

2.1.4.2 Blasting Landing Gear

Blasting - It is proposed to have "walk in" plastic media blaster's in the paint strip and clean shop areas and two cabinet plastic media blasters in the same area.

In the Machine Shop it is proposed to have a glass bead blasting machine, a walk-in shot peen machine and a cabinet shot peen machine. In the General Plating Shop, it is proposed to have a walk-in Aluminum Oxide blasting machine and a cabinet Aluminum Oxide blasting machine.

All of these blasting machines will be stationary.

Landing Gear Assembly Workshop: This area will contain work benches and some handheld tools for assembly of the landing gear.

2.1.4.3 Electroplating

Plating Workshop: Cadmium, nickel and chromium plating operations will be undertaken within this proposed area using electrolysis. The plating shop also carries out grit blasting using aluminum oxide. Aluminum Oxide is an abrasive cleaning process to clean the surface of the metal part being plated to give good adhesion. It is proposed to have a walk-in Aluminium Oxide blasting machine and a cabinet Aluminum Oxide blasting machine.

The nickel and chrome plating processes are used to restore original dimensions of components previously machined below their design dimension. Chrome is also used for wear, resistance, corrosion protection and lubrication in the "hydraulic ram" of landing gear. There is also an Alocrom process which is a dip tank for aluminum parts. Nital etch is also carried out in this area. Black oxide also a dip process is carried out in this area.

Cadmium Plating is used for corrosion protection of aircraft landing gear parts. The process generally consists of the following steps at the existing location which will be transferred to the proposed licensed facility:

a) The part to be plated is grit blasted or waxed in preparation for plating.
b) Waxing is part of the preparation process for chrome and Nickel parts and is a masking process to cover areas not to be plated. Masking is carried out on parts to be cadmium plated also but platers tape is used. which is a strong plastic sticky tape.
c) Surface preparation for cadmium uses grit blasting but chrome parts are prepared using pomous powder and abrasive pads to create a water-break-free surface before being plated.
d) The part is placed in the plating bath and a DC current is applied.
e) After an appropriate length of time (6 minutes (minimum in cadmium tanks) to 36 hours) the part is removed.
f) The part is rinsed in a drag-out tank adjacent to the plating bath.
g) Chrome and Nickel parts are rinsed in a cold-water tank and a hot water tank or in a demasking tank.
h) The part is either dried with a compressed air gun or degreased in a degreaser.
i) The part is heat treated to stress relieve the base metal during the plating process. The reaction of the Hydrogen gas during the plating process stresses the base metal. The baking stress relieves the part.

A cadmium recovery unit (BEWT) is used to remove the metal from the Cadmium plating drag-out tank by collecting cadmium on plates. This is a closed loop system and is not connected to main drainage in any way. An ion exchange filtration system is used in conjunction with this to remove any additional contamination. When the plates are fully coated, they are transferred to a cadmium strip tank, where the cadmium is removed from the plates. The hot and cold rinses overflow into a storage tank and are fed through a closed loop effluent treatment system. The drag-out tank from the chromium and nickel plating is fitted with an ion resin filter to remove surplus chromium ions from the water. The filters are changed out from this process by an external specialist and returned to the manufacturer for appropriate recycling/disposal. Storage of chemicals in this area will include acids, caustics, toxic metals (poisons) in solutions, degreasing chemicals and waxes. These will be all stored in bunded areas/containers in line with proposed EPA licence.

In the event of interruption to service e.g. power down, fire alarm occurrence etc. The power is switched off into the plating shop then the process is contained in situ. Lids on tanks fail safe closed in the event of air compressor failure (lids are pneumatically controlled). Table 1 below details the electroplating workshops tanks. Some volumes of the tanks are in the process of being manufactured and sizes must be confirmed (*TBC – To be Confirmed).*

Table 1: Electroplating Tank Data

Tank	Volume	Components	Concentration
Chrome tanks first Composition	TBC	Chromic acid	375g/L – 412g/L
Chrome tanks second Composition	TBC	Chromic acid	250g/L – 275g/L
Alocrom	2393 Litres	Alodine 1200S	6.25g/L – 18.74g/L
Ardrox 185L	2000 Litres	Ardrox 185L	20% - 40%
Ardrox 6333A	2393 Litres	Ardrox 6333A	5ml/L – 10ml/L
Bright Cadmium	TBC	Cadmium metal Sodium cyanide Sodium hydroxide	23g/L – 27g/L 90g/L – 130g/L 12g/L – 24g/L
Cadmium Strip	4850 Litres	Ammonium nitrate	105g/L – 157g/L
Caustic Dip	TBC	Sodium hydroxide	4ml/L – 6ml/L
Chrome Strip	TBC	Sodium hydroxide	42ml/L – 90ml/L
Hydrochloric Etch	TBC	Hydrochloric acid	4v/v – 6v/v
LHE Cadmium	4850 Litres	Cadmium metal Sodium cyanide Sodium hydroxide	49g/L – 56g/L 150g/L – 210g/L 26g/L – 38g/L
Nickel Plate	2960 Litres & 2300 Litres	Nickel sulphamate Chloride Boric acid Nickel metal	322g/L – 500g/L 3.37g/L – 4.9g/L 30g/L – 40g/L 50g/L – 90g/L
Nickel Strike	TBC	Nickel chloride Hydrochloric acid	225g/L – 262g/L 123g/L – 140g/L
Nital Etch	TBC	Nitric acid	3v/v – 5v/v
Passivate 22A	420 Litres	Sodium dichromate Nitric acid	19g/L – 30g/L 150g/L – 262g/L
Passivate A	4850 Litres	Sodium dichromate Sulphuric acid	180g/L – 225g/L 10ml/L
Passivate B	TBC	Sodium dichromate Sulphuric acid	180g/L – 225g/L 10ml/L
Sulphuric/Hydrofluoric Etch	2500 Litres	Sulphuric acid Hydrofluoric acid	411g/L – 575g/L 25g/L – 49g/L

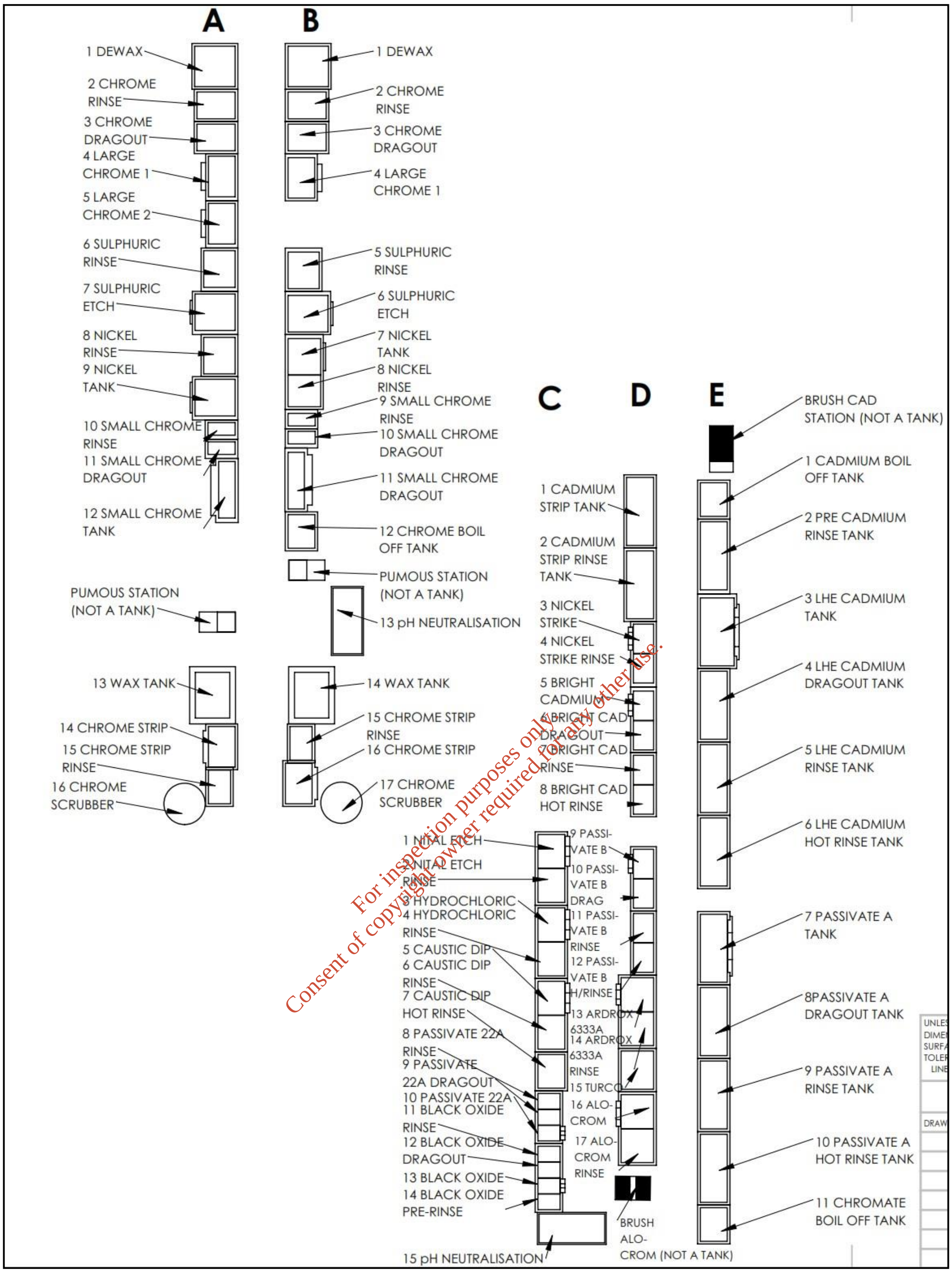


Figure 3: Process Tank Data

2.1.5 Testing via NDT

Non-Destructive Testing (NDT) Workshop: This area will consist of a number of small tanks that hold fluorescent dye material. The non-destructive testing process consists of various fluorescent dye penetrant tanks and an emulsifier which are used to highlight cracks (FPI fluorescent penetrant inspection). From there the part is then cleaned down and transported to the developer which all aids in identifying potential cracks in the part. Finally, the parts are inspected under ultraviolet light. Magnetic particle inspection (MPI) is also carried out in this location and is considered a non-destructive testing (NDT) process for detecting surface and slightly subsurface discontinuities in ferromagnetic materials such as iron, nickel, cobalt and some of their alloys.

2.1.6 Nitrogen

Nitrogen gas is used in the landing gear facility to “charge” the landing gear before being dispatched back into service. Nitrogen is stored in pressurised cylinders at 3,000 PSI; these cylinders are stored on a trolley and locked in position. The nitrogen is fed from the cylinders to the workpiece through a regulator and tubing to a connection on the landing gear. There gears are sealed and there is no discharge to air. Nitrogen gas is used at most once a week and amounts consumed are small in volume.

Liquid Nitrogen will be used in the freezing of the bushings to allow ease for placement for interference assembly. The liquid nitrogen which will be in a sealed unit in a designated area. Chemical Storage Area and Stores: The chemical storage area will contain quantities of various materials including solvents, acids, corrosives, etc. Materials will be segregated depending on their hazardous properties and will be stored in/on either self-bunded flame proof chemical units or approved bunded pallets. The storeroom will contain racks of storage for parts. These stores will also contain three small designated chemical stores for glues, cleaning materials and adhesives.

2.1.7 Chemical Storage Area and Stores

The chemical storage area will contain quantities of various materials including solvents, acids, corrosives, etc. Materials will be segregated depending on their hazardous properties and will be stored in/on either self-bunded flame proof chemical units or approved bunded pallets. The storeroom will contain racks of storage for parts. These stores will also contain three small designated chemical stores for glues, cleaning materials and adhesives.

The storage and use of all chemicals and nitrogen will be incorporated into the company’s Environmental, Health and Safety Management System

The following process flow diagram illustrates a summary of the operations for the proposed facilit

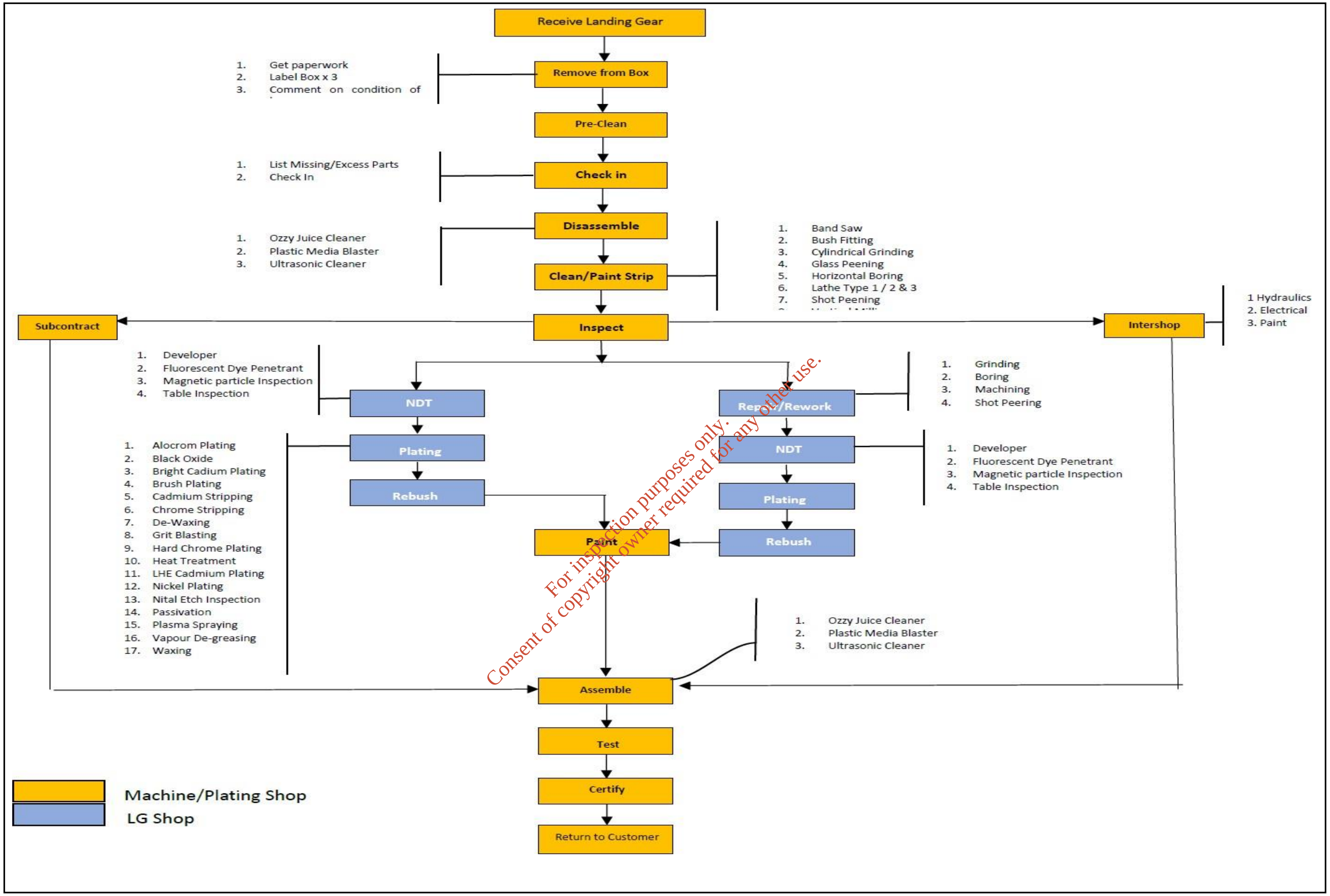


Figure 4: Flow Diagram of Proposed Operations

2.2 Summary & Schematics of the Process

Dublin Aerospace repairs and maintains landing-gear assemblies from aircrafts.

Table 2: Summary of Process Operations

On-site Processes at the Proposed Development	Associated Activities & Processes
Landing Gear Overhaul	• Stripping landing gear • Electroplating • Painting • Testing via NDT (Non-destructive testing) • Assembly and Disassembly
Stripping of Landing Gear	• Band Saw • Bush Fitting • Cylindrical Grinding • Glass Peening • Horizontal Boring • Lathe Type 1 • Lathe Type 2 • Lathe Type 3 • Shot Peening • Vertical Milling
Electroplating Shop	• Alocrom Plating • Black Oxide • Bright Cadium Plating • Brush Plating • Cadmium Stripping • Chrome Stripping • De-Waxing • Grit Blasting • Hard Chrome Plating • Heat Treatment • LHE Cadmium Plating • Nickel Plating • Nital Etch Inspection • Passivation • Plasma Spraying • Degreasing • Waxing
Testing via NDT (Non-destructive testing)	• Developer • Fluorescent Dye Penetrant • Magnetic particle Inspection • Table Inspection
Assembly and Disassembly	• Ozzy Juice Cleaner • Plastic Media Blaster • Ultrasonic Cleaner

The paint and cadmium plating finishes are initially removed to assess the integrity of each component. Each component is then reworked, checked for heat damage in the plating shop and non-destructive testing carried out by magnetic particle/dye inspection (NDT area). It is then shot peened in the machine shop to improve fatigue resistance and cadmium plated in the plating shop. It then has new bushings fitted and sealed in the machine shop. Finally, it is prepped using a solvent, the parts are then primed using a spray gun (1 coat).

Each part is then dried for 1 hour and then using a spray gun, once again, these parts are sprayed with 2 coats of paint, before final inspection and certification in the assembly area. Some parts would require a thicker paint finish e.g. Boeing gears.

The shock strut internal components are visually inspected dimension checked and magnetic particle/dye penetrant inspected (Inspection area) and magnetic particle/dye penetrated inspected (NDT area). The shock strut is reassembled using new seals, back up rings, scrapers, oil valve, air valve and serviced with Landing Gear Fluid (LGF), tested and certified (Assembly area).

The landing gear assembly is reassembled using consumables, namely nuts, bolts, washers, cotter pins, locking wire, clips and clamps. The assembly is then fully lubricated and tested for proper operation before packing for dispatch.

Figures 5 to 11 below summaries the process flow of activities in each of the unit areas outlined.

Appendices 1 to 4 give full details relating to each step of these processes

The delivery & acceptance of materials on-site is summarised in Figure 5.

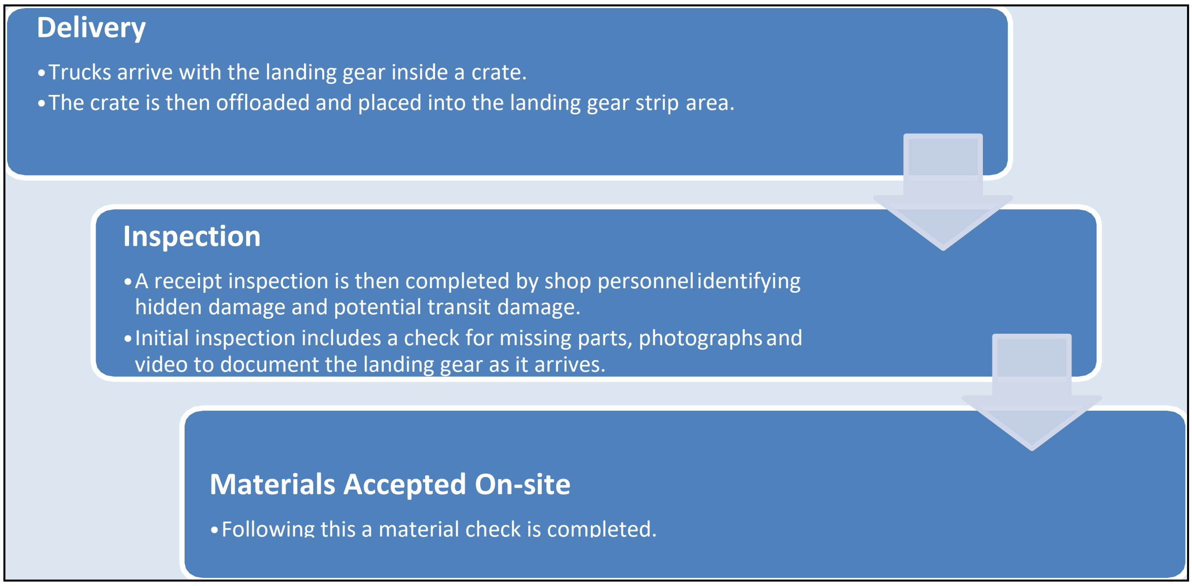


Figure 5: Delivery & Acceptance of Materials On-Site

2.2.1 Cleaning Landing Gear

All landing gear is stripped and cleaned on-site. Figure 6 below details the stripping process. Figure 7 details the cleaning, degreasing, stripping, blasting and inspection process.

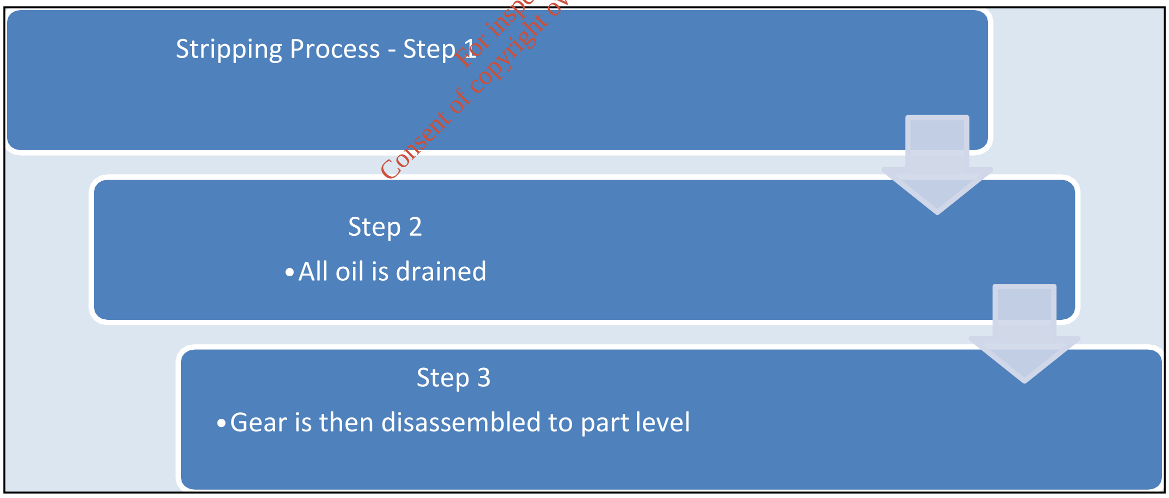


Figure 6: Stripping Process

2.2.2 Machining landing gear / Blasting landing gear

1. Cleaning Process

- All parts are cleaned removing all oil and grease.

2. Ultrasonic Cleaner

- A closed loop sealed ultra-sonic cleaner will be used for this part of the process, where the waste product is recycled within the sealed unit. The machine will use a chemical called perchloroethylene at a quantity of approximately 870 Litres.

3. Degreaser

- A new proposed de-greaser will be using a chemical called perchloroethylene.
- The closed loop vapour degreaser will be located in the Machine Shop area of the facility, where the waste product is recycled within the sealed unit.
- The degreaser is used for:
  - post chrome plating, to remove any wax residue from parts.
  - post machine repair operations to remove any coolant or lubricating oil residues.
  - post NDT processes to remove any fluorescent penetrant inspection (FPI) or Magnetic Particle Inspection (MPI) oils.
  - post bushing (bushes fitted to parts) to remove any lubricating oils or machine oils.
- The machine is used by most departments and uses a chemical called perchloroethylene at a quantity of approximately 800 Litres for this machine.

4. Paint stripping

- Plastic media is used to strip away the paint and in some cases a paint stripping chemical.
- Most parts are put in the paint strip tanks which is just a caustic based solution (this softens the paint making the blasting process easier).

5. Blasting

- Paint strip and clean shop areas - A “walk in” plastic media blaster and two cabinet plastic media blasters proposed.
- Machine Shop - Glass Bead blasting machine, a walk-in Shot Peen machine and a cabinet shot peen machine proposed.
- General Plating Shop - a walk-in Aluminium Oxide blasting machine and a cabinet Aluminium Oxide blasting machine proposed.
- All of these blasting machines will be stationary.

6. Inspection

- All parts are inspected as per manual (CMM) which are then sent to the applicable rework process.

Figure 7: Machining Landing Gear / Blasting Landing Gear

2.2.3 Machine Shop

Figure 8 below details process in the Machine Shop:

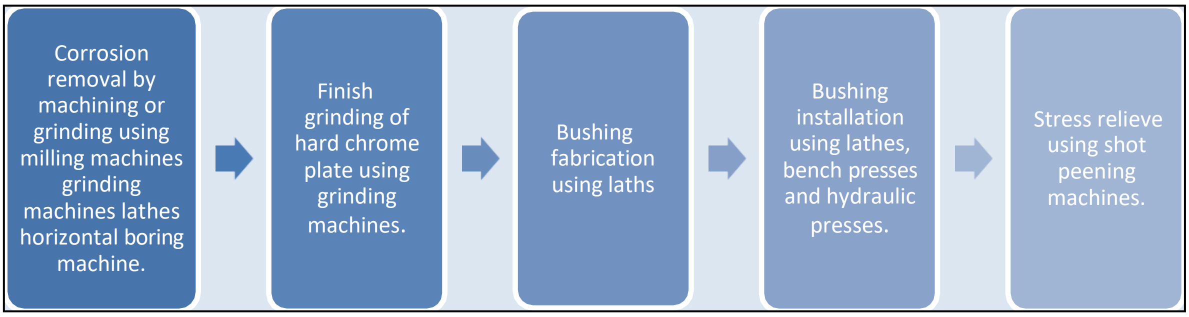


Figure 8: Machine Shop

2.2.4 Electroplating

The electroplating process is summarised in figure 9 below.

1. Nital

Nital Etch which is nitric acid treatment followed by water rinse followed by hydrochloric acid, water rinsed, sodium hydroxide treatment, water rinsed, washed in hot water and oven dried.

2. Bright / L.H.E Cadmium

Bright / L.H.E Cadmium which comprises blasting with aluminum oxide followed by immersion in a Bright / L.H.E Cadmium solution followed by drag out then water rinse.

- It is then washed with hot water and oven dried.

3. Masked & Waxed

Parts are masked and waxed then areas to be chrome plated are de-masked and surface cleaned before plating.

- Once plating is complete parts are rinsed in dragout then rinse tank before de-wax degrease and then oven dried.

4. Nickel treatment

- Comprises of a wax and application of a nickel solution followed by a water drag-out then rinse tank before de-wax, degrease then finally, it is oven dried.
- This process includes etching with hydrofluoric and sulphuric acid tank before nickel plating.

5. Alocrom process

- The Alocrom process to degrease with Alocrom solution, rinse with water and then wash with hot water and dry.
- Parts are degreased in vapour degreaser, then immersed in a caustic solution (Ardrox 6333A), rinsed, then there is an optional second cleaner (Turco Smut Go No.1) and another water rinse to get a water-break-free surface.
- The part is put in the Alocrom tank (chemical is called Alodine 1200S).
- Once finished it is rinsed in a hot rinse tank and air dried.

6. Black Oxide Process

- The Black oxide process involves blasting with aluminum oxide and treat with black oxide solution.
- This is followed by a water rinse, wash with hot water and dry.

Figure 9: Electroplating Process

2.2.5 Testing

Testing via Non-destructive testing is summarised in figure 11 (Magnetic Particle Inspection) and Figure 12 (Fluorescent Penetrant Inspection) below.

Magnetic Particle Inspection (MPI), is a non-destructive examination (NDE) technique used to detect surface and slightly subsurface flaws in most ferromagnetic materials such as iron, nickel, and cobalt, and some of their alloys. **The process includes the following steps:**	1.1. Induce a magnetic field in the specimen 1.2. Apply magnetic particles to the specimen's surface 1.3. View the surface under black light, looking for particle groupings that are caused by defects 1.4. Demagnetize and clean the specimen

Figure 10: NDT: Magnetic Particle Inspection

Fluorescent penetrant inspection (FPI) testing is that the liquid penetrant is drawn into the surface-breaking crack by capillary action and excess surface penetrant is then removed; a developer (typically a dry powder) is then applied to the surface, to draw out the penetrant in the crack and produce a surface indication. **It is usually a six-stage process:**	1.1. Surface cleaning (degreasing) 1.2. Application of a penetrant liquid (dipping, spray, brush) 1.3. Removal of excess penetrant (solvent, water) 1.4. Application of developer 5. Inspection of test surface (visual under UV Light) 6. Post-inspection cleaning

Figure 11: Fluorescent Penetrant Inspection

3 PROCESS CONTROL EQUIPMENT

The process equipment consists of tanks, vessels and pumps. All equipment will be connected with pipelines, fittings and control equipment in the proposed licence. High level alarms and subsequent monitoring of levels will be in place on all critical process tanks.

Both duty and standby compressors will be in place to ensure operations and abatement controls are operated effectively in the event of business interruption.

Continuous monitoring as part of process control is carried out, pH is monitored on the chromic acid scrubbing unit and if the alarm activates of the chrome scrubbing unit it means that the liquid inside the scrubber (2,750 litres) has become too acidic or too caustic and that the liquid needs to be removed for disposal as hazardous waste. Normal operational range of pH is between 6 and 9.

The proposed building is a standalone Industrial unit that has been dis-used since the previous EPA licence was surrendered on the 25th April 2008 (Polyglass - Integrated Pollution Control Licence P0237-01). Dublin Aerospace are proposing to re-fit and refurbish to make it suitable for its intended use. There will be provision of a designated waste storage area, new external cladding and provision of water attenuation tanks under the carpark located in the north western corner of the site and also on the northern boundary to connect into the existing surface water drain on the north west corner of the site.

The Process Building will have a concrete floor construction. All chemical tanks and containers will be bunded in line with EPA Guidance and conditions of the proposed licence. The plating solutions are mainly powder based and small quantities are added to water to make up plating solution. Plating solutions are only transferred when tanks are being cleaned.

Spill kits will be located throughout the new proposed facility and abatement system will be in place on all main emissions. Where volatile materials are used, equipment is designed to minimise fugitives. Where possible water-based paints will be utilised.

DAL have a detailed preventative maintenance plan in place and all critical spares are located on site in stores.

All staff are trained in the tasks they carry out and there is a detailed training plan in place. There are trained fire marshals and first aiders on all shifts which will also be in place for the proposed facility.

4 ENVIRONMENTAL MANAGEMENT PROCEDURES

The Dublin Aerospace facility located at Dublin Airport operates under an existing industrial emission licence P0480-02 and has in place an Environmental Management System (EMS) in line with licence conditions. This practice will be continued at the new facility. The EMS is managed by an experience team of Occupational Safety, Health and Environmental (OSHE) Specialists.

DAL have in place a detailed emergency plan at their existing location this will be updated to include all aspects of the new proposed facility. Fire prevention and protection will be a critical part of the design of the new proposed facility.

Under the current EMS a register of environmental and occupational safety aspects is maintained on site and significant controls and targets are in place to reduce impact. These are reviewed annually as part of the Annual Environmental Report (AER). The EMS will be updated to reflect all operations at the proposed facility.

Documentation is maintained and logged via the EMS. Where applicable, documents contain revision date(s)/ numbers. All documents pertaining to the EPA licence/ EMS are maintained directly by the OSHE Specialist via an electronic documentation control system. The EMS is designed to comply with the requirements of the international environmental standard ISO14001.

The EMS will prepare all procedures as required by the Licence for the facility. The following additional EMS procedures will be in place at the facility: Introduction

1. Environmental Policy
2. Management and Reporting Structure: Company Organisation Chart
3. Schedule of Environmental Objectives and Targets
4. Environmental Management Programme (EMP)
5. Environmental Management Documentation System / Document Index
6. Corrective Action
7. Emergency Response Procedures and Incident Notification
8. Accident Prevention

10. Awareness and Training
11. Communications Programme
12. Environmental Aspect Register
13. Legislation Register
14. Efficient Process Control
15. Odour Management Plan
16. Schedule of Documents and Drawings
17. Restoration / Contingency Plan
18. Copy of the Licence granted by the EPA
19. Safety Statement and Red Book

5 Laboratory Facilities

The proposed licence application will include a small technicians lab for general testing such as Ph testing of tanks used in the process.

6 Storage of Chemicals & Hazardous Waste

Dublin Aerospace Ltd have been operating Hangar 1 under an existing EPA license, P0480-

02. As part of this licence DAL have developed systems and procedures committed to complying with environmental, health and safety regulations and conditions of their existing license, these systems will be transferred to the new proposed licenced facility.

The proposed facility will be located on an impermeable base. All chemicals and hazardous wastes will be segregated in accordance with compatibility and health and safety and environmental regulations. All chemicals and hazardous wastes will be stored in line with EPA Guidance on storage and transfer of materials for scheduled activities and integrity testing will be carried out in line with conditions of the proposed EPA Licence to include integrity testing every three years.

The proposed planning for the facility has included a bunded store area. Details of storage as proposed are presented in Drawing AE12 T100 which have been included as part of this licence application.

7 Drainage Infrastructure

The proposal for the foul sewer and surface water drainage at the facility is as follows:

7.1 Sewer Drainage

The foul water drainage layout is indicated on EirEng Consulting Engineers drawing 191105-SK010 which has been included as part of the licence application. An Irish Water Pre-Connection Application has been submitted and is currently being processed by Irish Water.

Full details relating to the sewer drainage is contained within Chapter 6 Hydrology of the EIAR accompanying this licence application.

7.2 Surface Water Drainage

The surface water drainage layout is indicated on EirEng Consulting Engineers drawing 191105-SK010 which has been included as part of the licence application.

Full details relating to the surface water drainage is contained within Chapter 6 Hydrology of the EIAR accompanying this licence application.

8 Potential Emissions, Abatement and Capacity

Emission levels have been determined for the proposed site based on available historical monitoring data from the existing DAL Licensed facility (P0480-02), assessment through the Environmental Impact Assessment Report (EIAR) compilation and existing/proposed mitigation measures.

Attachments/Section 7 of this on-line application relates to all emissions from the existing and proposed process at DAL.

The potential sources of environmental emissions are to;

- **Air –** There will be five main air emissions points from plant stacks these are detailed in Attachment 7.4.1 Air Main of this licence application. There will be fourteen minor emissions which are detailed in Attachment 7.4.2 of this licence application. Fugitive emissions may be generated from opening of waste storage bins when in use, other waste storage areas that hold waste paints/solvents and paint/solvent containing rags/cloths. Emissions from tanks in the electroplating workshop are considered low where the lids are closed and extraction on all process tanks are in place. During operations extraction fans ramp up to increase extraction rates. Also, there is a push/ pull system in place, during operations, which creates a blanket of air over the tanks which is in turn is extracted to the abatement systems where required. Extraction remains on when lid is closed but fans are reduced when not in operation. The proposed emissions and mitigation measures for the proposed licensed facility are addressed in their entirety in Section 7 of this licence application and Chapter 7 Hydrology of the EIAR Volume 2.

- **Noise Emissions –** from plant and equipment used in the process, delivery/collection vehicles and air extractor fans. The operations are fully enclosed.

- **Emissions to Water –** wastewater from onsite activities discharged to main sewer network and sanitary wastewater from office buildings and rainwater from concrete hardstanding. The proposed emissions and mitigation measures for the proposed licensed facility are addressed in their entirety in Section 7 of this licence application and Chapter 6 Hydrology of the EIAR Volume 2.

The impact of the facility will be minimal due to the control measures which are proposed to combat the effect of these environmental emissions. Strict adherence to the conditions of the Planning Permission and EPA Licence, good management practices, control over individual procedures, and maintenance of abatement systems are essential to ensure the site will not impact on receptors in the area. The licensee has a good environmental record demonstrated through the control of its existing licence P0480-02 and has experience in managing an EPA licensed facility.

8.1 Emissions to Atmosphere

Emissions to atmosphere may arise as a result of the process. Drawing 1903-013 EPA 102 Roof Plan, Drawing 1903-013 EPA 100 Ground Floor Plan, Drawing 1903-013 EPA 101 First Floor Plan contained within Appendix III details all main and minor emissions to atmosphere.

8.1.1 Air Emissions

Emissions to atmosphere have been assessed in Chapter 7 of the EIAR. Table 3 summarizes proposed main emissions for the EPA licence application where waste gas is generated from the final gaseous emission from a stack or abatement equipment.

Table 3: Main Air Emissions

Point	Emissions Source	Details of Emissions sources
A1-1	Boilers X 2	Boiler Emissions through one emission point combining two boilers. Gas fired boilers 1.6MW each
A2-1	Scrubber	Emissions from plating shop extraction
A2-2	Scrubber	Emissions from plating shop extraction
A2-3	Spray Booths X 2	Emissions from through one emission point combining two spray booths, filter abatement
A2-4	Spray Booth	Emissions from smaller spray booth, filter abatement

8.1.1.1 Minor Air Emissions

Chapter 7 of the EIAR includes a detailed summary of emissions to Air. Minor emissions are broadly categorized as follows;

- Combined Heat and Power Plant
- Space Heating
- Workshop emissions e.g. test areas etc.
- Other plating shop emissions

Table 4: Minor Air Emissions

Minor Emission Point	Emissions Source
A3-1	Combined Heat and Power Plant (CHP) 250kW
A3-2	Process exhaust stack
A3-3	Process exhaust stack
A3-4	Process exhaust stack
A3-5	Process exhaust stack Process exhaust stack
A3-6	Process exhaust stack
A3-7	Extract exhaust
A3-8	Extract exhaust
A3-9	Inspection booth exhaust
A3-10	Inspection booth exhaust
A3-11	NDT area exhaust
A3-12	Inspection area exhaust
A3-13	Pickle tank extract discharge
A3-14	Paint strip tank extract discharge

8.1.1.2 Fugitive Air Emissions

Fugitive emissions may be generated from open waste storage bins, other waste storage areas that hold waste paints/solvents and paint/solvent containing rags/cloths. Emissions from tanks in the electroplating workshop are considered low where the lids are closed and extraction on all process tanks are in place. During operations extractions fans ramp up to increase extraction rates. Also, there is a push/ pull system in place, during operations, which creates a blanket of air over the tanks which is in turn is extracted to the abatement systems where required. Extraction remains on when lid is closed but fans are reduced when not in operation.

Fugitive emissions include emissions from non-point sources and diffuse sources. These may include dust, VOC, Nitrogen and Odour. Processes that can give rise to fugitive emissions include:

- Leaks from valve seals, pump seals and flanges;
- Breathing and working losses from liquid storage facilities;
- Dust emissions from solids stored in the open;
- Loading and unloading operations;
- Cleaning operations; and,

The measures taken to reduce/ prevent fugitive emissions to atmosphere must be addressed, and the facilities and operations required to control emissions must be detailed.
Schedule 2 of The European Union (Installations And Activities Using Organic Solvents) Regulations 2012 sets out emission limit values for the activities proposed for fugitive emissions and emission in waste gases. An exemption from Activity 8 Other Coating is also set out in the regulations for coating activities which cannot be applied under contained conditions (such as shipbuilding, aircraft painting) in accordance with Regulation 10(3). Details pertaining to BAT for aircraft painting have been presented with the aim to reduce overall VOC emissions and therefore the mass emissions of VOC's as fugitive emissions from aircraft painting. Point source emissions will be monitored directly to confirm compliance with EPA licence ELVs. Fugitive emissions will be calculated on the basis of a Solvent Management Plan for the proposed facility.

8.1.2 Air Emissions Abatement Equipment

All air emissions from the proposed facility have been designed to ensure that abatement is of the best available and will ensure mitigation against potential air emissions.

Operations with dust and VOC emissions within various areas/workshops at the proposed facility have a variety of abatement unit operations which are detailed as follows;

8.1.2.1 Scrubbers

The proposed scrubbers x 2 will abate air emissions from the chrome plating operations where off gases from tanks are passed through a scrubber system prior to discharge to atmosphere through proposed Main Emissions points A2-2 and A2-1 as detailed in

Drawing 1903-013 EPA 102 contained within Appendix III details all main and minor emissions to atmosphere. Drawing number 1903-013 EPA 100 detail ground floor level plans relating to emissions and Drawing number 1903-013 EPA 101 detail first floor level detail.

The ventilation gas from the process vessels will pass through two scrubbers (one per a line), and will be working as follows

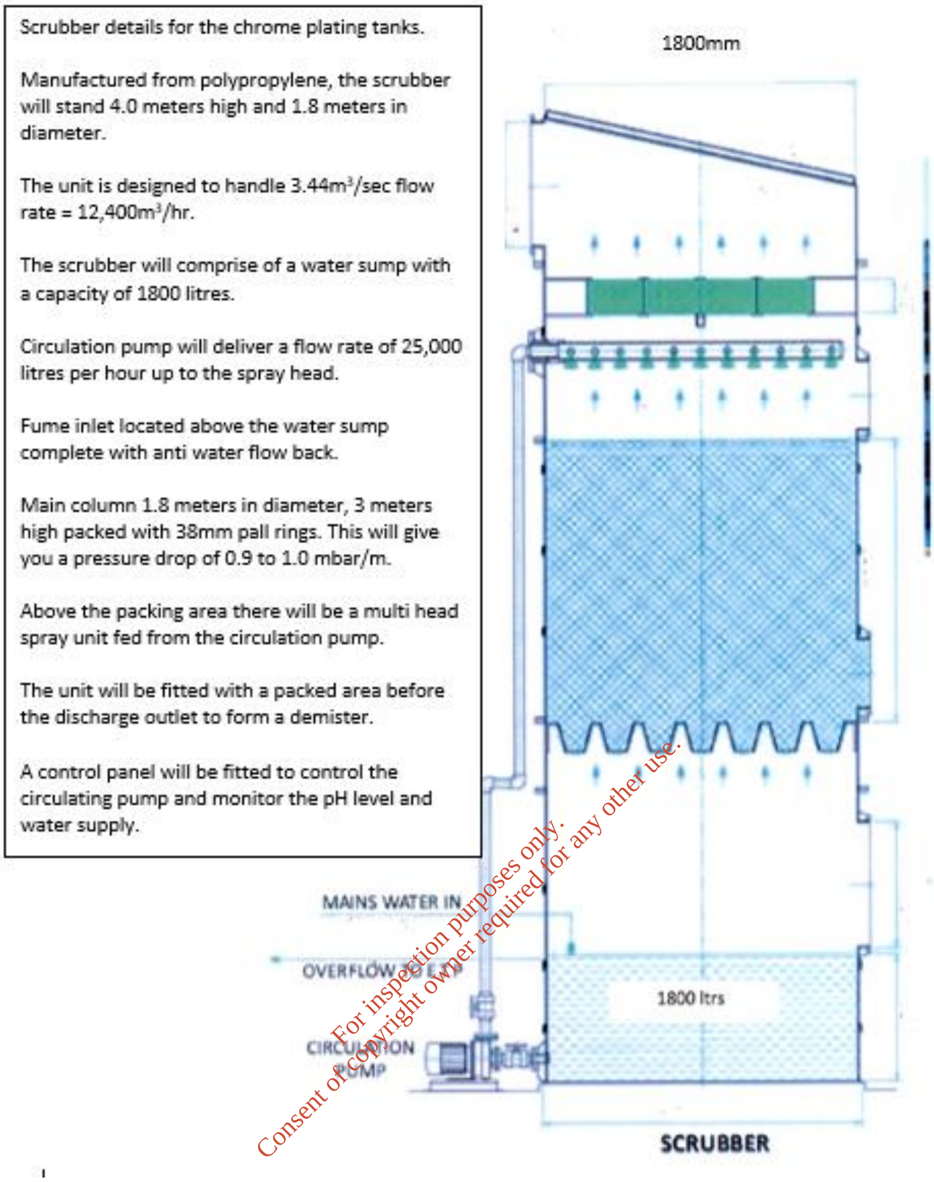


Figure 12: Proposed Air Abatement Scrubbers x 2

The proposed scrubber units are wet scrubbers and a summary of its operating process is contained with Figure 12.

8.1.2.2 Other Mitigation Measures

Ultrasonic Cleaner - A closed loop sealed ultra-sonic cleaner will be used for this part of the process, where the waste product is recycled within the sealed unit. The machine will use a chemical called perchloroethylene at a quantity of approximately 870 Litres.

Degreaser – A closed loop sealed vapour degreaser will be used for cleaning parts, where the waste product is recycled within the sealed unit. The new proposed degreaser will be using a chemical called perchloroethylene. The new proposed degreaser rig is a, EVT Gigant model which will replace the existing unit used at Hangar 1, Dublin airport under EPA licence P0480-02.

The closed loop vapour degreaser will be in the Machine Shop area of the proposed facility and will be used for post chrome plating, to remove any wax residue from parts, post machine repair operations to remove any coolant or lubricating oil residues. It will also be used post NDT processes to remove any fluorescent penetrant inspection (FPI) or Magnetic Particle Inspection (MPI) oils and post bushing (bushes fitted to parts) to remove any lubricating oils or machine oils.

Once the operation is completed the cleaning compartment is automatically evacuated of all vapour, the compartment is then analysed automatically by a calibrated analyser to ensure it is clear of perchloroethylene vapour before the lid can be unlocked and opened. All cleaning fluid is recycled within the rig for reuse on the next cycle. All dirty contaminated waste in automatically transferred into a sealed holding tank. When this holding tank becomes full it is then pumped through a sealed unit into a sealed transport contained to be collected by an approved waste collection company as hazardous waste. There is no operator interaction with the cleaning agent through any part of the process.

The rig is self-cleaning and has a distillation unit to recover the clean solution for reuse, this fluid also goes through an activated carbon filter within the unit. This filter goes through a regeneration process as required to keep it clean. The regenerated contaminated compound is then also stored in the sealed waste container within the unit.

The rig is fully bunded and holds approx. 800ltrs of perchloroethylene, it is estimated when the rig is operational the waste element should be between 200- 400 ltrs per year, which will be disposed of as hazardous waste as per above description.

The new proposed degreaser rig complies with BAT and is proposed to replace the current degreaser used under existing licence P0480-02, due to the cessation of the production of Lemium GS product which will not be manufactured after 2020.

Blasters - All blasters are closed loop systems, plastic media falls into a perforated floor and media is pulled back into the system, good media reused in the process, spent media is shaken in a fully contained which is sent for disposal by an authorised contractor.

Painting Spray Booths - All painting of parts will be carried out within one of the three proposed spray booths. The abatement process is filtration. Each spray booth contains a computer which measures the negative pressure of the booths. The pressure is adjusted automatically as the extract filters get used up to keep the spray booth under negative pressure (doors are kept closed at all times). Good housekeeping which will consist of a number of checks and a preventative maintenance plan will ensure that the spray booths are operating efficiently and effectively at all times. Spray booth filters will be regularly maintained and spent filters disposed of appropriately as solvent containing hazardous waste.

Powder Storm Cabinet – Non-Destructive Testing Area (NDT)- A cabinet containing development powder, Ardrox 9D4A, is located in the NDT area to assist in tracing cracks in metal components. The air is extracted through a filter system which collects the powder dust particles. At the end of the cycle a shaker motor shakes the dust from the filters into a container at the bottom of the unit. When full the container contents are returned to the cabinet process again.

In NDT the storm cabinet extract is just circulation air, the media is recycled and the extract for the storm cabinet is extracted locally.

8.2 Noise Emissions

8.2.1 Noise Emissions

The noise sources from the facility will be pumps, air handling units and air compressors. There will also be traffic related noise from vehicles delivering and receiving materials. The potential impact and mitigation measures are addressed in detail in Chapter 8 of the EIAR.

8.2.2 Noise Emissions Abatement Equipment

The proposed process will be fully enclosed within buildings. Noise has been fully assessed and is not considered to have any significant impact at the facility or facility surrounds. No abatement equipment is proposed.

8.3 Emissions to Water

8.3.1 Water Emissions

The following water emissions are predicted at the proposed facility:

- Wastewater from intake building
- Wastewater from cleaning shop (cleaning process);
- Wastewater from process building rinse tanks in electroplating shops (minus the water from closed loop drag out process which goes through ion exchange), water will be directed through ph neutralization process and then to sewer from this area
- Wastewater from administration toilets and wash facilities;
- Surface water from bunded area, loading/unloading areas; and
- Precipitation water from roofs, roads, car park and building services.
- Wastewater from wash down areas, detergent from (Ozzy Juice and XE3) wash basins will go through an oil interceptor before discharge to main sewer.
- Water from electroplating shops (general and chrome) will go through pH neutralisation before discharge to sewer (this will not include dragout tanks in process lines) it will only include rinse tanks and wash basins).
- With the exception of the precipitation water from roofs, roads and building services all other water will be discharged to foul sewer.

- Rainwater from the roofs and buildings will be directed to the proposed attenuation area prior to discharge offsite.

- Emissions to Water Abatement

Ph Neutralization– Cold water rinse tanks overflow by gravity back to the pH Neutralisation Tank. When the water enters the tank, it is channelled to the bottom of the tank. The water is agitated and there are baffles to direct the water back up to the pH probes. The first pH probe monitors the pH where the water is entering the pH Neutralisation Tank. The automatic dosing facility consists of two reservoirs, one containing alkaline and one containing acid. If the pH reading of the first pH probe goes below the set point the automatic dosing facility doses a quantity of alkaline into the pH Neutralisation tank in order to bring the pH back into the acceptable range. If the pH reading of the first pH probe goes above the set point the automatic dosing facility doses a quantity of acid into the pH Neutralisation tank in order to bring the pH back into the acceptable range.

A second pH probe monitors the pH where the water leaves the Neutralisation Tank and enters the second chamber (outlet chamber). The outlet chamber contains a float switch so when the water rises to the maximum level the pump then pumps the water to the Interceptor chamber prior to discharge. The second pH probe controls the high-level alarm system. If the pH reading of the second pH probe goes above or below the set points there is an audible alarm, the pump which pumps the water from the outlet chamber to the Interceptor chamber shuts down and the mains water flowing into the cold water rinse tanks is also shut down. When the automatic dosing facility adjusts the pH back into the acceptable range the audible alarm stops, the pump which pumps the water from the outlet chamber to the Interceptor chamber kicks back in and the mains water flowing into the cold water rinse tanks is turned back on.

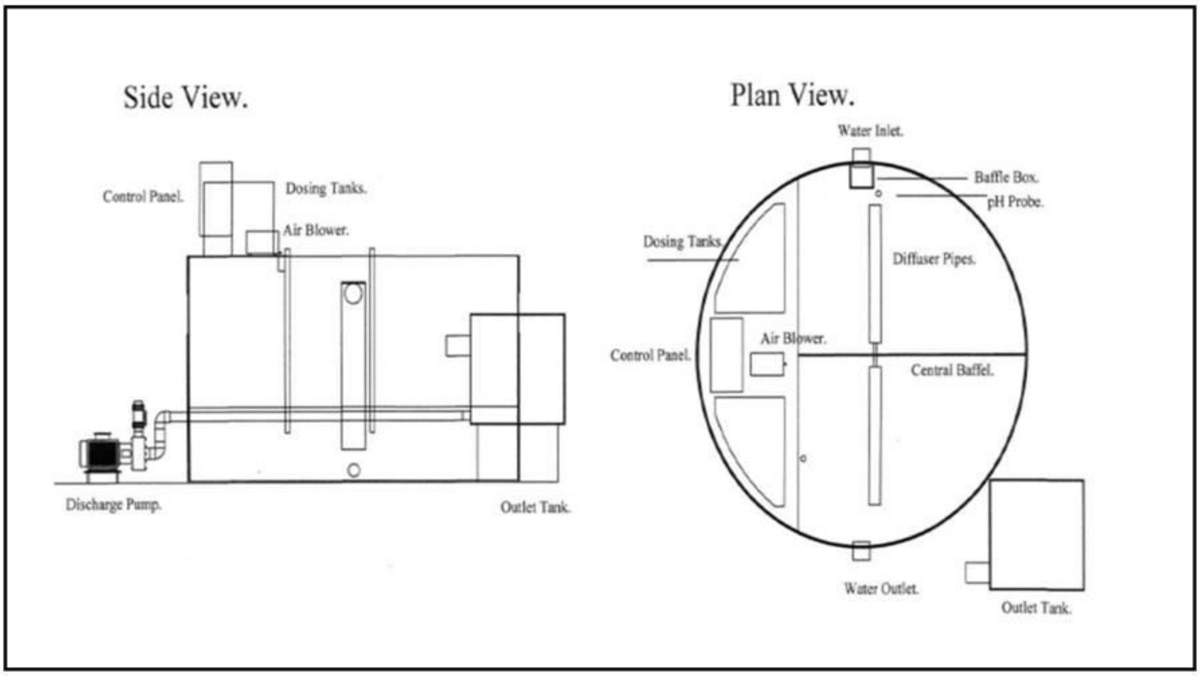


Figure 13: Proposed PH Neutralisation Process

8.3.2 Equipment

A cadmium recovery unit (BEWT) is used to remove the metal from the Cadmium plating drag-out (rinse) tank at the Dublin Airport facility. This is a closed loop system and is not connected to sewer. The same system will be used in the proposed Ashbourne facility.

There will be a closed loop system for degreasing with no emission to sewer from this process, waste product will be recycled within the sealed unit. The new proposed de-greaser will be using a chemical called perchloroethylene which will be stored in a secure and bunded area. There will also be in place a closed loop sealed ultra-sonic cleaner will be used for this part of the process, where the waste product is recycled within the sealed unit. The machine will use a chemical called perchloroethylene at a quantity of approximately 870 Litres.

8.3.2.1 Interceptors

It is proposed as part of the development of the proposed facility that interceptors will be installed. These are detailed in drawing 191105-SK010- IF12 Drainage Drawings.

8.3.2.2 Cadmium Abatement Units

The Cadmium process line has abatement equipment at two stages of the process. The drag out tank has a BEWT unit fitted the purpose of which is to remove concentrations of Cadmium from the drag out tank. The solution is pumped through this BEWT unit which by electrolysis removes the Cadmium from the solution and returns the water to the tank. When the plates are saturated with Cadmium, they are removed to the Cadmium strip tank where the Cadmium is removed from the plates by a solution of ammonium nitrate. The plates are returned to the BEWT unit and the process repeated.

The final rinse tanks for the Cadmium Plating line are pumped to an ion exchange plant and through two parallel cartridge filters. When the cartridges are saturated, they are sent to an authorized waste disposal facility and classified accordingly. This eliminates any discharge to sewer from the Cadmium process.

Please refer to Attachment 7.1.1 Emissions Overview Summary for a full detailed summary of proposed emissions for the licence application.

The proposed new emissions and mitigation measures for the proposed facility are addressed in their entirety in Section 6 of this EPA licence application in EIAR Volume 2.

9 WASTE ACTIVITIES

The proposed application is not for a waste activity so details of waste activities, details of waste quarantine and waste inspection areas, traffic control, (including location and detail of signs, barriers, parking, number of vehicles catered for, etc.) and delivery and reception of waste are not required for this operational report.

All waste generated by the activity will be classified on site as hazardous or non-hazardous. DAL have DGSA advisors who can be consulted in the handling, storage, labelling and transport of hazardous waste from the site. Only approved waste collection companies and authorised facilities will be used for the disposal, recovery and recycling of all wastes.

Various hazardous and non-hazardous waste materials shall be generated during the operational phase of the facility. Wastes shall include materials stripped from aircraft parts, products and solvents used in the stripping and refurbishment processes, in addition to by-products of these process e.g. batteries, oils and lubricants, etc. Municipal waste shall also be generated from the site offices and canteen. Table 5 below shows the projected types of waste generation from the facility during the operational phase of works.

Table 5: Predicted Waste Streams for Offsite Disposal/Recovery (Operational Phase)

List of Waste (LoW) Code entry *	Description of waste generated	Describe the disposal or recovery treatment technique *
06 01 05*	nitric acid and nitrous acid	Use principally as a fuel or other means to generate energy
06 01 06*	other acids	Recycling/reclamation of other inorganic materials
06 02 04*	sodium and potassium hydroxide	Use principally as a fuel or other means to generate energy
06 02 05*	other bases	Use principally as a fuel or other means to generate energy
06 13 02*	spent activated carbon (except 06 07 02)	Use principally as a fuel or other means to generate energy
07 01 04*	other organic solvents, washing liquids and mother liquors	Use principally as a fuel or other means to generate energy
08 01 11*	waste paint and varnish containing organic solvents or other hazardous substances	Use principally as a fuel or other means to generate energy
08 01 11*	waste paint and varnish containing organic solvents or other hazardous substances	Use principally as a fuel or other means to generate energy
08 04 09*	waste adhesives and sealants containing organic solvents or other hazardous substances	Use principally as a fuel or other means to generate energy
11 01 09*	sludges and filter cakes containing hazardous substances	Use principally as a fuel or other means to generate energy
11 01 11*	aqueous rinsing liquids containing hazardous substances	Use principally as a fuel or other means to generate energy

List of Waste (LoW) Code entry *	Description of waste generated	Describe the disposal or recovery treatment technique *
11 01 98*	other wastes containing hazardous substances	Use principally as a fuel or other means to generate energy
12 01 05	plastics shavings and turnings	Use principally as a fuel or other means to generate energy
12 01 07*	mineral-based machining oils free of halogens (except emulsions and solutions)	Use principally as a fuel or other means to generate energy
12 01 15	machining sludges other than those mentioned in 12 01 14	Use principally as a fuel or other means to generate energy
13 02 08*	other engine, gear and lubricating oils	Oil re-refining or other reuses of oil
13 05 07*	oily water from oil/water separators	Oil re-refining or other reuses of oil
14 06 03*	other solvents and solvent mixtures	Storage pending any of the operations numbered D1 to D14
15 01 10*	packaging containing residues of or contaminated by hazardous substances	Physico chemical treatment not specified elsewhere in this Annex which results in final compounds or mixtures which are discarded by means of any of the operations numbered D1 to D12 (e.g. evaporation, drying, calcination etc.)
15 02 02*	absorbents, filter materials (including oil filters not otherwise specified), wiping cloths, protective clothing contaminated by hazardous substances	Use principally as a fuel or other means to generate energy
15 02 02*	absorbents, filter materials (including oil filters not otherwise specified), wiping cloths, protective clothing contaminated by hazardous substances	Use principally as a fuel or other means to generate energy
15 01 10*	packaging containing residues of or contaminated by hazardous substances	Use principally as a fuel or other means to generate energy
16 02 13*	discarded equipment containing hazardous components other than those mentioned in 16 02 09 to 16 02 12	Recycling/reclamation of metals and metal compounds
16 02 14	non-household waste white goods	Recycling/reclamation of metals and metal compounds
16 05 06*	laboratory chemicals, consisting of or containing hazardous substances, including mixtures of laboratory chemicals	Use principally as a fuel or other means to generate energy

List of Waste (LoW) Code entry *	Description of waste generated	Describe the disposal or recovery treatment technique *
16 05 07*	discarded inorganic chemicals consisting of or containing hazardous substances	Use principally as a fuel or other means to generate energy
16 05 08*	discarded organic chemicals consisting of or containing hazardous substances	Use principally as a fuel or other means to generate energy
16 05 09	discarded chemicals other than those mentioned in 16 05 06, 16 05 07 or 16 05 08	Use principally as a fuel or other means to generate energy
16 06 01*	Lead acid batteries	Exchange of waste for submission to any of the operations numbered R1 to R11
16 07 08*	Wastes containing oil	Oil re-refining or other reuses of oil
16 10 01*	aqueous liquid wastes containing hazardous substances	Physico chemical treatment not specified elsewhere in this Annex which results in final compounds or mixtures which are discarded by means of any of the operations numbered D1 to D12 (e.g. evaporation, drying, calcination etc.)
20 01 21*	Fluorescent tubes	Recycling/reclamation of metals and metal compounds
20 01 33*	Batteries	Recycling/reclamation of other inorganic materials
20 01 35*	Household light bulbs	Recycling/reclamation of other inorganic materials
20 01 35*	WEEE	Recycling/reclamation of other inorganic materials
20 01 40	Metal	Recycling/reclamation of metals and metal compounds
20 03 01	Municipal Waste	Recycling/reclamation of organic substances which are not used as solvents (including composting and other biological transformation processes)
20 03 01	Dry Mixed Recyclables	Recycling/reclamation of organic substances which are not used as solvents (including composting and other biological transformation processes)
20 03 07	Bulky Waste	Exchange of waste for submission to any of the operations numbered R1 to R11
20 03 01	Municipal Waste	Exchange of waste for submission to any of the operations numbered R1 to R11

All wastes generated on site shall be stored in appropriate containers prior to being sent for recycling, recovery or disposal to a suitably licenced or permitted waste contractor in compliance with the conditions of planning for the proposed development and the EPA licence for the facility.

10 SEVESO

Due to the small volumes of proposed relevant materials to be used on site these regulations will not apply however DAL will continue to monitor and liaise accordingly with the Health and Safety Authority if required for the new proposed facility as it expands.

11 HOURS OF OPERATION

The proposed facility will operate Monday to Friday over two shifts: 7a.m to 4p.m and 11a.m to 8p.m. It is proposed that the hours of operation will be 24 hours per day seven days a week to ensure critical maintenance can be maintained. It is envisaged that there will be a total of 63 staff employed at the proposed facility initially with future expansion plans.

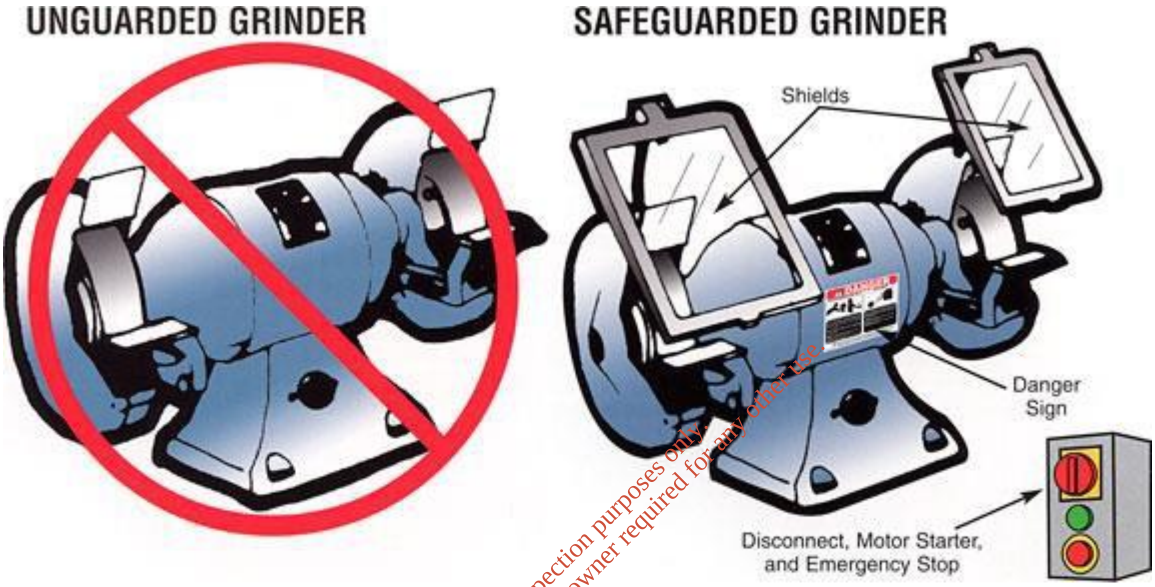
Dublin Aerospace have been operating under an EPA licence at Dublin Airport P0480-02 and currently have no restrictions in relation to operating hours under existing conditions of their licence.

Appendix 1 - Machine Shop

What is a Pedestal Bench Grinder?

A bench grinder is a type of benchtop grinding machine used to drive abrasive wheels. A pedestal grinder is a larger version of a bench grinder that is mounted on a pedestal, which is bolted to the floor. These types of grinders are commonly used to hand grind cutting tools and perform other rough grinding.

At Dublin Aerospace bench grinders are used for removing rough edges from parts and sharpening tools.

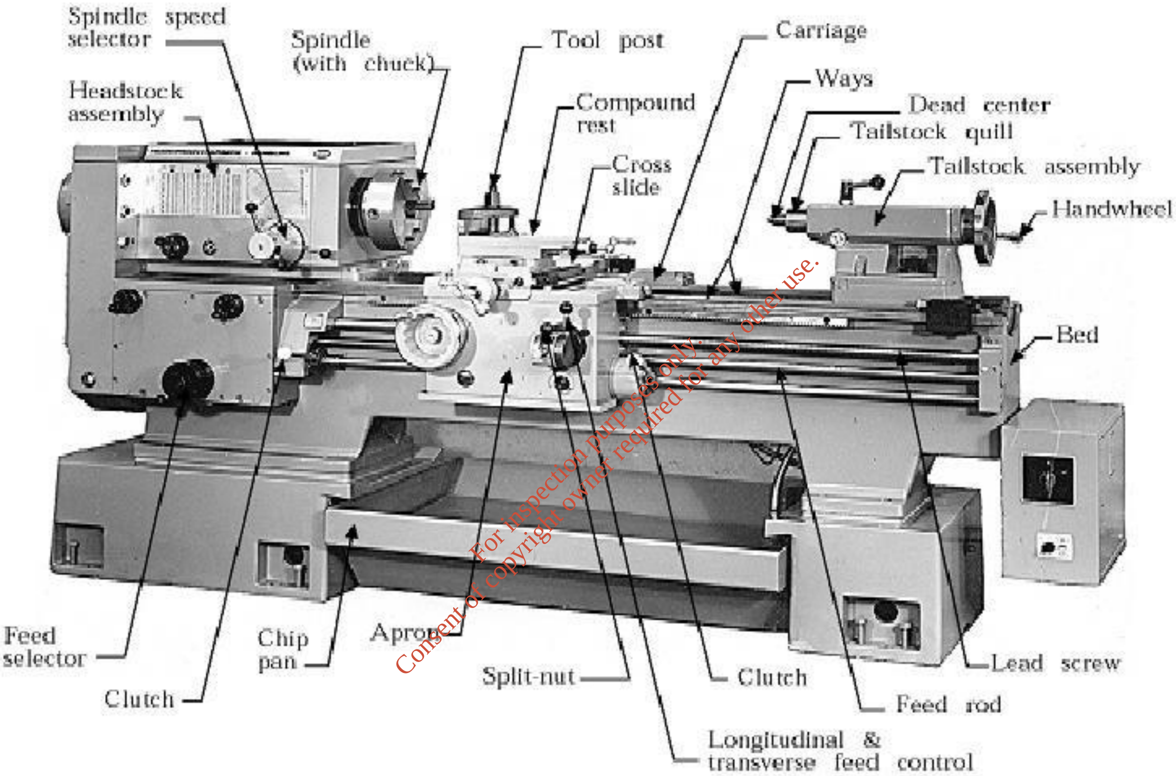


See a bench grinder in use: https://www.youtube.com/watch?v=qY3Y0VDcliI

What is a Lathe?

A lathe is a machine for shaping wood, metal, or other material by means of a rotating drive which turns the piece being worked on against changeable cutting tools.

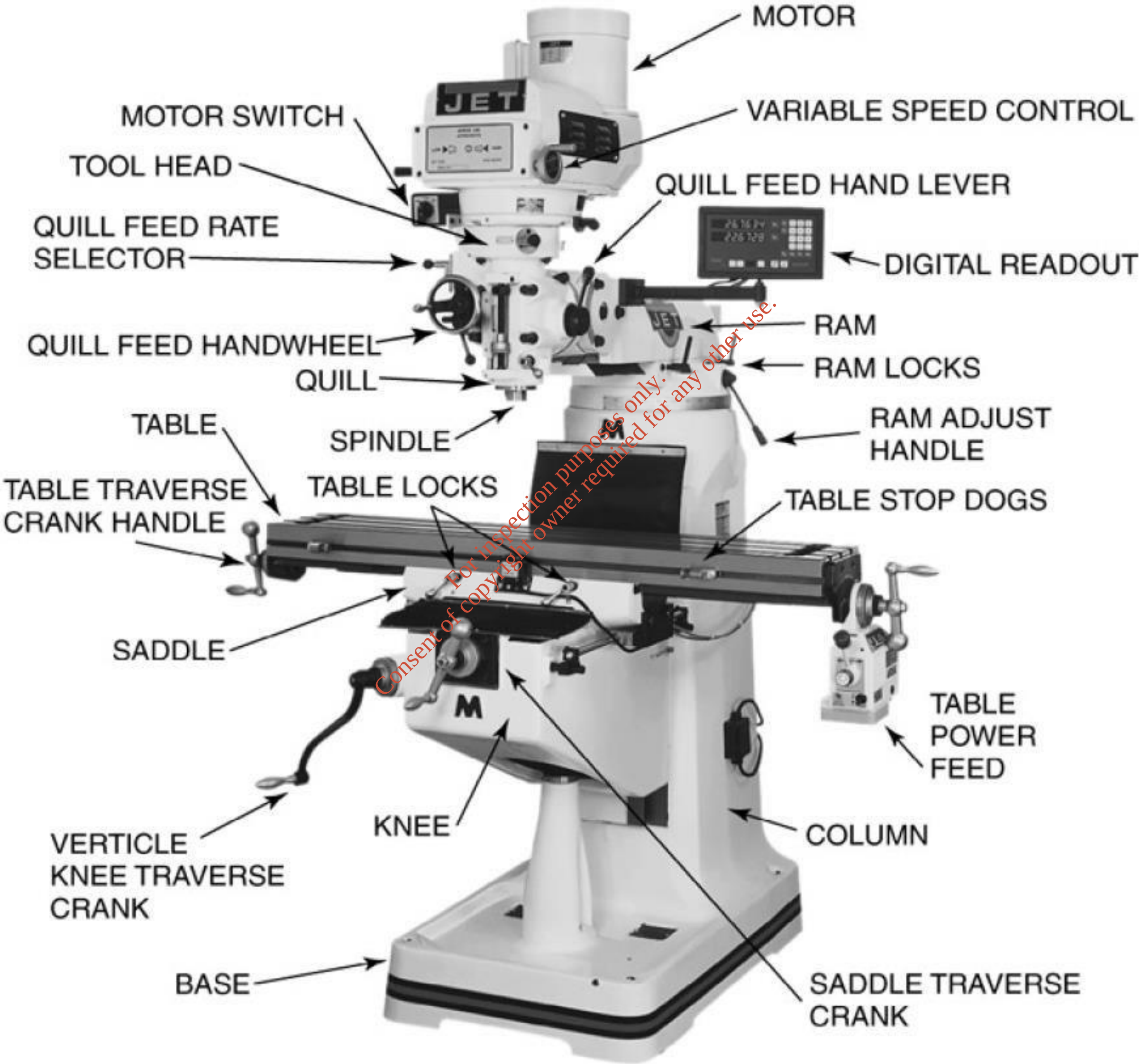
At Dublin Aerospace lathes are used for the modification and reshaping of parts and also repairing damaged parts.



See a lathe in use: https://www.youtube.com/watch?v=IYVNIV1Bkxk

What is a Milling Machine?

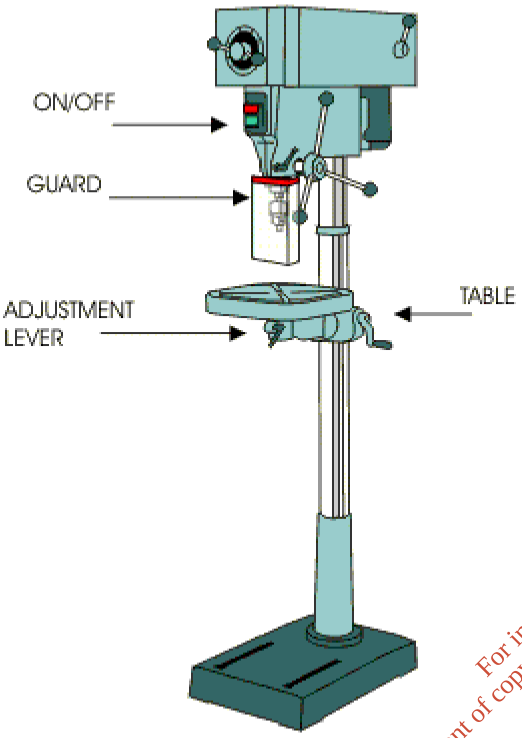
Milling is the machining process of using rotary cutters to remove material from a workpiece by feeding in a direction at an angle with the axis of the tool. It covers a wide variety of different operations and machines, on scales from small individual parts to large, heavy-duty gang milling operations. It is one of the most commonly used processes in industry and machine shops today for machining parts to precise sizes and shapes.



See a milling machine in use: https://www.youtube.com/watch?v=3735B42v-wI

What is a Pillar Drill?

A pillar drill is a fixed style of drilling machine that can be mounted on a stand or bolted to the floor or workbench. Unlike a hand-held drill machine; it is far more accurate. The pillar drill is also known as drill press, pedestal drill or bench pillar drill.



See a milling machine in use: https://www.youtube.com/watch?v=fGbnim4GcAE

What is a Grinder?

Dublin Aerospace Ltd will have two large grinders for grinding chrome journals to size

What is a Boring Machine?

Dublin Aerospace Ltd will have four horizontal boring machines. These will be used for boring our parts of the gears (larger parts) for corrosion removal and damage repair. wo large grinders for grinding chrome journals to size

Appendix 2 - Plating Shop Process

ABRASIVE BLASTING

Code of Practice
October 2012

Safe Work Australia is an Australian Government statutory agency established in 2009. Safe Work Australia consists of representatives of the Commonwealth, state and territory governments, the Australian Council of Trade Unions, the Australian Chamber of Commerce and Industry and the Australian Industry Group.

Safe Work Australia works with the Commonwealth, state and territory governments to improve work health and safety and workers' compensation arrangements. Safe Work Australia is a national policy body, not a regulator of work health and safety. The Commonwealth, states and territories have responsibility for regulating and enforcing work health and safety laws in their jurisdiction.

ISBN 978-0-642-78417-9 [PDF]
ISBN 978-0-642-78418-6 [RTF]

FOREWORD

This Code of Practice on abrasive blasting is an approved code of practice under section 274 of the *Work Health and Safety (WHS) Act*.

An approved code of practice is a practical guide to achieving the standards of health, safety and welfare required under the WHS Act and the Work Health and Safety Regulations (the WHS Regulations).

A code of practice applies to anyone who has a duty of care in the circumstances described in the code. In most cases, following an approved code of practice would achieve compliance with the health and safety duties in the WHS Act, in relation to the subject matter of the code. Like regulations, codes of practice deal with particular issues and do not cover all hazards or risks which may arise. The health and safety duties require duty holders to consider all risks associated with work, not only those for which regulations and codes of practice exist.

Codes of practice are admissible in court proceedings under the WHS Act and Regulations. Courts may regard a code of practice as evidence of what is known about a hazard, risk or control and may rely on the code in determining what is reasonably practicable in the circumstances to which the code relates.

Compliance with the WHS Act and Regulations may be achieved by following another method, such as a technical or an industry standard, if it provides an equivalent or higher standard of work health and safety than the code.

An inspector may refer to an approved code of practice when issuing an improvement or prohibition notice.

This Code of Practice has been developed by Safe Work Australia as a model code of practice under the Council of Australian Governments' *Inter-Governmental Agreement for Regulatory and Operational Reform in Occupational Health and Safety* for adoption by the Commonwealth, state and territory governments.

SCOPE AND APPLICATION

This Code provides practical guidance for persons conducting a business or undertaking on how to manage health and safety risks associated with abrasive blasting. This Code applies to all workplaces covered by the WHS Act where abrasive blasting processes are carried out and where abrasive blasting products and equipment are used and stored.

How to use this code of practice

In providing guidance, the word 'should' is used in this Code to indicate a recommended course of action, while 'may' is used to indicate an optional course of action.

This Code also includes various references to provisions of the WHS Act and Regulations which set out the legal requirements. These references are not exhaustive. The words 'must', 'requires' or 'mandatory' indicate that a legal requirement exists and must be complied with.

1. INTRODUCTION

1.1 What is abrasive blasting?

Abrasive blasting means propelling a stream of abrasive material at high speed against a surface using compressed air, liquid, steam, centrifugal wheels or paddles to clean, abrade, etch or otherwise change the original appearance or condition of the surface.

It is used in a wide range of industries for many different purposes, including cleaning surfaces such as steel, bricks, cement and concrete. The most common method uses compressed air to propel abrasive material from a blast pot, through a blasting hose to a nozzle that is manually controlled by the operator. Automated abrasive blasting machines such as centrifugal wheel systems and tumblers are also used. Blasting is generally performed in enclosed environments like blasting chambers or cabinets, or on open sites, for example on buildings, bridges, tanks, boats or mobile plant.

Common hazards include dusts, hazardous chemicals and risks associated with the use of plant and equipment.

1.2 Who has health and safety duties in relation to abrasive blasting?

A **person conducting a business or undertaking** has the primary duty to ensure, so far as is reasonably practicable, that workers and other persons are not exposed to health and safety risks arising from the business or undertaking.

A person conducting a business or undertaking that carries out abrasive blasting must eliminate risks arising from abrasive blasting, or if that is not reasonably practicable, minimise the risks so far as is reasonably practicable.

The WHS Regulations include more specific requirements to manage the risks of hazardous chemicals, airborne contaminants and plant, as well as other hazards associated with the abrasive blasting activities such as noise and manual tasks.

Designers, manufacturers, importers and suppliers of plant or substances used in abrasive blasting must ensure, so far as is reasonably practicable, that the plant or substance is without risks to health and safety. This duty includes carrying out testing and analysis as well as providing specific information about the plant or substance.

Officers, such as company directors, have a duty to exercise due diligence to ensure that the business or undertaking complies with the WHS Act and Regulations. This includes taking reasonable steps to ensure that the business or undertaking has and uses appropriate resources and processes to eliminate or minimise risks that arise from abrasive blasting.

Workers have a duty to take reasonable care for their own health and safety and that they do not adversely affect the health and safety of other persons. Workers must comply with any reasonable instruction and cooperate with any reasonable policy or procedure relating to health and safety at the workplace. If personal protective equipment is provided by the person conducting the business or undertaking, the worker must use it in accordance with the information, instruction and training provided.

1.3 What is required to manage risks associated with abrasive blasting?

The WHS Regulations require a person conducting a business or undertaking to 'manage risks' associated with specific hazards, including noise, hazardous chemicals, plant and electricity.

> **Regulation 32-38:** In order to manage risk under the WHS Regulations, a duty holder must:
> a) identify reasonably foreseeable hazards that could give rise to the risk
> b) eliminate the risk so far as is reasonably practicable
> c) if it is not reasonably practicable to eliminate the risk, minimise the risk so far as is reasonably practicable by implementing control measures in accordance with the hierarchy of risk control
> d) maintain the implemented control measure so that it remains effective
> e) review, and if necessary revise all risk control measures so as to maintain, so far as is reasonably practicable, a work environment that is without risks to health and safety.

This Code provides guidance on managing the risks of abrasive blasting by following a systematic process that involves:

- identifying hazards
- if necessary, assessing the risks associated with these hazards
- implementing control measures, and
- reviewing control measures.

Guidance on the general risk management process is available in the *Code of Practice: How to Manage Work Health and Safety Risks.*

Consulting your workers

Consultation involves sharing of information, giving workers a reasonable opportunity to express views and taking those views into account before making decisions on health and safety matters.

> **Section 47:** A person conducting a business or undertaking must consult, so far as is reasonably practicable, with workers who carry out work for them who are (or are likely to be) directly affected by a work health and safety matter.
> **Section 48:** If the workers are represented by a health and safety representative, the consultation must involve that representative.

Consultation with workers and their health and safety representatives is required at each step of the risk management process. By drawing on the experience, knowledge and ideas of your workers you are more likely to identify all hazards and choose effective control measures.

Consultation with workers can help you select appropriate control measures, including any personal protective equipment they may require.

Consulting, co-operating and coordinating activities with other duty holders

> **Section 46:** A person conducting a business or undertaking must consult, cooperate and coordinate activities with all other persons who have a work health or safety duty in relation to the same matter, so far as is reasonably practicable.

Sometimes you may share responsibility for a health and safety matter with other business operators who are involved in the same activities or who share the same workplace. In these situations, you should exchange information to find out who is doing what and work together in a cooperative and coordinated way so that all risks are eliminated or minimised so far as is reasonably practicable.

For example, if you engage a contractor to carry out abrasive blasting activities at your workplace, then you should find out what blasting medium and what work processes are being used, any associated hazards and how the risks will be controlled. This may include jointly conducting a risk assessment for the work and determining the control measures to implement. After the risk assessment has been conducted, it is important for all duty holders to cooperate and coordinate activities with each other to implement the control measures.

Further guidance on consultation is available in the *Code of Practice: Work Health and Safety Consultation, Co-operation and Co-ordination*.

2. THE RISK MANAGEMENT PROCESS

2.1 Identifying the hazards

The first step in managing risks associated with abrasive blasting activities is to identify all the hazards that have the potential to cause harm.

Potential hazards may be identified in a number of different ways including:

- conducting a walk through assessment of the workplace
- observing the work and talking to workers about how work is carried out
- inspecting the plant and equipment that will be used during the abrasive blasting activity
- reading product labels, safety data sheets and manufacturer's instruction manuals
- talking to manufacturers, suppliers, industry associations and health and safety specialists
- reviewing incident reports.

Examples of abrasive blasting hazards include:

- airborne contaminants such as dust
- hazardous chemicals, particulate matter, for example small particles or pieces of the substrate or blasting medium
- noise
- abrasive blasting plant and equipment.

Exposure standards

Regulation 49: A person conducting a business or undertaking must ensure that no person at the workplace is exposed to a substance or mixture in an airborne concentration that exceeds the exposure standard for the substance or mixture.

Exposure standards represent airborne concentrations of a particular substance or mixture that must not be exceeded. There are three types of exposure standard:

- 8-hour time-weighted average
- peak limitation
- short term exposure limit.

Exposure standards are based on the airborne concentrations of individual substances that, according to current knowledge, should not cause adverse health effects nor cause undue discomfort to nearly all workers.

Chemicals with workplace exposure standards are listed in the *Workplace Exposure Standards for Airborne Contaminants*. These exposure standards are also available from the Hazardous Substances Information System (HSIS) on the Safe Work Australia website. The HSIS database contains additional information and guidance for many substances. Although exposure standards may also be listed in Section 8 of the Safety Data Sheet (SDS), you should always check the *Workplace Exposure Standards for Airborne Contaminants* or HSIS to be certain.

If the blasting medium or the surface being blasted contains any crystalline silica, lead or any other substance with an exposure standard, you must ensure that workers are not exposed to levels that exceed the relevant exposure standard.

To comply with the WHS Regulations, monitoring of workplace contaminant levels for chemicals with exposure standards may need to be carried out.

Guidance on interpreting exposure standards is available in the *Guidance on the Interpretation of Workplace Exposure Standards for Airborne Contaminants*.

2.2 Assessing the risks

Under the WHS Regulations, a risk assessment is not mandatory for abrasive blasting activities however it is required for specific situations, for example when working in a confined space. In many circumstances a risk assessment will assist in determining the control measures that should be implemented. It will help to:

- identify which workers are at risk of exposure
- determine what sources and processes are causing that risk
- identify if and what kind of control measures should be implemented
- check the effectiveness of existing control measures.

The following questions may help to assess the risk:

- How often, and for how long, will exposure to the hazard occur?
- In the event of exposure to the hazard, will the outcome be severe, moderate or mild?
- What are the properties of the blasting medium being used?
- What is the substrate being blasted?
- What are the surface coatings of the items being blasted? For example do they contain lead or other toxic metals
- What are the conditions under which abrasive blasting is carried out (for example, confined spaces)?
- What are the skills, competence and experience of the operator?

Monitoring airborne contaminant levels

Regulation 50 A person conducting a business or undertaking at a workplace must ensure that air monitoring is carried out to determine the airborne concentration of a substance or mixture at the workplace to which an exposure standard applies if:

- the person is not certain on reasonable grounds whether or not the airborne concentration of the substance or mixture at the workplace exceeds the relevant exposure standard; or
- monitoring is necessary to determine whether there is a risk to health.

The results of air monitoring must be recorded and kept for 30 years after the date the record is made.

Air monitoring is the sampling of workplace atmospheres to obtain an estimate of workers' potential inhalation exposure to hazardous chemicals.

Air monitoring can be used:

- when there is uncertainty about the level of exposure
- to indicate whether the exposure standards are being exceeded or approached
- to test the effectiveness of the control measures.

Air monitoring should be carried out by a person such as an occupational hygienist with skills to carry out the monitoring according to standards and to interpret the results.

Where monitoring of airborne contaminants is used to determine a person's exposure, the monitoring must be undertaken in the breathing zone of the worker (i.e. inside the abrasive blasting helmet) to ensure the effectiveness of the abrasive blasting helmet.

Monitoring should also be conducted in the breathing zones of other workers in the vicinity, to ensure that they are not exposed to hazardous levels of dust.

Results from air monitoring indicate how effective your control measures are, for example whether ventilation systems are operating as intended. If monitoring identifies that the exposure standard is being exceeded, the control measures must be reviewed and any necessary changes made.

In dense clouds of dust it is often necessary to take a measurement more than once to ensure an accurate reading. Air monitoring is particularly important in measuring exposure when a toxic material is introduced into the blasting process.

Air monitoring cannot be used to determine a risk to health via skin contact of airborne chemicals.

2.3 Controlling the risks

The hierarchy of control measures

Some control measures are more effective than others. Control measures can be ranked from the highest level of protection and reliability to the lowest. This ranking is known as the *hierarchy of control*.

You must always aim to eliminate a hazard and associated risk first. If this is not reasonably practicable, the risk must be minimised by using one or more of the following approaches:

- *Substitution* – for example, use a less hazardous abrasive material
- *Isolation* – for example, carry out blasting in a blasting cabinet or enclosure
- *Implementing engineering controls* – for example, use automatic cut-off devices on abrasive blasting equipment.

If risk remains, it must be minimised by implementing *administrative controls*, so far as is reasonably practicable, for example by establishing exclusion zones around open air blasting activities. Any remaining risk must be minimised with suitable *personal protective equipment* (PPE).

Administrative control measures and PPE rely on human behaviour and supervision, and used on their own, tend to be least effective in minimising risks.

A combination of these control measures may be required in order to adequately manage the risks with abrasive blasting. You should check that your chosen control measure does not introduce new hazards.

Chapters 3 and 4 of this Code provide information on control measures for abrasive blasting activities.

2.4 Reviewing control measures

The control measures that are put in place to protect health and safety should be regularly reviewed to make sure they are effective. This may involve, for example, air monitoring to measure the concentration of crystalline silica in the worker's breathing zone during the abrasive blasting process. If the control measure is not working effectively it must be revised to ensure it is effective in controlling the risk.

Common review methods include workplace inspection, consultation, testing and analysing records and data.

You can use the same methods as in the initial hazard identification step to check control measures. You should also consult your workers and their health and safety representatives and consider the following questions:

- Are the control measures working effectively in both their design and operation?
- Have the control measures introduced new problems?
- Have all hazards been identified?
- Have new work methods, new equipment or chemicals made the job safer?
- Are safety procedures being followed?
- Has the training and instruction provided to workers on how to work safely been successful?
- Are workers actively involved in identifying hazards and possible control measures?

- Are they openly raising health and safety concerns and reporting problems promptly?
- Are the frequency and severity of health and safety incidents reducing over time?
- If new legislation or new information becomes available, does it indicate current control measures may no longer be the most effective?

If problems are found, go back through the risk management steps, review your information and make further decisions about risk control.

Health monitoring

Regulation 368: A person conducting a business or undertaking must ensure health monitoring is provided to a worker carrying out work for the business or undertaking if:

- the worker is carrying out ongoing work at a workplace using, handling, generating or storing hazardous chemicals and there is a significant risk to the worker's health because of exposure to a hazardous chemical referred to in Schedule 14, table 14.1, column 2; or
- the person identifies that because of ongoing work carried out by a worker using, handling, generating or storing hazardous chemicals there is a significant risk that the worker will be exposed to a hazardous chemical (other than a hazardous chemical referred to in Schedule 14, table 14.1) and either:
  — valid techniques are available to detect the effect on the worker's health; or
  — a valid way of determining biological exposure to the hazardous chemical is available and it is uncertain, on reasonable grounds, whether the exposure to the hazardous chemical has resulted in the biological exposure standard being exceeded.

Health monitoring of a person means monitoring the person to identify changes in the person's health status because of exposure to certain substances. It involves the collection of data in order to evaluate the effects of exposure to determine whether or not the absorbed dose is within safe levels. This allows decisions to be made about implementing ways to eliminate or minimise the worker's risk of exposure, for example, reassigning a worker to other duties that involve less exposure or improving control measures.

Substances commonly encountered during abrasive blasting (either in the blasting medium or the surface being blasted) that may require health monitoring to be carried out include:

- asbestos
- crystalline silica
- cadmium
- inorganic arsenic
- inorganic chromium, and
- inorganic lead.

Health monitoring, which may include biological monitoring, can assist in:

- establishing whether an identifiable disease or health effect known to be linked to exposure to dust, chemicals or noise has occurred
- determining levels of toxic substances in the body so that informed decisions can be made about the effectiveness of control measures and whether any further action needs to be taken (e.g. a reduction in or cessation of exposure).

Biological monitoring is a way of assessing exposure to hazardous chemicals that may have been absorbed through the skin, ingested or inhaled, therefore, biological monitoring techniques should also be used. For example, workers exposed to lead may require biological monitoring to measure the level of lead in their blood.

Biological monitoring has the specific advantage of being able to take into account individual responses to particular hazardous chemicals. Individual responses are influenced by factors including size, fitness, personal hygiene, work practices, smoking and nutritional status.

A person conducting a business or undertaking must ensure that where health monitoring must be provided to a worker, the type of health monitoring referred to in the WHS Regulations is provided unless:

- an equal or better type of health monitoring is available, and
- the use of that other type of monitoring is recommended by a registered medical practitioner with experience in health monitoring.

Health monitoring is not an alternative to implementing control measures. If the results indicate that a worker is experiencing adverse health effects or signs of exposure to a hazardous chemical, the control measure must be reviewed and if necessary revised.

A person conducting a business or undertaking must:

- inform workers and prospective workers about health monitoring requirements
- ensure health monitoring is carried out by or under the supervision of a registered medical practitioner with experience in health monitoring
- consult workers in relation to the selection of the registered medical practitioner
- pay all expenses relating to health monitoring
- provide certain information about a worker to the registered medical practitioner
- take all reasonable steps to obtain a report from the registered medical practitioner as soon as practicable after the monitoring has been carried out
- provide a copy of the report to the worker and the regulator if the report contains adverse test results or recommendations that remedial measures should be taken. Also provide the report to all other persons conducting a business or undertaking who have a duty to provide health monitoring for the worker
- keep reports as confidential records for at least 30 years after the record is made (40 years for reports relating to asbestos exposure), and
- not disclose the report to anyone without the worker's written consent unless required to under the WHS Regulations.

The WHS Regulations also contain specific requirements relating to health monitoring for lead. If a worker is carrying out lead risk work, health monitoring must be provided to a worker before the worker first commences lead risk work and one month after the worker first commences lead risk work.

Further information on health monitoring can be found in the *Health Monitoring for Exposure to Hazardous Chemicals – Guide for Workers* and *Health Monitoring for Exposure to Hazardous Chemicals – Guide for Persons Conducting a Business or Undertaking.*

3. SPECIFIC HAZARDS AND CONTROL MEASURES

3.1 Prohibited and restricted chemicals

The WHS Regulations prohibit and restrict the use of some hazardous chemicals as abrasive material in an abrasive blasting process.

Regulation 381: A person conducting a business or undertaking must not use, handle or store, or direct a worker to use, handle or store the hazardous chemicals listed in table 1 for abrasive blasting.

Table 1 – Restricted hazardous chemicals

Any substance that contains greater than: • 1 % free silica (crystalline silicon dioxide) • 0.1 % antimony • 0.1 % arsenic • 0.1 % beryllium • 0.1 % cadmium • 0.5 % chromium (except as specified for wet abrasive blasting) • 0.1 % cobalt • 0.1 % lead (or which would expose the operator to levels in excess of those set in the WHS Regulations covering lead) • 0.1 % nickel • 0.1 % tin
For wet abrasive blasting, any substance than contains chromate, nitrate or nitrite
Polychlorinated biphenyls (PCBs)

There are also other carcinogenic chemicals that are prohibited or their use is restricted under the WHS Regulations and therefore cannot be used in abrasive blasting, for example acrylonitrile (CAS number 107-13-1) must not be used, handled or stored for *any purpose*, including abrasive blasting, unless the regulator has properly authorised it. Restricted and prohibited carcinogenic chemicals and restricted hazardous chemicals are listed in Schedule 10 of the WHS Regulations.

Asbestos

R.446 A person conducting a business or undertaking must not use, direct or allow a worker to use high pressure water spray or compressed air on asbestos or asbestos containing materials.

The use of high pressure water spray or compressed air on asbestos or asbestos containing materials is prohibited. Asbestos can release airborne fibres whenever it is disturbed, and the inhalation of these fibres into the lungs is a significant health risk.

Asbestos has been used in products including:

- certain textured coatings and paints
- roofing materials
- vinyl or thermoplastic floor tiles, profiled sheets used on roofs and walls and flat sheets in flashings
- imitation brick cladding, and
- plaster patching compounds.

The WHS Regulations contain specific requirements on asbestos and asbestos-containing material.

It can be difficult to identify the presence of asbestos by sight so having a sample of the suspected material analysed will confirm whether it is asbestos or not. Sampling can be hazardous and should only be undertaken by a competent person and samples should only be analysed by a National Association of Testing Authorities (NATA) accredited laboratory or a laboratory approved by the regulator or operated by the regulator.

Further guidance is available in the *Code of Practice: How to Safely Remove Asbestos* and the *Code of Practice: How to Manage and Control Asbestos in the Workplace*.

Lead

Lead may be present in surface coatings or the object being blasted. The WHS Regulations contain specific requirements for working with lead in addition to the hazardous chemicals requirements. These include the identification of lead risk work and removing a worker from lead risk work in certain circumstances.

Naturally occurring radioactive material

Some abrasive blasting mediums such as garnet and staurolite may contain trace levels of thorium. Thorium is a naturally occurring radioactive material. While the concentration of thorium or other radioactive materials is low, mineral extraction may concentrate naturally occurring radioactive material. Exposure to naturally occurring radioactive material is through inhaled dust. Exposure to radioactive materials may increase the risk of cancer.

The use of abrasives containing any radioactive substance where the level of radiation exceeds 1 becquerels per gram (Bq/g) is prohibited, so far as reasonably practicable. You should actively source material with lower radioactive content levels to minimise the risks from radiation.

Further information on selecting an abrasive blasting medium is at Appendix A.

3.2 Dust

One of the main hazards in abrasive blasting is dust which in many cases can be toxic. Crystalline silica and lead are typical examples of toxic dusts that can be generated during abrasive blasting activities.

Identifying dust hazards

Abrasive blasting can generate large quantities of respirable and inhalable dust from the abrasive blasting medium and the surface of the object being blasted.

'Inhalable' dust means the dust present in the air which a worker can inhale through the nose or mouth during breathing. 'Respirable' dust is that portion of inhalable dust that is small enough to enter the lungs down to the lower bronchioles and alveolar regions.

Respirable dusts may be more hazardous than inhalable dusts for some materials, such as crystalline silica which can result in permanent scarring of the lung tissue.

Labels and SDSs should be checked to identify dust hazards in the blasting medium. Manufacturers, importers and suppliers of hazardous chemicals have a duty under the WHS Regulations to ensure that the current SDS is provided to a person at the workplace if the person asks for it. The SDS provides information about the chemical, possible health effects, control measures that may be used to minimise exposure and first aid requirements.

You should also consider dust hazards presented by the surface being blasted, which could discharge particles of hazardous chemicals. Hazards include any paint or coating on the surface (which, for example, could contain lead) and the composition of the object or structure being blasted (which could contain asbestos or other hazardous chemicals).

Crystalline silica dust

Crystalline silica dust can be generated by:

- using abrasive materials that contain traces of crystalline silica, (e.g. staurolite or garnet), or
- abrasive blasting surfaces that contain crystalline silica (e.g. concrete, sandstone masonry, calcium silicate bricks, foundry castings).

Exposure to respirable crystalline silica can result in silicosis, which is stiffening and scarring of the lungs. It results in shortness of breath, coughing, and chest pain. The effects are irreversible and lead to a degeneration in the person's health, invariably resulting in death. Exposure to respirable crystalline silica is also associated with chronic lung diseases and cancer.

Silicosis can result from short-term exposure to high concentrations of crystalline silica dust (acute silicosis) or it can develop after long-term exposure over a number of years.

Lead dust

Lead dust can be generated by:

- using an abrasive material that contains lead (prohibited under the WHS Regulations)
- the abrasive blasting of surfaces containing lead, or
- abrasive blasting surfaces covered by paint that contains lead.

These surfaces commonly occur on bridges, ships, machinery, vehicles and recycled old housing timber.

Lead is easily absorbed or taken into the body by:

- inhaling dust or fumes
- eating contaminated food, or
- eating, drinking or smoking using contaminated fingers.

The major risk associated with lead is lead poisoning (plumbism). This affects the blood system and can cause anemia. Other symptoms include abdominal pain, convulsions, hallucinations, coma, weakness, tremors and the possible increased risk of cancer. Lead exposure can also affect both male and female reproductive systems. A developing foetus is particularly at risk, especially in the early weeks before a pregnancy becomes known.

The rate of absorption of lead depends on the size of the particles and the route of entry. Abrasive blasting produces particles small enough to be absorbed rapidly, leading to more acute and severe toxic effects.

Regulation 392: Under the WHS Regulations using a power tool, including abrasive blasting and high pressure water jets to remove a surface coated with paint containing more than 1 percent by dry weight of lead metal and handling waste containing lead is a *lead process*.

This means certain requirements in the WHS Regulations apply including:

- giving information to a person likely to be engaged to carry out a lead process, before the person is so engaged, on the health risks and toxic effects associated with lead, and the need for medical examinations and biological monitoring of workers carrying out a lead process, and
- assessing each lead process to determine if the lead process is lead risk work, i.e. if the work is likely to cause a worker’s blood lead level to be more than 10 micrograms per decilitre (for a female of reproductive capacity) or 30 micrograms per decilitre (for all other cases).

Assessing the risks from dust exposure

There are a number of factors that affect the degree of risk associated with dust produced in abrasive blasting activities. These factors include:

- the concentration of airborne dust in the breathing zone of the worker
- the size of the dust particles generated (whether dust particles are inhalable or respirable)
- the duration of exposure, and
- the type of dust and its biological effect

You should also identify situations where dust could spread to other workplaces or the environment.

Control of dust

Using a less hazardous abrasive material

Before purchasing any abrasive blasting mediums, you should look at the label and SDS to check the concentration of impurities and whether its use is prohibited or restricted under the WHS Regulations. Where a material is prohibited from use, your supplier may be able to advise alternative abrasive blasting medium (see Appendix A).

It is important to select an abrasive blasting medium with qualities that will generate minimum dust levels. Metallic abrasives have proven characteristics that resist shattering on impact, which is the major cause of the dust produced during blasting. Environmentally clean and recyclable abrasives, such as chilled iron grit or cast steel grit, should be used where reasonably practicable.

Using a less hazardous surface preparation method

The selection of methods of surface preparation can also affect the amount of dust in the air.

Wet abrasive blasting

A standard blast machine and compressed air are used to propel the abrasive with just enough water added to suppress the dust. Inhibitors are sometimes added to the water to minimise flash rusting. For effective dust suppression, the water should be added before the abrasive leaves the nozzle. The use of inhibitors such as chromate, nitrate or nitrite must comply with the restrictions on use in Table 10.3 of Schedule 10 of the WHS Regulations.

Water jetting (high and ultra high pressure)

High pressure water jetting is an alternative method to abrasive blasting. For further information on high pressure water jetting you should refer to AS/NZS 4233.1 *High pressure water (hydro) jetting systems Part 1:– Guidelines for safe operation and maintenance* and AS/NZS 4233.2: *High pressure water (hydro) jetting systems Part 2:- Construction and performance*.

Centrifugal wheel blasting

Centrifugal wheel blasting involves a rotating wheel assembly, either air or electrically driven, inside an enclosure fitted with a dust collector. Abrasive is propelled outwards from the spinning wheel by centrifugal force, striking the surface to be cleaned and removing rust, paint and mill scale.

Abrasives used include steel shot, steel grit, cut wire and chilled iron grit. They are recyclable and are continuously recovered, cleaned and returned for re-use.

Centrifugal wheel blasting is normally used where the work is of a consistent size, (e.g. pipes, valves, or steel sections). Normally, the rotating wheel assembly remains fixed and the surface to be cleaned is passed through the enclosure, but centrifugal wheel blasting can also be used on-site, (e.g. on a tank), with special adaptors where the wheel assembly moves across a stationary work surface.

Because all blasting takes place within an enclosure, there is no contact with airborne dust or high velocity particles. This minimises the risk to operators. However, attention should be paid to seals on wheel abrading equipment to ensure that toxic dusts cannot escape into the workplace during operation and that sufficient extraction clearance time is allowed before access doors are opened.

Vacuum blasting

Vacuum blast cleaning uses a standard abrasive blast nozzle, operating inside a shroud which is in close contact with the work surface, forming a tight seal. As the abrasive impinges on the surface, a vacuum is applied inside the shroud, removing the debris. The abrasive material, which typically can be steel shot, steel grit, chilled iron grit, aluminium oxide or garnet, is separated, and returned for re-use.

A variety of heads may be used to achieve a tight seal for inside corners, outside corners, and flat surfaces. In practice, however, operators tend not to change heads, lifting the assembly from the surface to clean odd shapes and inaccessible surfaces. While this may save time, it breaks the seal, defeating the purpose of the vacuum and exposing workers and the environment to hazards. This practice should be avoided where possible.

When used properly, vacuum blast cleaning can clean effectively with minimal dust generation.

Other removal methods

There are many emerging techniques and equipment that may minimise airborne dust levels. These include:

- sodium bicarbonate blasting
- blast cleaning with reusable sponge abrasives
- carbon dioxide (dry ice) blast cleaning.

You should also consider cleaning techniques that do not involve blasting, particularly for smaller jobs. These include:

- chemical strippers
- heat guns
- power tools with dust collection systems
- manual sanding
- scraping.

Although these techniques should generate low levels of dust, and therefore generally present lower risks to workers than abrasive blasting, other risks involved in using such techniques still need to be assessed and controlled.

Isolation and engineering controls

Abrasive blasting should be carried out in a blasting cabinet or blasting chamber where practicable.

Blasting cabinets

These are suitable for blasting small objects. The cabinet (see Figure 1) is fully sealed and the operator manipulates the work piece and the blasting hose from outside, viewing the object through a sealed window.

When using a properly designed and maintained cabinet, there is no need to wear a respiratory device. However, a low toxicity abrasive should still be used as poor maintenance of the cabinet may expose workers to dust.

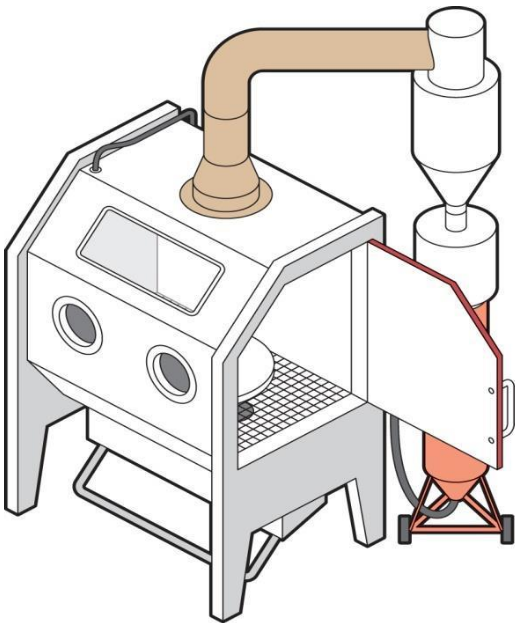


Figure 1: Blasting cabinet

<u>Blasting chambers</u>

Blasting chambers (also known as blast rooms – see Figure 2) should be used for cleaning transportable objects that are too large to be treated inside a blasting cabinet.

Blasting is done manually by operators working inside the chamber. Operators working inside blasting chambers must wear a hood or helmet type airline respirator which should be fitted with an inner bib and a high visibility shoulder cape, jacket or protective suit. Further information on hood or helmet type airline respirators can be found in *AS/NZS* 1716: *Respiratory protective devices.* The necessary capacity of any air service for respiratory protection should be calculated on a minimum requirement of 170 litres per minute continuous flow for each person, measured at the regulator. Where air cooling or encapsulated suits are used additional air will be required and advice should be sought from a competent person. Further information on quality of breathing air can be found in AS/NZS 1715: *Selection, use and maintenance of respiratory protective equipment.*

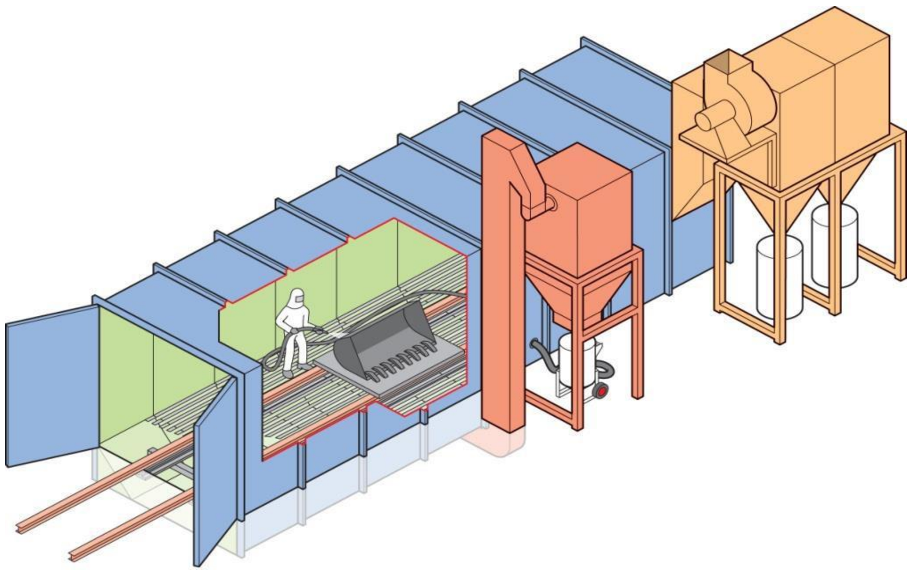


Figure 2: Blasting chamber

Temporary enclosures

Temporary enclosures should be used when the object or structure to be blasted is unable to be transported or too large for a blasting chamber. Temporary enclosure should also be used for fixed structures such as bridges or water tanks.

Where monitoring indicates that persons in surrounding areas may be exposed to dust levels in excess of the exposure standards, they should be excluded from the area where possible by warning signs and barricading, or provided with PPE.

Regardless of the control measures chosen, you must ensure that no-one at the workplace is exposed to dust levels in an airborne concentration that exceeds the relevant exposure standard.

Further information on blasting cabinets, blasting chambers and temporary enclosures can be found in Section 3.4 of this Code.

Administrative controls

Exclusion zones

Although open air blasting activities are not recommended, there may be occasions when there is no alternative. In these circumstances, exclusion zones (also known as buffer zones) should be used to protect workers and other persons in the vicinity from exposure to hazardous dust (see Figure 3). Exclusion zones may also be used in conjunction with blasting chambers and temporary enclosures.

The size of the exclusion zone should be determined after assessing the risk to all unprotected people. The prevailing conditions at the time of blasting should be taken into account, for example, the exclusion zone may need to be extended down-wind.

An exclusion zone should be established and maintained to exclude workers and other persons who are not wearing respiratory protective equipment (RPE). Warning signs should be located so that they are clearly visible before entering the area.

Signs should warn that:

- abrasive blasting is in progress and that there is a dust hazard
- access to the area is restricted to authorised persons
- RPE should be worn in the exclusion zone.

Where an exclusion zone interferes with other activities at a workplace, other workers should only work within the exclusion zone after being provided with RPE.

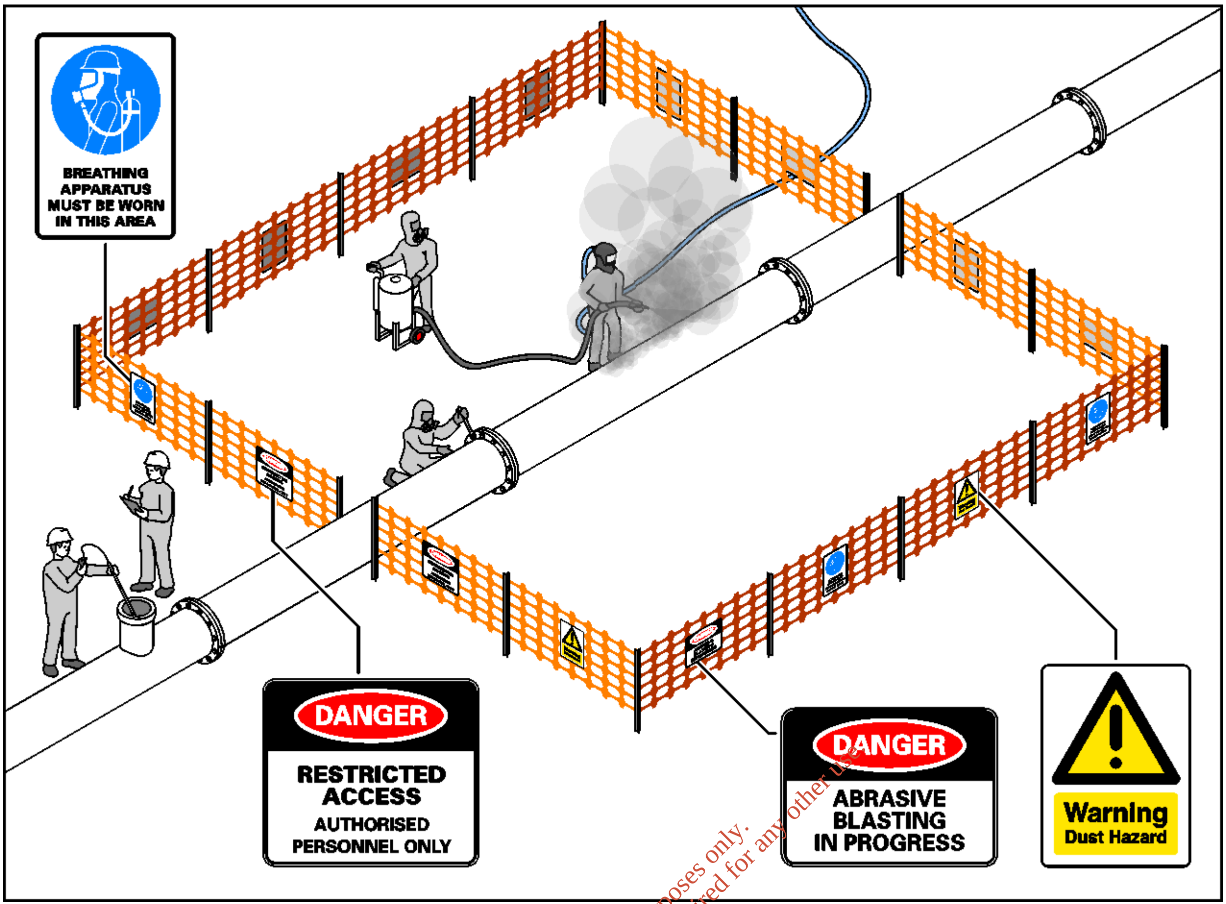


Figure 3: Exclusion Zone

Scheduling abrasive blasting activities

The number of people who will be exposed to dust should be reduced by:

- shifting the site of abrasive blasting away from other workers
- scheduling blasting outside normal working hours
- ceasing blasting in windy conditions
- stopping other work on a site and clearing people while blasting is taking place.

Housekeeping

Drift from abrasive blasting can be harmful not only to workers but also to members of the public. Good housekeeping can minimise the risk of exposure.

While other control measures should prevent dust escaping from the area where blasting is being done, any dust or residue that does make its way into the workplace should be removed as soon as practicable after blasting has finished. This includes the surfaces in an exclusion zone.

Where practicable, accumulated dust should be removed using wet cleaning methods, or High Efficiency filter vacuum methods.

Because workers undertaking cleaning work may be exposed to dust levels that exceed the exposure standard, they should wear PPE.

Facilities

Decontamination facilities should be provided to allow workers to shower and change clothes after the completion of blasting. Many types of dust (particularly lead dust) may enter the body by ingestion. It is therefore important that workers take care with personal hygiene by washing hands and face prior to eating or drinking. A clean area, separated from the blast site, should be provided for consuming food.

Further guidance on the type of facilities that should be provided is available in the *Code of Practice: Managing the Work Environment and Facilities.*

Personal protective equipment

PPE should include:

- an airline respirator of the hood or helmet type, fitted with an inner bib and a high visibility shoulder cape
- protective clothing (a jacket or protective suit)
- protective gloves (canvas or leather)protective footwear
- personal hearing protectors.

Regulation 44: If personal protective equipment (PPE) is to be used at the workplace, the person conducting the business or undertaking must ensure that the equipment is selected to minimise risk to health and safety including by ensuring that the equipment is:

- suitable for the nature of the work and any hazard associated with the work
- a suitable size and fit and reasonably comfortable for the person wearing it
- maintained, repaired or replaced so it continues to minimise the risk
- used or worn by the worker, so far as is reasonably practicable.

A person conducting a business or undertaking who directs the carrying out of work must provide the worker with information, training and instruction in the proper use and wearing of personal protective equipment; and the storage and maintenance of personal protective equipment.

A worker must, so far as reasonably able, wear the PPE in accordance with any information, training or reasonable instruction and must not intentionally misuse or damage the equipment.

As abrasive blasting is a high hazard activity, some PPE should always be worn regardless of other control measures in place.

<u>Respiratory protection</u>

Workers engaged in abrasive blasting should be supplied with and wear an airline positive pressure hood or helmet fitted with an inner bib and a high visibility shoulder cape, jacket or protective suit.

Respirator helmets must be supplied with breathing air of an adequate quality. If the air is supplied from compressed air cylinders, the source should be fitted with an alarm device that warns the wearer or an attendant when the cylinder pressure falls below a predetermined level. For information on air quality refer to *AS/NZS 1715: Selection, use and maintenance of respiratory protective equipment.*

Any air-fed respirator should have an alarm that warns and logs the incidence of carbon monoxide gas.

An air purifying respirator should also be worn by the pot attendant and any other person within the work area while abrasive blasting is in progress, during maintenance or repair work or during the clean-up of dust. For further information refer to *AS/NZS 1716: Respiratory protective devices.*

Care should be taken to ensure breathing air lines cannot be run over by vehicles or damaged by the blasting process. Air intakes to breathing air compressors should be situated well away from sources of contaminants, particularly exhaust gases from mobile liquid fuel engines, or areas where exhaust fumes may accumulate.

Respirators should be fitted for each person individually and if one is to be used by another operator, it should be disinfected and refitted before use. The tightness of all connections and the condition of the face piece, headbands and valves should be checked before each use.

Respirators should be selected, fitted, used and maintained in accordance with the manufacturer's instructions. For further information also refer to AS/NZS 1715: *Selection, use and maintenance of respiratory protective equipment*.

Protective clothing

To keep out dust and abrasive grit, protective suits or clothing should be worn and should have leather or elastic straps at the wrist and ankles and overlapping flaps at all suit closures.

Protective gloves should be industrial safety gloves or mittens of an appropriate material to reduce penetration of particulate matter. For further information refer to *AS/NZS 2161*: *Occupational protective gloves*.

Protective footwear should be made of material which reduces penetration from particulate matter, and where appropriate, should be waterproof. For further information refer to *AS/NZS 2210*: *Occupational protective footwear*.

If disposable clothing is worn, the clothing should be appropriately disposed of after use, without risk to the safety and health of others.

Helmets and eye protection

Helmets will provide protection from flying fragments to the eyes, head and neck.

Helmets should not be held or hung up by the air feed hose, dropped or left in areas where they might be exposed to dust and dirt or be subject to distortion. After removing the helmet, dust should be vacuumed and the cleaned helmet placed in an airtight plastic bag. It should be stored in a dust-free area, away from direct sunlight. At least once a week, the inside of the helmet should be washed with warm water and mild detergent.

The helmet cape requires frequent inspection, periodic cleaning and immediate replacement if damaged. You should never use tape to repair holes or worn areas. The inner collar should be replaced when the elastic becomes stretched out of shape.

For further information on the selection, use and maintenance of helmets refer to AS/NZS 1800: *Occupational protective helmets – selection, care and use*.

Protective eye equipment includes safety glasses, goggles, face shields, hoods or helmets with lenses designed to withstand medium to high velocity impact by flying objects. For further information refer to *AS/NZS 1336 Recommended practices for occupational eye protection* and AS/NZS 1337: *Eye protectors for industrial applications*.

Maintenance of PPE

The WHS Regulations require that PPE is maintained, repaired or replaced so as to ensure that it continues to be effective. A maintenance program should include procedures for:

- daily cleaning and inspection of PPE by the worker for wear and damage
- identification and repair or replacement of any worn or defective components of equipment
- regular periodic inspection, maintenance and testing of respiratory protective equipment in accordance with the manufacturer's instructions
- regular periodic testing of breathing air quality, in accordance with the manufacturer's instructions or, where manufacturer's instructions are not available, the instructions of a competent person.

3.3 Particulate matter

Identifying particulate matter

Particulate matter is small particles or pieces of the substrate being blasted, or of the blasting medium which are generated during abrasive blasting. Particulate matter can also include water.

Workers carrying out abrasive blasting can be struck by particulate matter. Serious injuries or death can result from being struck by particulate matter discharged under high pressure.

Common injuries include:

- eye damage
- severe lacerations
- burns
- skin penetration.

Assessing the risks

You should observe workers undertaking abrasive blasting. This will allow you to see if they are following correct procedures and using the PPE provided. The risk of sustaining a serious injury from particulate matter is increased when:

- blasting in a confined space
- working in an elevated position
- the operator is out of the line of sight of a pot tender or there is no dedicated pot tender who can provide assistance if required.

Controlling the risks

<u>Isolation</u>
Abrasive blasting activities should be isolated from other workplace activities to minimise the possibility of workers being struck by particulate matter. This can be done by using blasting chambers, blasting cabinets, temporary enclosures and exclusion zones.

Abrasive blasting plant can also incorporate guards to reduce the possibility of particulate matter striking the operator.

<u>Engineering controls</u>
Abrasive blasting equipment should be fitted with a fast acting self-actuating cut-off device under the direct control of the nozzle operator that will immediately stop the flow of abrasive material. The device most commonly used is called a ‘dead man control’ (see Figure 4).

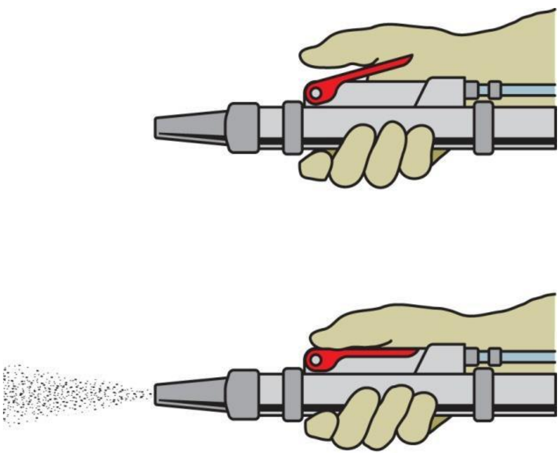


Figure 4: Nozzle with dead man control

Using a blast machine without a dead man control (under the direct control of the operator) is dangerous and may result in serious injury or death.

The dead man control is usually attached to the nozzle. When the nozzle is dropped, the air supply shuts off and prevents the hose from whipping and injuring the worker and the abrasive material firing at the operator or other people nearby. For more information on dead man controls, refer to the following section on abrasive blasting plant and equipment.

Administrative controls
When blasting, the nozzle should only be pointed at the work. A blast nozzle should never be pointed at any person. Blast hoses should be uncoiled when in use and operators should be adequately trained in the use and maintenance of this equipment.

PPE
Workers exposed to high velocity particulate material should wear suitable PPE to protect against flying abrasive particles. The PPE should include:

- eye protection
- protective gloves (canvas or leather)
- protective footwear
- protective clothing (overalls, long trousers, blast suits, aprons)
- RPE

3.4 Abrasive blasting plant and equipment

Persons conducting businesses or undertakings who have management or control of plant at a workplace must ensure, so far as is reasonably practicable, that the plant is without risks to the health and safety of any person.

Designers of plant must ensure, so far as is reasonably practicable, that the plant is designed to be without risks to the health and safety of persons.

When purchasing abrasive blasting plant and equipment you should ensure that safety features have been incorporated into the design. The following information must be passed on from the designer through to the manufacturer and supplier to the end user:

- the purpose for which plant was designed or manufactured
- the results of any calculations, analysis, testing or examination
- any conditions necessary to ensure the safe use of the plant.

A supplier must give this information to each person who receives the plant (which may be in the form of a manufacturer's manual).

Air compressors and blast pots

All valves should be of a rating equivalent to that of the pressure vessel and be correctly attached. A safety relief valve should be fitted on the compressor or air supply system and regularly checked. Further information on the design of pressure vessels can be found in *AS/NZS 1200: Pressure equipment*.

Blow-down procedures (if applicable), should be developed and implemented. Never exceed the rated working pressure as this may lead to explosion.

A muffler should be attached to blast pots to minimise the noise from escaping air when the machine is depressurised.

Portable blast pots should have wheels and be ergonomically designed.

Planned inspection and routine maintenance should be carried out by a competent person. Further information can be found in *AS/NZS 378: Pressure equipment – In-service inspection, and the manufacturer's instructions*.

Nozzle

Where dry blasting is being conducted, an efficient means for the discharge of static electrical charge from the blast nozzle and the object being blasted should be provided.

The nozzle lining and threads should be checked for wear and damage. Use nozzle washers, and replace them when they show signs of wear.

Dead man controls (also known as fast acting automatic cut-off device)

Abrasive blasting equipment should be fitted with an automatic cut-off device (deadman control) near the blast nozzle so that it is under direct control of the nozzle operator to quickly stop the flow of abrasive material to the nozzle.

Dead man controls can be either pneumatic or electric. Pneumatic controls are only suitable for distances up to 40 metres because the response time increases with distance. Electric controls are recommended for distances over 40 metres as they respond almost instantly and response times do not increase with distance. Dead man controls are subjected to rough treatment because they are located at the nozzle which results in damage and rapid wear. Deadman controls (especially the lever and lever lock) should be inspected and tested several times each working day. Moving parts should be cleaned regularly to prevent jamming. You should also:

- replace the rubber buttons and seals as necessary to prevent air escaping and abrasive from entering
- inspect and clean control hose line fittings before connecting them to prevent dust and dirt clogging air passageways throughout the system which can damage control valve cylinder walls.

You should never modify, remove or substitute parts and never tape down or prevent free movement of the control handle. This defeats the safety purpose of the remote control system and may cause serious injury if an uncontrolled nozzle is dropped.

Blast hoses, hose whips and couplings

Hoses should be constructed with anti-static rubber linings or fitted with an earth wire or similar mechanism to prevent electric shock. Static electricity may build up in dry blasting operations, from abrasive blasting equipment and/or from the surfaces being blasted. Static electricity can shock workers and create an ignition source, with the potential for explosion if there is a combustible atmosphere (for example, an atmosphere containing metal dust, organic abrasive or fine paint particles). You should ensure that:

- hoses or couplings are purpose designed
- the rated working pressure of a blast hose is not exceeded
- the hose from the pot to the blast nozzle is kept as straight as possible. In situations where a hose needs to be curved around an object, a long radius curve should be used. The use of sharp curves may create rapid wear on the hose, leading to the possibility of the hose malfunctioning
- blasting does not take place with a coiled hose
- hose whip checks or hose coupling safety locks or both are fitted to hoses
- safety cables are used to support the weight of elevated hoses
- pin holes are not taped in the blast hose. The hole will enlarge quickly and will cause a blow-out
- blast hoses are coiled and stored away from water, oil and chemicals to prevent rotting
- coupling fit is checked
- screws provided by the coupling manufacturer are used
- the hose end fits uniformly flush with the coupling shoulder

- nozzle holders and couplings fit snugly on the blast hose. Reject those that are loose
- hoses that have a damaged outer cover are replaced
- all hoses or lines are positioned in locations where they are not subject to damage, fouling or restrictions
- hoses, hose whips and couplings are inspected, tested and maintained in accordance with the manufacturer's instructions.

Blasting cabinets

Blasting cabinets should be used for blasting small objects. The cabinets should be constructed from an abrasive resistant, non-combustible material and should also:

- have a sealed window so that the operator can view the object being cleaned
- be fitted with a dust extraction/collection system which has a sufficient air change rate to increase visibility and keep dust exposures less than the relevant exposure standards when the cabinet is opened
- have a dust tight light fixture, and
- have interlocked doors to eliminate the possibility of the machine being operated while the door is open.

In conjunction with the air change rate, a suitable clearing time should also be allowed before opening the cabinet.

Cabinets should be regularly inspected and maintained in accordance with the manufacturer's instructions, especially in relation to gloves, gasket, door seals and structural integrity.

Blasting chambers

Blasting chambers should be constructed from an abrasive resistant, non-combustible material designed to prevent the escape of dust and minimise internal projections on which dust may settle.

Blasting chambers should have a mechanical exhaust system that effectively extracts the dust from the blasting chamber and which is arranged so as to prevent re-entry of the extracted dust into the blasting chamber and the workplace. Extracted air should be passed through a filtering or cleaning device that removes airborne contaminants before discharge. In a down-draught air flow blasting chamber, the ventilation system should produce a minimum air velocity of 0.3 linear metres per second; and in a cross-draught air flow blasting chamber, the ventilation system should produce a minimum air velocity of 0.4 linear metres per second in the direction of extraction. The ventilation system ducts should be fitted with inspection ports and cleaning ports, ideally at locations where dust might be reasonably expected to accumulate. Bonding and grounding should be used to prevent static build-up.

Blasting chambers should also have:

- easily accessible operating controls and interlocked doors to prevent the machinery being operated while the door is open
- windows or inspection ports which are fixed in a metal sash and constructed of toughened safety glass, laminated safety glass or safety wired glass. Windows or inspection ports should be maintained so as to allow effective visibility
- an emergency exit located at the furthermost position from the main entrance that is signposted and backlit so that it is visible if the power is cut
- a ventilation system kept in continuous operation whenever blasting is being done and for at least 5 minutes after blasting has finished or when cleaning, maintenance or repair is carried out on the chamber or cabinet, except where the operation of the ventilation system may create a hazard (in which case effective alternative means of ventilation should be provided)

- an illumination of at least 200 lux measured on a horizontal plane one metre above the floor of the blasting chamber or enclosure
- an electrical supply which complies with relevant standards, for example *AS/NZS 2381: Electrical equipment for explosive gas atmospheres* and AS/NZS 3000*: Electrical installations* (known as the Australian /New Zealand Wiring Rules).

Blasting chambers should be maintained so as to prevent dust from escaping. Doors should be kept closed during blasting.

Only abrasive blasting work, work incidental to abrasive blasting, or maintenance or repairs to the blast room or its equipment should be carried out in the blasting room.

Manufacturers of blasting chambers should conduct testing to ascertain the level of ventilation required under normal operating conditions. This should assist you to select a chamber appropriate to your needs.

Testing of the ventilation should be conducted on-site when the chamber is installed to ensure that it is operating to the design specifications. Ventilation should also be tested when there is a change in blasting procedures (e.g. use of a different abrasive material), after damage or repairs and on a regular basis (e.g. every 12 months). This testing can be conducted by an occupational hygienist or other competent person.

Temporary enclosures

Where possible the object being blasted should be fully enclosed. Where full enclosure is not possible, screening should extend two metres above the structure and blasting should be conducted downwards. Where persons outside the structure may be exposed to dust, exclusion zones, signage and PPE should be used. Stringent monitoring may be necessary to ensure that people outside the structure are not exposed to dust levels greater than national exposure standards.

Temporary enclosures should have:

- dust extraction/collection systems fitted, and
- containment screens made of puncture- and tear-resistant materials (for example, woven polypropylene fabric or rubber) for high abrasion areas inside the enclosure. Selection should also consider fire retardancy, burst strength, and ultraviolet (UV) resistance.

Porous material like shade cloth will not prevent the escape of fine dust, and should not be used for temporary enclosures if the work generates silica, lead, or other toxic dusts.

Maintenance of plant and equipment

Regular inspection and maintenance is particularly important for abrasive blasting plant and equipment as the process is self-destructive by nature. Every blasting chamber, blasting cabinet, ventilating system duct, filtering or cleaning device and item of abrasive blasting equipment should be inspected by a competent person in accordance with the manufacturer's instructions.
In addition, plant and equipment should be checked daily by the operator for wear and damage. You should keep log books and inspection reports containing a full history of service and repairs. Further guidance on plant is available in the *Code of Practice: Managing the risks of plant in the workplace.*

3.5 Recycling of blast material

The recycling of blast material involves three stages - collection, cleaning and reuse of spent material that contains some useable abrasive grains. During abrasive blasting, the spent material has endured high velocity impact with the surface being cleaned, producing shattered abrasive and dust, combined with particles of the material being removed. The recycling process needs to separate these and allow the recovered abrasive to be reused efficiently and safely without an increase in dust levels. Abrasive that has become wet cannot be recycled as dust separation is not possible. It may not be possible to remove toxic chemicals such as lead paint from used abrasive and the abrasive should be disposed of in accordance with relevant environmental and waste management regulations.

<u>Collection</u>

Collection of the spent material from the blasting site is best done using the method that least disturbs the spent material. Vacuum recovery equipment offers the best protection for operators. Using methods that generate dust (e.g. sweeping or compressed air blowdown) should be avoided.

<u>Cleaning</u>

The following contaminants should be extracted before the blast material is reused:

- oversized trash – all particles (e.g. rust, paint flakes and other foreign matter) that are of sufficient size to clog the blast machine metering valve or nozzle
- toxic dust – any toxic contaminants that have been introduced or released into the media (e.g. lead from lead paint material)
- nuisance dust – fine shattered abrasive grains
- respirable dust – powdered material that is respirable and will penetrate to the lower respiratory system.

If abrasive blasting has been carried out on a substrate containing grains of sand (e.g. foundry castings, concrete), it may subsequently contain a significant amount of crystalline silicon dioxide in a particle size range similar to that of the spent abrasive material which is to be re-cycled. Abrasive materials used in this kind of work should not be recycled unless it can be established that the concentration of crystalline silicon dioxide remains below the allowed amount.

<u>Reuse</u>

The collected material will contain various contaminants (see above) as well as the reusable abrasive grains. The contaminants should be separated from the media by passing through engineered equipment including airwashes, cyclones and screens as required, before it can be returned to the blast machine for reuse.

3.6 Disposal of waste

To minimise risks, waste products from abrasive blasting should be covered to prevent them from becoming airborne.

The waste material resulting from abrasive blasting should be disposed of in accordance with any local laws that apply to the disposal of waste materials.

4. OTHER HAZARDS AND CONTROL MEASURES

4.1 Noise

Regulation 57: A person conducting a business or undertaking must manage risks to health and safety relating to hearing loss associated with noise. The person conducting a business or undertaking must ensure that the noise a worker is exposed to at the workplace does not exceed the exposure standard for noise.

Regulation 58: Audiometric testing must be provided to a worker who is frequently required to use personal protective equipment to protect the worker from the risk of hearing loss associated with noise that exceeds the exposure standard for noise.

Exposure to high noise levels can cause permanent hearing loss. Abrasive blasting equipment can generate various noise levels that may cause workers to be exposed to noise that exceeds the exposure standard.

The exposure standard for noise in relation to hearing loss, is defined in the WHS Regulations as an LAeq,8h of 85 dB(A) or an LC,peak of 140 dB(C). There are two parts to the exposure standard
for noise because noise can either cause gradual hearing loss over a period of time or be so loud that it causes immediate hearing loss.

In the abrasive blasting industry, the main sources of noise for the operator are:

- discharge of compressed air from the blast nozzle – 112 to 119 dB (A)
- the feed air inside the protective helmet – 94 to 102 dB (A)
- blast cabinets – 90 to 101 dB (A)
- air compressors – 85 to 88 dB(A).

Maximum noise levels up to 137dB(A) have been measured at the operator's position during blasting activities when the abrasive runs out.

Operators of small abrasive blasting cabinets are particularly at risk. They may not perceive the noise to be damaging because of the relatively short periods of use. However, average noise levels at the operator's ears have been measured between 90 - 101 dB (A). This means that at 101 dB(A), for instance, an exposure of unprotected ears of only 12 minutes is allowed in any eight hour shift so as not to exceed the exposure standard of LAeq,8h 85 dB(A). Following such exposure, other work activities must not contribute to further noise exposure.

Unprotected workers and others close to the blasting process may also be exposed to excessive noise.

Control measures

- Using an alternative, quieter method to clean or prepare surfaces, where possible
- Isolating workers and other persons from the noise source by:
  - using blast chambers
  - relocating or enclosing noisy equipment - blast cabinets, air compressors, and grit pots can be located in sound proof enclosures or separate rooms away from the work area. In the open air, mobile enclosures lined internally with sound absorbent material could be used at locations where noisy work has to be carried out and other people may be affected. Such enclosures could reduce operator exposure by about five to 20 dB(A) depending on their construction.
- Using engineering controls, for example:
  - reducing the amount of pressure used to abrade the substrate
  - improving mufflers on blast pots
  - silencers on intake and exhaust systems
  - baffles and muffling materials in air supply hoses for blast helmets
  - sound attenuating material on walls and ceilings, and

- sound transmission barriers around compressors.
- Using administrative controls, for example:
  - undertaking abrasive blasting out of normal working hours to minimise noise exposure to other workers
  - stopping other work and clearing people from a site while blasting is taking place
  - establish a rotation system for work to be carried out in shifts
  - establishing exclusion zones where noise exposure levels are in excess of the exposure standard and restricting entry to only persons with adequate hearing protectors
  - regularly maintaining abrasive blasting plant and equipment
  - providing quiet areas for rest breaks for workers exposed to noisy work, and
  - limit the time workers spend in noisy areas by moving them to quiet work before their daily noise exposure levels exceed the exposure standard.
- Providing personal hearing protectors such as ear plugs, ear canal caps, ear muffs, and hearing protective helmets. Further information on requirements relating to PPE can be found in *AS/NZS 1269.3: Occupational Noise management – Hearing protector program.*

Further guidance on how to identify, assess, control and monitor exposure to noise is available in the *Code of Practice: Managing Noise and Preventing Hearing Loss at Work*.

4.2 Heat

Heat is also a common hazard associated with carrying out abrasive blasting. Workers are at risk of heat strain due to working in hot, poorly ventilated or confined spaces and the type of personal protective equipment that is worn, for example blast helmets, protective suits or leather coveralls.

Heat strain is a serious medical condition which could lead to heat exhaustion and death.

When assessing the risks associated with heat, you should consider a number of factors including the workplace temperature, humidity, air movement, exposure to sources of heat, the work demands, how much clothing is worn (including PPE), individual risk factors, and whether the worker is acclimatised to the conditions.

Control measures

- fitting cooling devices to the air supply of blast helmets
- providing PPE that is selected and fitted to minimise the build up of heat and wearing cotton undergarments
- providing a cool, well-ventilated area where workers can take rest breaks or carry out other tasks
- scheduling work so that abrasive blasting is done at cooler times and
- ensuring cool drinking water is readily available.

Further guidance on controlling the risks of heat exposure is available in the *Code of Practice: Managing the Work Environment and Facilities.*

4.3 Vibration

The force of the abrasive moving through the blast hose transmits vibration to the hands and arms of operators holding the equipment. Prolonged use of abrasive blasting equipment may lead to a condition known as occupational Raynaud's disease (also called white finger or dead finger). It results from persistent microscopic damage to nerves and blood capillaries. It may also cause carpal tunnel syndrome.

Symptoms include:

- blanching (whiteness) and numbness in the fingers
- fingers are cold to touch

- loss of dexterity or increased clumsiness
- decreased sensitivity to touch, temperature and pain, and
- loss of muscular control.

Chronic exposure may result in gangrenous and necrotic changes in the finger. The condition may take months or years to develop. There is no effective treatment to reverse the effects of white finger.

The risk of injury or disease from vibration will vary depending on the equipment being used, the intensity of the vibration, frequency and duration of exposure, the force of grip applied by the worker, maintenance of the equipment and insulation provided by protective gloves.

Further information on measuring exposure to hand/arm vibration is available in AS 2763: *Vibration and shock – Hand transmitted vibration – guidelines for the measurement and assessment of human exposure*.

Control measures:

- Using an alternative method to clean or prepare surfaces, where possible
- Using engineering controls, for example vibration-reduced equipment such as vibration isolating handles incorporated into blasting nozzles and/or supports to reduce the pressure of the hand to control the nozzle
- Using administrative controls, for example reducing the amount of time an operator is required to operate a blast nozzle by job rotation or more frequent breaks. Frequent maintenance of equipment may also reduce the level of vibration
- Using PPE, for example vibration absorbing gloves may assist in dampening vibration.

4.4 Manual tasks

Regulation 60: A person conducting a business or undertaking must manage risks to health and safety relating to a musculoskeletal disorder associated with a hazardous manual task.

Abrasive blasting may result in musculoskeletal disorders from performing hazardous manual tasks, for example:

- back strain from lifting or pushing
- muscle strain from working in awkward positions
- strain from hose whip
- Occupational Overuse Syndrome from controlling the blast hose.

Ways of reducing the risk of musculoskeletal disorders include:

- appropriately designed plant and hoses which are tied to prevent hose whip
- reducing the amount of force necessary to perform tasks, for example, fixing wheels to heavy equipment, and moving heavy objects into and out of blasting chambers by using specially designed equipment
- ensuring workers do not have to perform manual tasks in excess of their capability
- job rotation.

Further information on how to manage the risks of hazardous manual tasks can be found in the *Code of Practice: Hazardous Manual Tasks.*

4.5 Confined spaces

Regulation 66: A person conducting a business or undertaking must manage the risks to health and safety associated with a confined space at a workplace including risks associated with entering, working in, on or in the vicinity of a confined space (including a risk of a person inadvertently entering the confined space).

Hazards that may be encountered in a confined space include:

- Flammable gases or vapours, toxic gases or vapours, flammable, combustible or toxic liquids or solids, or potentially explosive dusts
- oxygen deficiency or excess
- physical agents such as thermal extremes, radiation, noise or flooding
- engulfment
- mechanical equipment.

A wide range of injuries can be sustained from working in a confined space including:

- burns
- electrocution
- asphyxiation and suffocation
- poisoning
- brain damage and death
- crush injuries.

A risk assessment must be carried out by a competent person before workers enter confined spaces. Any identified risks must be eliminated or minimised and a confined space entry permit issued for the work.

Control measures

- Elimination – assess the need to undertake abrasive blasting in a confined space
- Isolation – the confined space should be isolated to avoid the introduction of harmful substances or activation of moving parts (e.g. isolate the confined space from power sources, lock or tag all moveable components)
- Engineering – mechanical ventilation systems should be used to remove hazardous contaminants produced by the work being performed in the confined space
- Administrative – develop and document a method for confined space entry.

Further information on how to work safely in confined spaces can be found in *Code of Practice: Confined Spaces.*

APPENDIX A – SELECTING AN ABRASIVE BLASTING MEDIUM

<table>
<tr><th>Do not use:</th><th>Blast material which may be used:</th></tr>
<tr><td>

Materials with any radioactive substances where the level of radiation exceeds 1 becquerels per gram, so far as is reasonably practicable
Materials containing more than:

0.1% antimony
0.1% arsenic
0.1% beryllium
0.1% cadmium
0.5% chromium (except as specified for wet blasting)
0.1% cobalt
0.1% lead (or which would expose the operator to levels in excess of those set out in Part 7.2 of the Regulations)
0.1% nickel
0.1% tin

Materials containing more than 1% free silica (crystalline silicon dioxide) including:

River sand
Beach sand or other white sand
Dust from quartz rock
Diatomaceous earth (pool filter material)

In dry abrasive blasting:

Recycled materials which have not been treated to remove respirable dust
Recycled materials for which treatment has not removed toxic materials to below the prescribed concentrations
Any substance likely to harm the upper respiratory tract

In wet abrasive blasting:

any substance that contains chromate, nitrate or nitrite

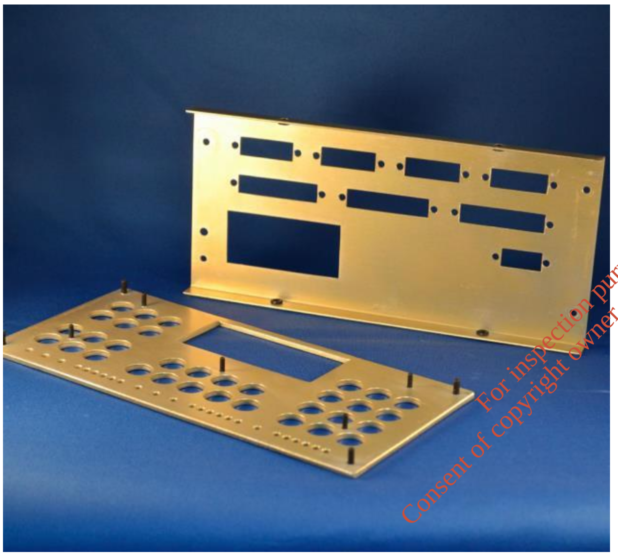
</td><td>
The following materials will not usually result in exposures greater than national exposure standards. However, you should check the Safety Data Sheet to ensure the composition of substances does not exceed prohibited levels

ilmenite
aluminium oxide
garnet (low crystalline silica content only)
other rocks and mineral sands which do not contain significant levels of silica
metal shot
steel grit
crushed glass
sodium bicarbonate
plastic beads
glass beads
some metal slags (check content analysis before purchase)
dry ice

Note: There are environmental requirements in relation to abrasive blasting mediums. If in doubt, seek advice from your local council.
</td></tr>
</table>

Alocrom Plating:

Alocrom is a Chromate conversion coating chemically applied to aluminium, which provides corrosion protection. It is also applied prior to painting or powder coating and is used when protection and/or electrical conductivity is required.
Light to medium Alocrom coatings have minimum effect on surface electrical resistance. The contact electrical resistance is less than 5000 micro-ohms per square inch measured under an applied electrode pressure of 200 pounds per sq. inch. (MIL-C-5541 method).It is suitable for all types of aluminium alloy including castings and high silicon alloys which can be problematical to anodise.



Example

Alocrom 1200 is a rapid non-electrolytic dip which gives excellent protection against corrosion to both painted and unpainted aluminium surfaces, which forms a protective golden coloured chromate coating on aluminium and its alloys.

Features

- Best electrical conductivity of all Alocrom conversions.
- Minimal change in surface appearance: maintaining metallic appearance.
- Easy to use and control: Timing can be varied by concentration changes.
- Improved adhesion and corrosion resistance for lacquered and painted surfaces.
- Coatings are integral with the metal and will withstand bending and denting of the surface.
- Gives excellent protection against corrosion to both painted and unpainted aluminium surfaces.
- Provides an excellent foundation for paint and other organic coatings

Alocrom 1200 is approved to DEF STAN 03-18 Certificate No. 031801 for use on aircraft, (including special approval for repairing damaged anodic coatings).

Black Oxide:

Black oxide is a conversion coating formed by a chemical reaction produced when parts are immersed in the alkaline aqueous salt solution operated at approximately 285 degrees F. The reaction between the iron of the ferrous alloy and the hot oxide bath produces a magnetite (Fe_3O_4) on the actual surface of the part. It is possible to oxidize non-ferrous metals under suitable conditions to form black oxides. It is possible to apply black oxide at room temperature; however it is not possible to achieve all of the benefits available from the "hot" oxide process. The cold black oxide process routinely shows colour variation from part to part and the black material frequently rubs off in your hands. The cold process does not meet military or automotive specifications.
Therefore the remainder of this article addresses the "hot" black oxide process.

The five basic steps for the black oxide conversion coating are clean; rinse; black oxide; rinse; supplementary coating (after-finish). If rust or scale is present on the part, additional steps such as acid pickling or alkaline de-scaling may have to be added before oxiding. Neutralizing and/or further rinsing may be necessary on assemblies and parts with blind holes to eliminate "flowering" or bleed- out. Black oxide cannot be produced over plated parts (zinc, nickel, chromium, cadmium, phosphate). This plating must be stripped prior to the black oxide process.
The supplementary coating (after-finish) will dictate the final appearance and function of the part. When a print or drawing specifies "Black Oxide" without any specific after-finish, it is interpreted as Black Oxide and Oil. It is recommended that an after-finish is always applied, as black oxide without an after-finish has very poor corrosion protection. However, with an oil, wax, or lacquer, it is possible to achieve excellent indoor corrosion protection (100+ hrs. in a humidity cabinet). Black oxides on steel are not suitable for severe outdoor applications or corrosive environments, but they can provide superior humidity cabinet results with proper supplementary coating. Black Oxides on Stainless steel and/or brass alloys will yield excellent corrosion protection, primarily due to their inherent properties.
The after-finish is usually determined by the part configuration and the end-use. If a "dry-to-touch" finish is needed, it is important to specify either Oil spin dry to touch, wax or lacquer. The oil after- finish will generally be a glossy finish, whereas the wax will be more matte. It is possible to use a torque/tension wax to provide added lubricity and reduced drive torque. In order to determine the appropriate after-finish, you must first evaluate which after-finish to use. The following factors should be considered:

- ✓ Length of protection required
- ✓ Desired finish appearance (gloss/matte)
- ✓ Storage conditions (humidity, vapour, temperature)
- ✓ Final application

Bright Cadmium Plating:

Cadmium (Cad) is a bright silvery white metal deposit (as plated). Supplementary treatments for type II can be golden, iridescent, amber, black, olive drab, or clear. All enhance the corrosion resistance of the coating.

Corrosion resistance is very good, especially with type II finish. The cadmium plating is smooth, adherent, uniform in appearance, free from blisters, pits, nodules, burning, and other defects when examined visually without magnification.

Luster: Unless otherwise specified, the use of brightening agents in plating solution is prohibited on components with a specified heat treatment of 180 Ksi minimum tensile strength (HRc 40) and higher. Either a bright (not caused by brightening agents) or dull luster shall be acceptable. Brighteners may be used with alloys listed in paragraph 3.2.8 of the specification.

Parts which have been machined, ground, cold formed, or cold straightened after heat treatment shall receive stress relief bake in accordance with table I or Ia of the specification prior to shot peening, cleaning or plating. All parts shall be baked within 4 hours of plating as specified in tables I of this specification. Baking on Types II and III shall be done prior to application of supplementary coatings.

For Class 1 and 2 the minimum cadmium thickness requirement shall be met after the supplementary treatment.

Excellent for plating of stainless steels that are to be used in conjunction with aluminium to prevent galvanic corrosion.

Cadmium deposits should not be used when an alternate process meets the performance requirements of this specification.

Applications Include:

Fasteners; Aircraft Components; Automotive Components.

11.1.1.1.1.1.1 SAE AMS-QQ-P-416

Type I: As Plated

Type II: Supplementary chromate treatment. Type II plating shall not show white corrosion products of cadmium, pitting, or basis metal corrosion products at the end of 96 hours (20%) salt spray exposure per following table:

Salt-Spray Test		
Type	Class	Test period for white corrosion products (hours)
Type II	Class 1	96
	Class 2	96
	Class 3	96

Unless otherwise specified, chromate treatment required for Type II is distinctly coloured iridescent bronze to brown including olive drab, black and yellow (gold).

Type III: Supplementary phosphate treatment. Type III shall conform to Type I of TT-C-490. Type III is used as a paint base.

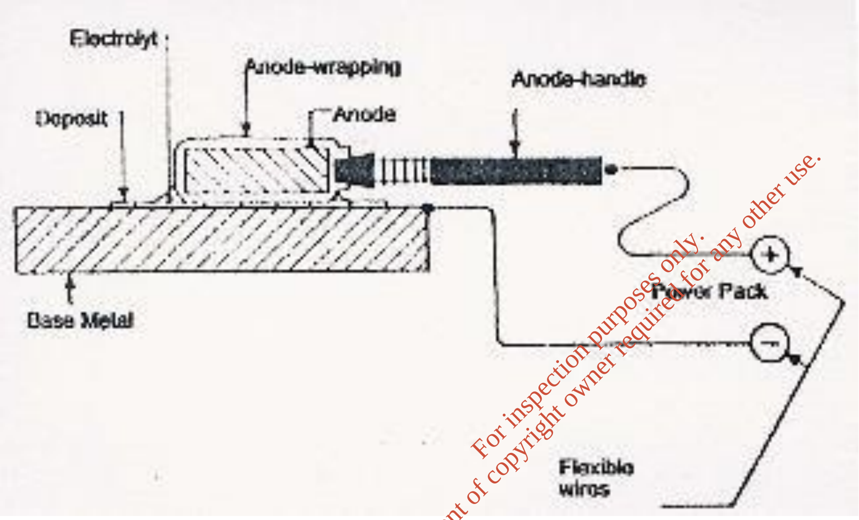
Class 1: .0005" minimum thickness

Class 2: .0003" minimum thickness, additional thickness requirements are given in paragraph 3.3.1 amendment 2, of this specification.

Class 3: .0002" minimum thickness.

Brush Plating:

Brush-plating, also known as selective plating or spot-plating is a technique which makes it possible to deposit metals and/or alloy's on conducting materials. Actually the process exists as long as bath- plating and formerly was used to repair parts that were not completely covered; electrolyte from the bath was used then. In the sixty's they started to develop the process to a complete surface- technique and this development is still going on.



At first brush-plating looks more like welding than plating. The part to be plated is connected by a flexible wire to the negative output of a Power Pack; this is a DC-transformer with rather some electronics added, and acts in this way as a cathode. As an anode mostly a piece of carbon is used. This anode is connected to an anode handle and wrapped with an absorbing material, such as polypropylene wool or something like that. This wrapping is needed to absorb the electrolyte, which contains a high concentration of the metal to be deposit. The anode handle now is connected by a flexible wire to the positive output of the Power Pack. When the anode is placed on the part, the current circuit is closed and the metal from the electrolyte will deposit on the surface. (see figure) As long as the anode moves over the part to be plated and the anode is supplied with electrolyte this process will go on continuously. The electrolyte can be supplied by dipping or pumping through. In this way it is possible to apply metal on a selective area, for instance to repair a scratch in a printing cylinder.

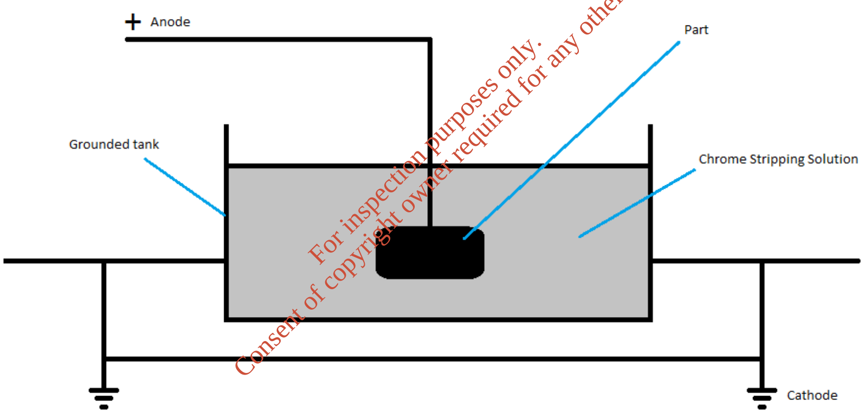
Cadmium Stripping:

The stripping of electrodeposited and flame-sprayed coatings is a necessary part of surface finishing. Stripping may be required to allow for the re-plating of a part rejected due to defective finishing or as part of rework processes such as those commonly conducted by airline/aerospace facilities.

Stripping Theory

The basic chemical reaction conducted when stripping a metal is that of oxidation, i.e. , the metal is converted from zero valent state to a higher valent (Ionic) state. Essentially, this is reverse of the deposition process. To allow such a chemical reaction to proceed, we basically have 2 choices.

1. React the metallic coating(s) with a solution that is powerful enough to oxidize the metal (dissolve it).
2. React the metallic coating(s) with a combination of electrical power and a chemical solution that will keep the metallic coating in either the dissolved state, or will allow the dissolved metal to crystallize out and be removed from the process as a salt or sludge.



Stripping metallic coatings in aerospace application

The stripping of electrodeposited and flame-sprayed coatings (along with organic coatings such as paints and lacquers) is a necessary part of surface finishing. Stripping may be required to allow for the re-plating of a part rejected due to defective finishing or as part of rework processes such as those commonly conducted by airline/aerospace facilities. Airline/aerospace facilities conduct stripping of a number of metallic/semi-metallic coatings. Some of those more commonly encountered are:

- Cadmium/cadmium alloy
- Copper
- Nickel/electroless nickel
- Chromium
- HVOF spray
- Pack diffusion (high temperature) coatings
- PVD deposited coatings

Chrome Stripping:

The stripping of electrodeposited and flame-sprayed coatings is a necessary part of surface finishing. Stripping may be required to allow for the re-plating of a part rejected due to defective finishing or as part of rework processes such as those commonly conducted by airline/aerospace facilities.

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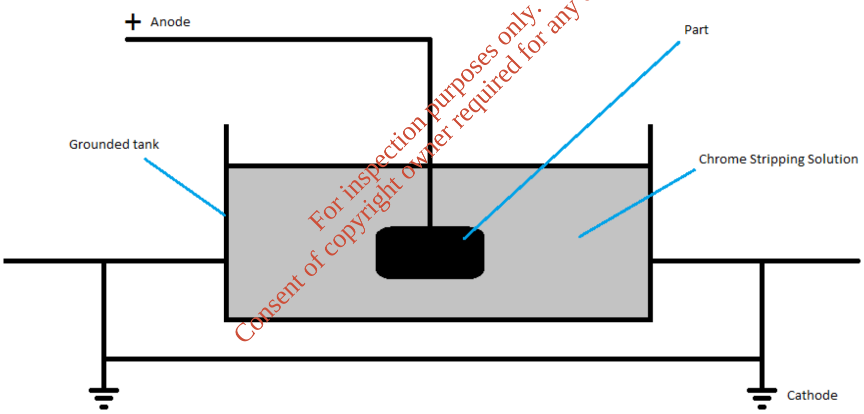

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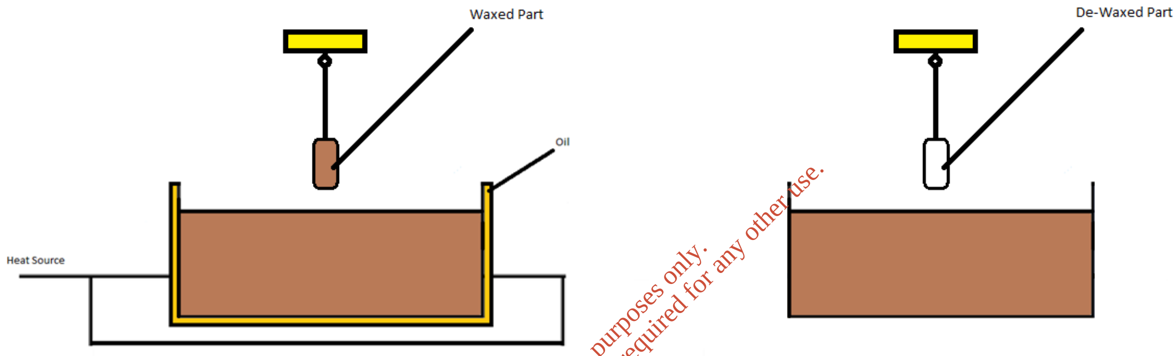
- Cadmium/cadmium alloy
- Copper
- Nickel/electroless nickel
- Chromium
- HVOF spray
- Pack diffusion (high temperature) coatings
- PVD deposited coatings

De-Waxing:

De-waxing is a process for removing wax from a part, after the plating process is complete. It consists of a bath of water heated to 98 Degrees C.
Where the part is immersed until the wax melts off.



Dublin Aerospace

Grit Blasting (Abrasive Blasting):

Abrasive blasting means propelling a stream of abrasive material at high speed against a surface using compressed air, liquid, steam, centrifugal wheels or paddles to clean, abrade, etch or otherwise change the original appearance or condition of the surface.

It is used in a wide range of industries for many different purposes, including cleaning surfaces such as steel, bricks, cement and concrete. The most common method uses compressed air
to propel abrasive material from a blast pot, through a blasting hose to a nozzle that is manually controlled by the operator. Automated abrasive blasting machines such as centrifugal wheel systems and tumblers are also used. Blasting is generally performed in enclosed environments
like blasting chambers or cabinets, or on open sites, for example on buildings, bridges, tanks, boats or mobile plant.

Common hazards include dusts, hazardous chemicals and risks associated with the use of plant and equipment.

Workers have a duty to take reasonable care for their own health and safety and that they do not adversely affect the health and safety of other persons. Workers must comply with any reasonable instruction and cooperate with any reasonable policy or procedure relating to health and safety
at the workplace. If personal protective equipment is provided by the person conducting the business or undertaking, the worker must use it in accordance with the information, instruction and training provided.

Dublin Aerospace

Hard Chrome Plating:

Hard Chrome plating (also known as "Industrial Chrome") is applied to ferrous and nonferrous materials to improve wear and abrasion resistance, reduce friction, prevent seizing and galling, and to restore the dimensions of undersized parts.

Hard Chrome is used in a variety of industries including: Nuclear, Aerospace, Automotive, Lawn and Garden and many more. Contact an Electrolysing sales engineer to discuss your specific application.

APPLICATIONS

Hard Chrome can be applied to all types of stainless steel alloys, most ferrous metals, and some nonferrous metals including copper and brass. Please contact our application engineers to discuss the feasibility of applying Hard Chrome to other metals such as aluminium.

Hard Chrome improves the performance of:

- Piston rings & valves
- Tools & dies
- Printing wear roll surfaces
- Brake discs
- Auto engine, drive train and suspension parts
- Motor shafts
- Aircraft landing gears and components
- Machinery parts
- Medical devices
- Fasteners
- Commercial firearm components (not for personal firearms)
- Gears

Specifications

AMS 2460 - AMS 2460 is the new specification to cover chromium plating, intended to replace AMS-QQ-C-320.

AMS-QQ-C-320 AMS 2406 AMS 2438	ASTM B-177 ASTM B-254

Hard Chrome should not be confused with decorative chrome. It cannot be used to restore automotive or motorcycle parts.

11.1.1.1.1.1.1.2 FEATURES

Standard Thickness

The standard thickness for Hard Chrome plating in nonsalvage applications is .0002 - .0006" (.00508 - .01524 mm). High wear applications should have .001" or more for the best results. Thickness over 1 mil generally requires the plating to be applied thicker than desired, then ground to size.

11.1.1.1.1.1.1.3 Surface Roughness

Most RMA finishes can be maintained using our Hard Chrome plating process. For best results, the area to be coated should be completely finished prior to processing. For surface finishes finer than 6 RMS, post-plate lapping or polishing may be required.

11.1.1.1.1.1.1.4 Hardness

Hard Chrome plate hardness is Rc 65-68, measured on a cross-section with an appropriate micro-hardness tester.

11.1.1.1.1.1.1.5 Chemical/Corrosion Resistance

Corrosion resistance of Hard Chrome plating depends on factors such as basis metal, Roughness Height Reading (RHR), surface porosity of basis metal, micro-inch finish, corrosive media, and coating thickness. Although Hard Chrome plating offers good corrosion resistance, for parts that require greater hardness and corrosion resistance, various non-corrosive coatings may need to be applied prior to plating.

11.1.1.1.1.1.1.6 Masking

A variety of different types of masking is available to protect the hard chrome from coating in unwanted areas. Please consult an electrolysing sales engineer for your masking requirements.

Heat Treatment:

The **landing gear** of an airplane is a critical part of the aircraft, a component that guarantees passengers are safe. The landing gear is able to absorb the energy generated by the impact with the ground, to restrain the aircraft and to do everything with an incredible control and stability.

The landing gear consists of several parts: the mechanism of extraction / retraction, the leg, the shock absorber, brake and wheel, springs, joints, cables, discs, bolts, metal and rubber parts and many other components.

When landing, the kinetic energy, the movement, is transformed into heat and causes an overheating of the brakes and of the wheels. For this reason, the metal parts used in the manufacture of these fundamental instruments must be subjected to heat treatments which enhance the mechanical and structural characteristics, in order to withstand the powerful stresses caused by weight, speed, and heat.



Hydrogen embrittlement is the process by which various metals, most importantly high-strength steel, become brittle and fracture following exposure to hydrogen. Hydrogen embrittlement is often the result of unintentional introduction of hydrogen into susceptible metals during forming or finishing operations and increases cracking in the material. This phenomenon was first described in 1875.
Hydrogen embrittlement is also used to describe the formation of zirconium hydride and delayed hydride cracking. Use of the term in this context is common in the nuclear industry.

The Hydrogen De-embrittlement bake process will happen after all electroplating processes. The reason for that is because during the process you get a build-up of hydrogen in the part, which means you will get cracks in the parts when the landing gear is back in operation.
Here is the step by step guidance to what would happen if you didn't de-embrittle the part:

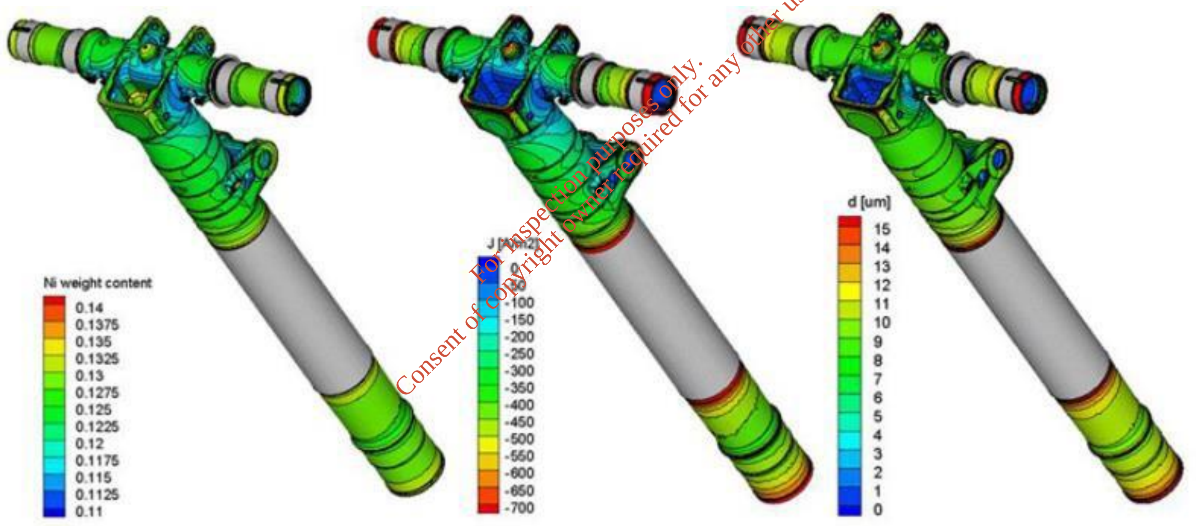
Step 1. You get a crack in the part.
Step 2. Overtime the crack becomes a fracture.
Step 3. The landing gear collapses on landing.

Typical electrolytic processes which cause hydrogen embrittlement are: acid zinc, bright cadmium, bright nickel & bright chrome.
De-embrittlement is a heat treatment process which is carried out after electroplating where hydrogen embrittlement is likely to take place.

LHE Cadmium Plating:

Used Extensively on High Strength Steel Aerospace Parts

- Process is Highly-Embrittling
    - Plate at High Current Density, No Brighteners and Higher NaCN/CdO Ratio to form a Dull (Porous) Plating
        - Hydrogen Baked Out at 375oF/190C for 23 Hours
            - Verified by ASTM F 519 Sustained Load Test or ASTM F 326 Electronic Measurement
    - No Concerns for Hydrogen Embrittlement When Exposed to Maintenance Fluids
        - Water and Salt Water Exposure Can Be Challenging



Note:
This part is different to Bright cadmium as it will need to be put into the oven for 23 hours unlike bright cadmium which is only baked for 4 hours.
If you forget to heat treat the part in time or even not put it into the oven in time the part can possibly be scrapped.

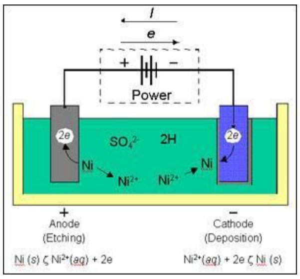
Nickel Plating:

Electro nickel plating, also known as nickel electro-deposition, is becoming an increasingly popular process for a variety of different manufacturing applications. Electro nickel plating is a process that uses an electrical current to coat a conductive material, typically made of metal, with a thin layer of nickel.

Benefits of Electro Nickel Plating

In general, electroplating improves a wide range of characteristics not inherently present in the base material. Some of these benefits include:

- Increased resistance to corrosion
- Improved hardness
- Superior strength
- Resistance to wear
- Improved ductility



How Electro Nickel Plating Works

To transfer nickel onto the surface of a product properly, a negative charge must be applied to the base material. To achieve this, the product is typically attached to a rectifier, battery or other power supply via a conductive wire. Once attached, a rod made of nickel is connected in a similar fashion to the positive side of the rectifier or power source.

Once the initial steps have been completed, the base material is submerged in a solution that features a salt with a chemical makeup, including the electroplating metal. With electro nickel plating, this solution consists of water and nickel chloride salt. Due to the electric current present in the solution, the nickel chloride salt dissociates to negative chloride ions and positive nickel cat-ions. The negative charge of the base metal then attracts the positive nickel ions, while the positive charge of the nickel rod attracts the negative chloride anions. Through this chemical reaction, the nickel in the rod oxidizes and dissolves into the solution. From here, the oxidized nickel is attracted to the base material, and subsequently coats the product.

Nital Etch Inspection:

On all steel parts with surface areas which were machined or ground in the hardened and tempered condition, do these steps:

(1) Visually examine the surface for any discoloration from overheating.

(2) Surface temper etch examine the alloy steels that are 180 ksi or above, but not the corrosion resistant steels, as specified in Paragraph 11..

NOTE: The visual and etch examinations are not necessary for holes smaller than 1.0 inch diameter, or for holes 1.0-2.5 inch diameter that have a depth-to-diameter ratio of 1.5 or more. If the hole is open at each end, the depth is measured to the center of the bore.

(3) Stress relieve.

NOTE: If during overhaul of a hardened steel part, the only operation is the repair of holes smaller than 2.5 inches in diameter and all hole preparation parameters as specified in SOPM 20-10-02 are obeyed during this repair, it is not necessary to stress relieve
the part.

NOTE: Corrosion resistant steels A-286 and 300 series, 17-7PH (CH900), nickel alloys 625 and 718, and copper alloys do not require stress relief. Corrosion resistant precipitation hardened steels PH13-8Mo, 15-5PH, 17-4PH and 17-7PH, at strength levels less than
200 ksi that will not be plated, do not require stress relief.

NOTE: Stress relief could be necessary in some procedures, such as cleaning as specified in BAC5625.

(a) Stress relief will decrease surface residual stresses that were caused during some metal removal practices. But hand tools without power, such as files or emery paper, do not cause sufficient residual stresses to make stress relief necessary.
(b) Stress relieve as specified in Figure 1. As an option, stress relief at 350-4008F for 4 hours can be used as indicated in Figure 1, but will not give as much stress relief.
(c) If you make a new part of high-strength steel and the part will get a second heat treatment after it is heat treated and machined, that second temper can be used for this stress relief.
(d) If the part was stress relieved, and then small areas were repaired with portable hand-held power tools as specified in Paragraph 8., a second stress relief is not necessary if you
etch examine the part by the Nital etch procedure (preferred) or the ammonium persulfate etch procedure (optional) (Paragraph 11.).
(e) Before plating, stress relief is not necessary for:

1) Parts which were not ground, machined, straightened, cold worked or proof loaded after heat treatment.
2) Parts which were only honed, lapped, or repaired with unpowered hand tools after heat treatment.
3) Parts which were stress relieved before they were shot peened or before some other plating. This includes plating which was stripped for plating replacement.
(4) Apply MIL-L-7870 oil unless the stress relief is followed by a magnetic particle check within 2 hours.
(5) Magnetic particle examine (SOPM 20-20-01).
(6) Apply MIL-C-11796, class 3 corrosion preventive compound, except use MIL-L-7870 oil if more work will be done on the part in the next 48 hours. Hot dip coatings can be used for dry storage of noncarburized parts up to 6 months. If a cut or break goes through the coating, immediately strip the part and apply the coating again.
B. Do all finishing operations such as shot peening, honing, lapping, or plating required by overhaul instructions on machined surfaces after you do the procedures in par. A. Surfaces made by handheld tools without power (such as a file or emery cloth used to make radii or break sharp edges) do
not require the surface temper etch examination, the stress relief, or the magnetic particle examination.
C. If more than 60 minutes elapse between the etch or the inspection and the bake, or subsequent work,
give the parts protection with MIL-PRF-21260 or other soft films, oils and greases as specified in BAC5034 (SOPM 20-44-02).

Nital Etch Inspection

11. EXAMINATION FOR HEAT DAMAGE

A. General

(1) Incorrect material removal procedures will make the part too hot and will cause heat damage. The etch inspection procedure will help you find retempering burns, rehardening burns, grinding or machininQ burns, and other heat-related damage.

(2) Visually examine all completed holes and completed machined surfaces for the correct surface roughness and to see if they became too hot. The surface quality (such as local differences from the specified contour, nicks, gouges, and scratches) must agree with standard industry practices. Parts are unserviceable if they have color changes (such as a blue or dark gray tint) because they became too hot, or if they have tears, chatter marks, or cracks. The surface roughness of holes must be 125 micro inches or smoother unless overhaul instructions are different. No sign of corrosion is permitted.

B. Solution Preparation - See Table 14. Be sure to use containers that are nonreactive to the solutions.

Table 14: Solution Details

Solution	Initial Makeup [1]	Control Limits	
		Chemical	Temperature
Alkaline Rinse	5% by weight sodium hvdroxide in water [2]	4-6% by weight	60-212°F
Ammonium Persulfate	10% by weight ammonium persulfate in water	[3]	Room
Hydrochloric Acid	5% hydrochloric acid in alcohol or water	4-6% HCl	Room
Cadmium-titanium plate stripping (BAC5771 Solution 1)	12% by weight ammonium nitrate in water	10-15% by weight	Room
Cadmium Spot Check Solution 1	10% by weight ammonium nitrate in waler	-	Room
Cadmium Spot Check Solution 2	5% by weight sodium sulfide in water	-	Room
Hydrochloric-Hydrolluoric	5% hydrochloric acid and 1% hydrofluoric acid in water	4-6% HCl 0.5-1.5% HF	Room
Nital	4% nitric acid in alcohol or water	3-5% HNO3	Room
Nital with anti-smut additive	4% nitric acid in water plus 3.5% JAR 3N anti- smut additive	3-5% HNO_3 [4]	Room
Nitric Acid	1.5% nitric acid in water	1-2% HNO_3	Room

Nital EbL Inspection

5) Blow dry immediately with clean, dry air.

6) Examine the part under bright light (200 foot candles minimum) without magnification for signs of heat damage. Refer to Paragraph 11.F. for interpretat ion of etch results.

(e) After Inspection

1) Apply MIL-C-11796, Class 3 corrosion preventive compound or MIL-L-7870 oil.

2) Do all other finishing operations specified by the overhaul instructions such as shot peening, honing, lapping and plating after the etch operations are completed.

F. Interpretation of Results

(1) Unburned areas of an etched part will be a constant gray or black color without reflections when cleaned and etched. This color change is not a problem and can be removed with fine aluminum oxide abrasive cloth.

(2) Retempering burns (overtempered martensite) wip show as darker areas on the etched part. This indicates that the surface temperature was hotter than the normal tempering lef11Perature of the material during grinding or machining operations and will result in local softening of the surface material. Retemper ing burns on through-hardened material in the lower heat treat ranges, 180 to 220 ksi, will not be easy to see because the original tempering temperature is sufficiently high that all etched areas will be dark in color. This type of burn usually results in decreased strength and fatigue life.

(3) Rehardening burns (untempered martensite) will show as white or light-colored areas on the etched part. Such burns will normaly be surrounded by a black retempered area of overtempered martensite. This indicates that the surface temperature was hotter than the austenite transformat ion temperature of the material during grinding or machining operations. This type of burn results in ocal hardened areas of untempered martensite which will usually decrease the fatigue life and toughness of the part, and increased risk of hydrogen embri ttlement and stress corrosion.

(4) Ground surfaces of carburized parts that are deficient in carbon or have had too much material removed during grinding will appear light in color when compared to an unburned sample with normal case carbon content.

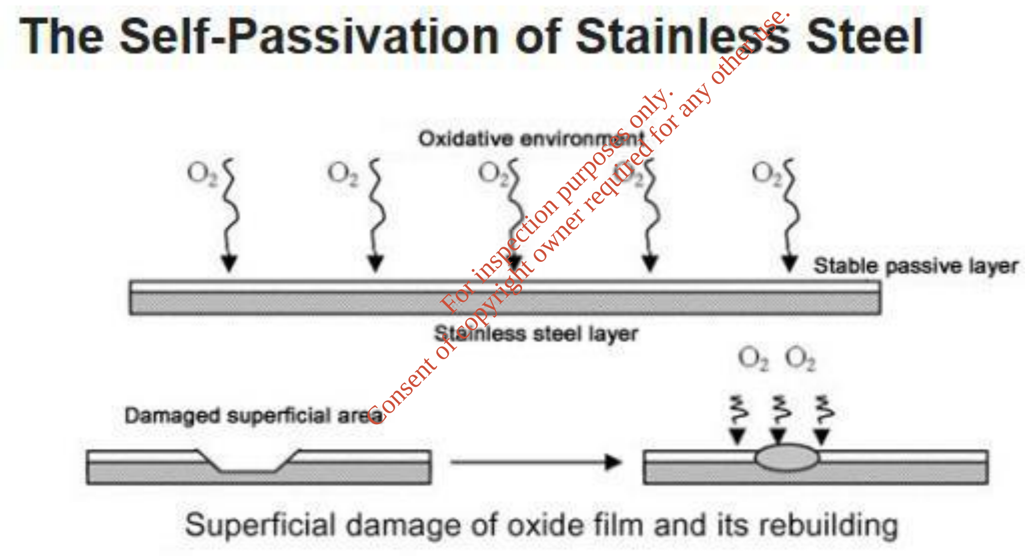
(5) A metallurg ist can help when you are not sure about the results of the etch. The Barkhausen inspection (BAC 5653) can also help.

Passivation:

Passivation remains a critical step in maximizing the essential corrosion resistance of parts and components machined from stainless steels. It can make the difference between satisfactory performance and premature failure. Incorrectly performed, passivation can actually induce corrosion.

Passivation is a post-fabrication method of maximizing the inherent corrosion resistance of the stainless alloy from which the work piece was produced. It is not a scale removal treatment, nor is it like a coat of paint.

There is no universal agreement on the precise mechanics of how passivation works. But it is certain that a protective oxide film is present on the surface of passive stainless steel. This invisible film is considered to be extremely thin, less than 0.0000001 inch thick, which is about 1/100,000 the thickness of a human hair!

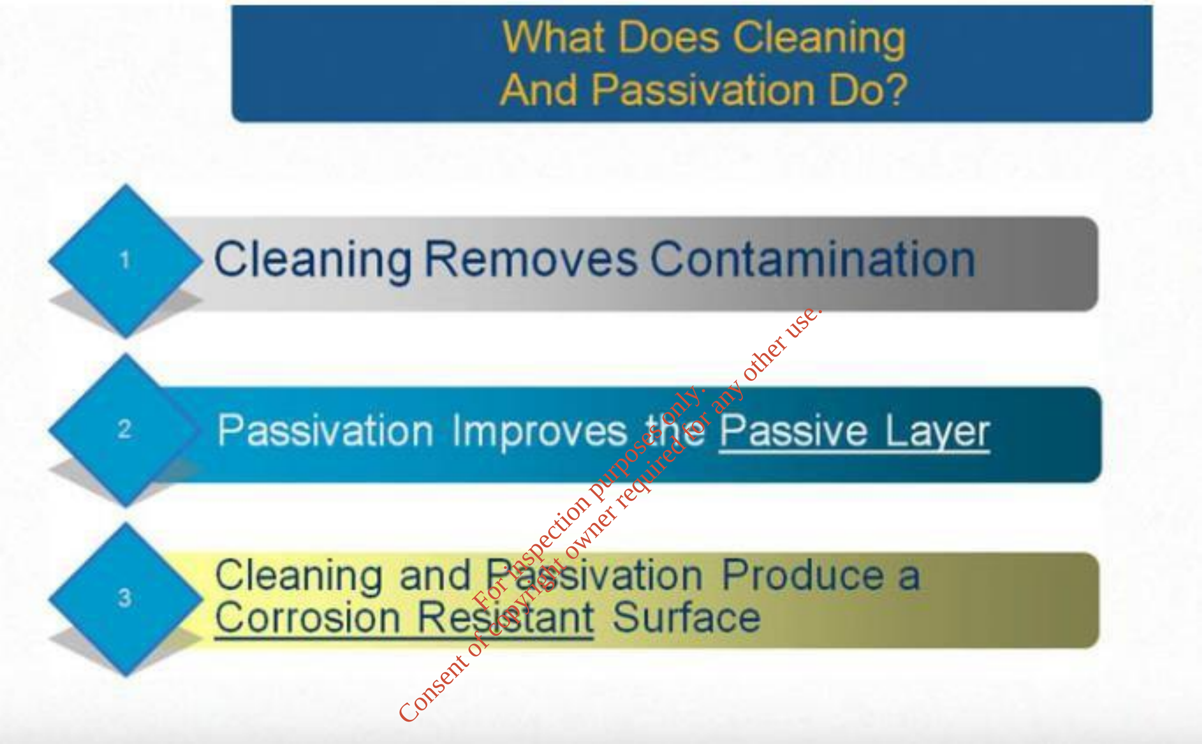


A clean, freshly machined, polished or pickled stainless steel part automatically acquires this oxide film from exposure to oxygen in the atmosphere. Under ideal conditions, this protective oxide film completely covers all surfaces of the part.

In actual practice, however, contaminants such as shop dirt or particles of iron from cutting tools may be transferred to the surface of the stainless steel parts during machining. If not removed, these foreign particles can reduce effectiveness of the original protective film.

During the **machining process**, a microscopic amount of free iron may be worn off the cutting tool and transferred to the surface of the stainless steel work piece. Under certain conditions, a thin coating of rust may appear on the part. This is actually corrosion of the steel from the tool and not the parent metal. Sometimes the crevice at the embedded particle of steel from the cutting tool or its corrosion products may cause an attack of the part itself.

Similarly, small particles of **iron**-containing shop dirt may adhere to the part surface. Although the metal may appear shiny in the as-machined condition, the invisible particles of free iron can lead to rusting on the surface after exposure to air.



Exposed sulfides also can be a problem. They come from the addition of sulfur to stainless steels to improve machinability. Sulfides improve the alloy's ability to form chips that break away cleanly from the cutting tool during the machining process. Unless the part is properly passivated, sulfides can act as initiation sites for corrosion on the surface of the fabricated product.

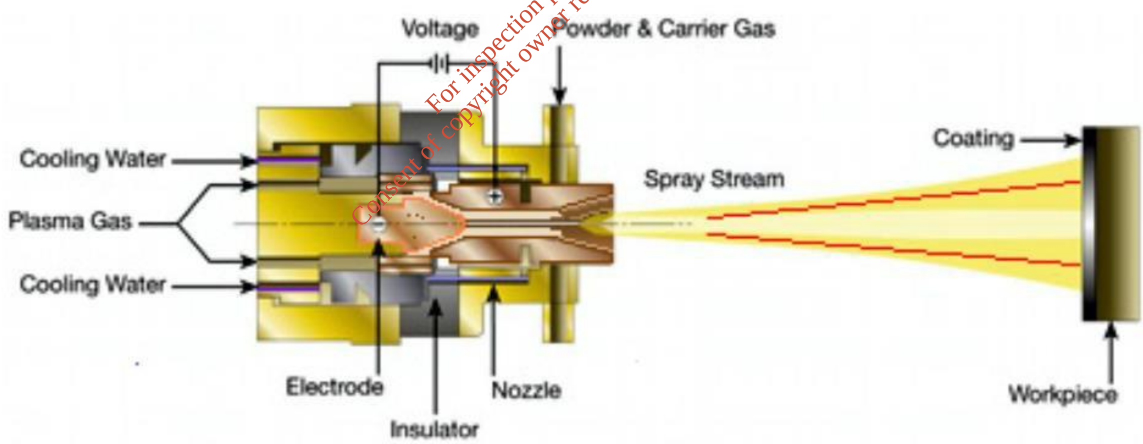
In both cases, passivation is needed to maximize the natural corrosion resistance of the stainless steel. It can remove surface contamination, such as particles of iron-containing shop dirt and iron particles from cutting tools that can form rust or act as initiation sites for corrosion. Passivation also can remove sulfides exposed on the surface of free-machining stainless alloys.

A two-step procedure can provide the best possible corrosion resistance: 1. cleaning, a fundamental, but sometimes overlooked procedure and 2. An acid bath, or passivating treatment.

Plasma Spraying (Thermal Spraying):

Thermal spraying techniques are coating processes in which melted (or heated) materials are sprayed onto a surface. The "feedstock" (coating precursor) is heated by electrical (plasma or arc) or chemical means (combustion flame).

Thermal spraying can provide thick coatings (approx. thickness range is 20 micrometres to several mm, depending on the process and feedstock), over a large area at high deposition rate as compared to other coating processes such as electroplating, physical and chemical vapour deposition. Coating materials available for thermal spraying include metals, alloys, ceramics, plastics and composites.
They are fed in powder or wire form, heated to a molten or semi molten state and accelerated towards substrates in the form of micrometre-size particles. Combustion or electrical arc discharge is usually used as the source of energy for thermal spraying. Resulting coatings are made by the accumulation of numerous sprayed particles. The surface may not heat up significantly, allowing the coating of flammable substances.



The detonation gun consists of a long water-cooled barrel with inlet valves for gases and powder. Oxygen and fuel (acetylene most common) is fed into the barrel along with a charge of powder. A spark is used to ignite the gas mixture and the resulting detonation heats and accelerates the powder to supersonic velocity through the barrel. A pulse of nitrogen is used to purge the barrel after each detonation. This process is repeated many times a second. The high kinetic energy of the hot powder particles on impact with the substrate results in a build-up of a very dense and strong coating

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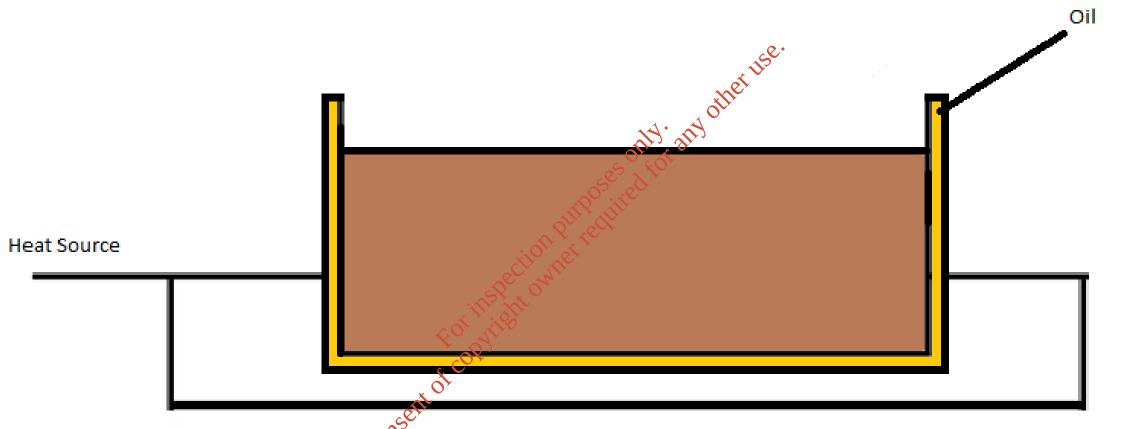
Waxing:

Waxing is a process whereby you coat the part with a thick crust of wax.

The wax will protect the part from the chemical, which is been used at the time. The waxing tank is at a temperature of 100 degrees C, which means thermal burns would be the most highlighted hazard associated with the job.

You must place the part into the tank and wait for the part to come up to the temperature of the wax so that the wax sets on the part better, this process is completed several times until you get a build of a wax on the part.



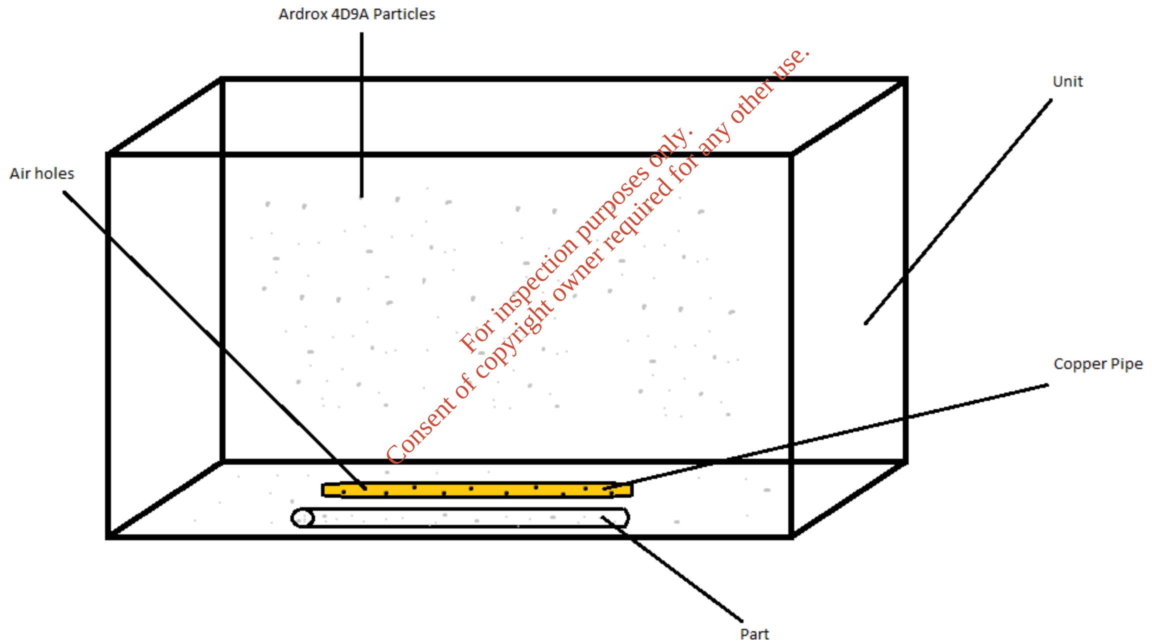
As you can see from the image above, the wax tank has an outer shell (2 tanks in the one tank). The outer tank is heated first and in turn the inner tanks heats up to the recommended temperature.

Appendix 3 - Non-Destructive Testing (NDT)

Developer:

The developer is strictly used for the fluorescent dye-penetrant process.

The contents of the machine consists of 4 walls, roof and a sealed door, Between the four walls you have a copper pipe with holes, then you push air through the copper pipe which in turn agitates the powder Ardrox 9D4A. The unit is now full of swirling Ardox 9D4A which will eventually cover the part
i.e. the cracks/fractures and burns.



The fact that the Ardrox 9D4A is drawn to the penetrant within the cracks, when it comes to inspection the cracks will be highlighted under UV light.

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Fluorescent Dye Penetrant:

Fluorescent penetrant inspection (FPI) is a type of dye penetrant inspection in which a fluorescent dye is applied to the surface of a non-porous material in order to detect defects that may compromise the integrity or quality of the part in question. Noted for its low cost and simple process, FPI is used widely in a variety of industries.

Liquid penetrant inspection of non-magnetic aircraft metal parts.

There are many types of dye used in penetrant inspections. FPI operations use a dye much more sensitive to smaller flaws than penetrants used in other DPI procedures. This is because of the nature of the fluorescent penetrant that is applied. With its brilliant yellow glow caused by its reaction with ultraviolet radiation, FPI dye sharply contrasts with the dark background. A vivid reference to even minute flaws is easily observed by a skilled inspector.

Because of its sensitivity to such small defects, FPI is ideal for most metals which tend to have small, tight pores and smooth surfaces. Defects can vary but are typically tiny cracks caused by processes used to shape and form the metal. It is not unusual for a part to be inspected several times before it is finished (an inspection often follows each significant forming operation).

Selection of inspection type is, of course, largely based on the material in question. FPI is a non- destructive inspection process which means that the part is not in any way damaged by the test process. Thus, it is of great importance that a dye and process are selected that ensure the part is not subjected to anything that may cause damage or staining.

Magnetic Particle Inspection:

Magnetic particle Inspection (MPI) is a non-destructive testing (NDT) process for detecting surface and slightly subsurface discontinuities in ferromagnetic materials such as iron, nickel, cobalt, and some of their alloys. The process puts a magnetic field into the part. The piece can be magnetized by direct or indirect magnetization. Direct magnetization occurs when the electric current is passed through the test object and a magnetic field is formed in the material. Indirect magnetization occurs when no electric current is passed through the test object, but a magnetic field is applied from an outside source. The magnetic lines of force are perpendicular to the direction of the electric current which may be either alternating current (AC) or some form of direct current (DC) (rectified AC).

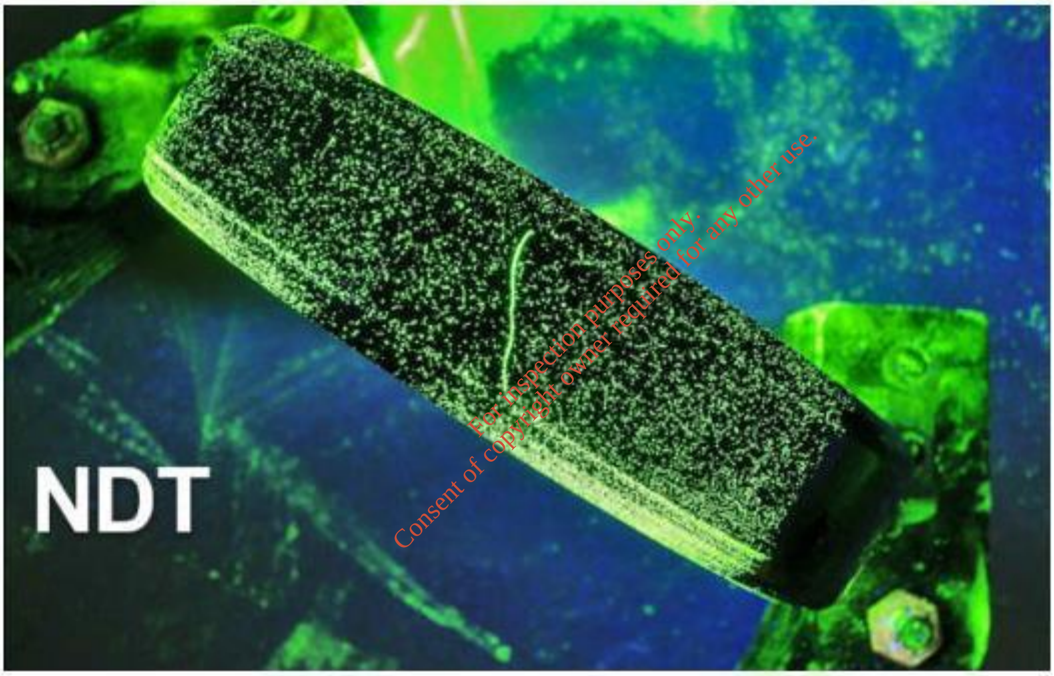
The presence of a surface or subsurface discontinuity in the material allows the magnetic flux to leak, since air cannot support as much magnetic field per unit volume as metals. Ferrous iron particles are then applied to the part. The particles may be dry or in a wet suspension. If an area of flux leakage is present, the particles will be attracted to this area. The particles will build up at the area of leakage and form what is known as an indication. The indication can then be evaluated to determine what it is, what may have caused it, and what action should be taken, if any.

 A technician performs MPI on a pipeline to check for stress corrosion cracking using what is known as the "blac and white" method. No indications of cracking appear in th picture; the only marks are the 'footprints' of the magnetic yoke and drip marks.	 A close-up of the surface of a (different) pipeline showing indications of stress corrosion cracking (two clusters of small black lines) revealed by **magnetic particle inspection**. Cracks which would normally have been invisible are detectable due to the magnetic particles clustering at the crack openings. The scale at the bottom is numbered in centimetres.

A popular name for magnetic particle inspection is or used to be magnafluxing; The Company of the same name was one of the early manufacturers of equipment and materials for the process.

Table Inspection:

In the case of fluorescent inspection, the inspector will use ultraviolet black light with an intensity appropriate to the intent of the inspection operation. This must take place in a dark room to ensure good contrast between the glow emitted by the penetrant in the defected areas and the backround. The inspector carefully examines all surfaces in question and records any concerns. Areas in question may be marked so that location of indications can be identified. The inspection should occur at a given point in time after the application of the developer. Too short a time and the flaws may not be fully blotted, too long and the blotting may make proper interpretation difficult.



Advantages

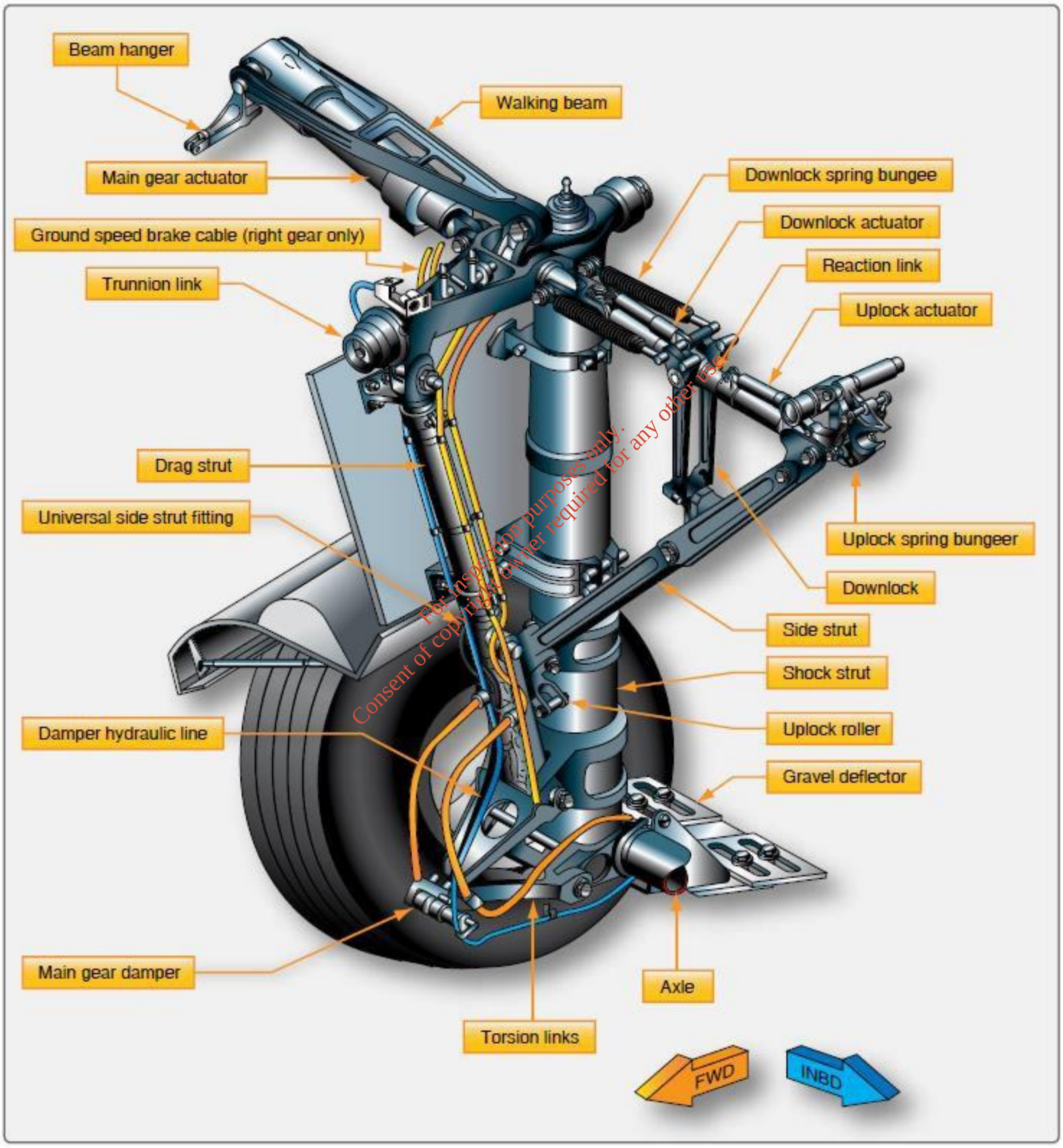
Highly sensitive fluorescent penetrant is ideal for even the smallest imperfections Low cost and potentially high volume
Suitable for inspection of non-magnetic materials and electrical insulators.

Potential Disadvantages

The method requires thorough cleaning of the inspected items. Inadequate cleaning may prevent detection of discontinuities.
Test materials can be damaged if compatibility is not ensured. The operator or his/her supervisor should verify compatibility on the tested material, especially when considering the testing of plastic components and ceramics. The method is unsuitable for testing porous ceramics.
Penetrant stains clothes and skin and must be treated with care.

Appendix 4 - Assembly and Disassembly

<u>Disassembly and Assembly:</u>



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Ozzy Juice Cleaner:

SmartWasher Ozzy®

BIOREMEDIATING parts washing systems

1.1.1.2

11.1.1.1.1.1.3

The EPA's Design for the Environment
Program (DfE) has awarded ChemFree
Corporation's proprietary SW-4 Heavy

Smarter. Clean. Green.

Duty OzzyJuice® degreasing solution their seal of approval. The DfE Program restricts the use of their logo to products thoroughly assessed by their DfE scientific review team and proven to contain the safest possible ingredients.

OzzyMat™

FL-4	**Multi-Layer**	Recommended for normal to heavy particulate. (Ships standard with all SmartWasher models.)
FL-3	**Single-Layer**	Recommended for light particulate .

Smarter Clean Green ● 10 Hobill Ave, Manukau 2104, Auckland ● (64) 9 263 8005

A Division of Centralised Pumping Systems, Manukau 2104, Auckland, New Zealand PO Box 98-017, Manukau 2241, Auckland, New Zealand.
scg@smarterclean.com
www.smarterclean.com

the sustainable solution

SmartWasher Ozzy® er ®

BIOREMEDIATING parts washing systems

Smarter.Clean.Green.

definition

bioremediation:

the use of biological agents, such as microbes or plants, to remove or neutralize contaminants.

benefits

NO Flash Point
NO Waste
Hauling NO
Toxic Solvents
NO Environmental Damage
NO Health & Safety
Hazards NO Liquid
Hazardous Waste NO
Cradle to Grave Liabilities

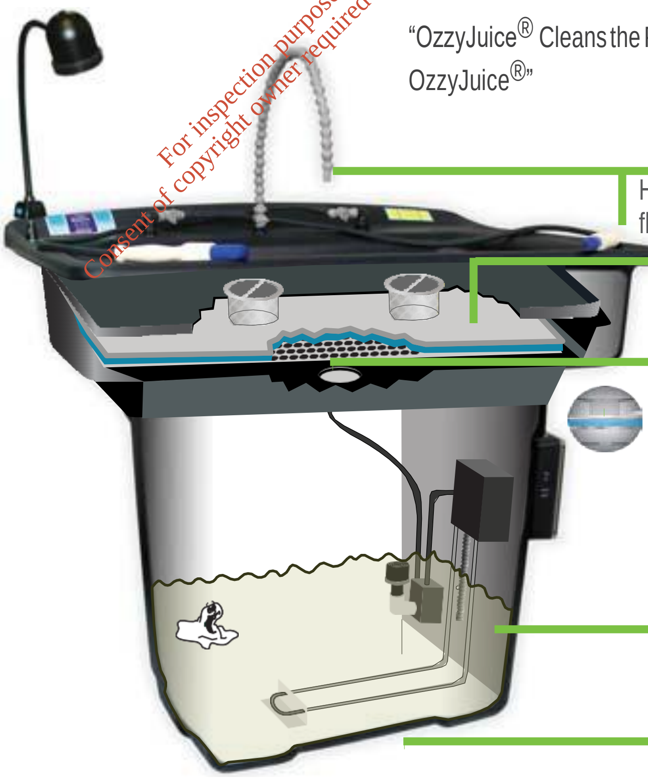
300 gph Pump
Flow Control
Timer HDPE
Construction
Onboard Diagnostics
500 lbs. Load
Capacity Adjustable
Thermostat

how

The SmartWasher Bioremediating

Parts Washing System is both self-cleaning and deregulated. Utilizing the natural occurring process of bioremediation, the SmartWasher constantly main- tains the cleanliness of the OzzyJuice without the need for hauling, skimming or evacuating the unit. The microbes (Ozzys®) in the system eat the grease, oil and other contaminants, turning these hazardous materials into a harmless by-product of carbon dioxide and water. Eliminating the need for hauling liquid hazardous waste, this amazing process keeps the OzzyJuicee clean and strong for every use.

"OzzyJuice® Cleans the Part ... Ozzy® Microbes Clean the OzzyJuice®"



Heated OzzyJuice® flows through nozzle and flow-through brush onto the dirty part.

Grease, oil and other contaminants are washed from the part and flow through the OzzyMat™.

The OzzyMat™ is the KEY to the SmartWasher system. It not only traps particulate down to 50 microns in size but also contains Ozzys®(microbes). The Ozzy microbes become activated by the OzzyJuice, and transported, along with the OzzyJuice, into the SmartWasher tank. Ozzys® are nonpathogenic and hydrocarbon busting microbes that eat grease, oil, and other contaminants from the OzzyJuice. Creating a harmless by-product of carbon dioxide and water, these microbes leave the solution clean to use time after time without the need for changing or hauling it away.

Ozzy®

Ozzy® The Microbe

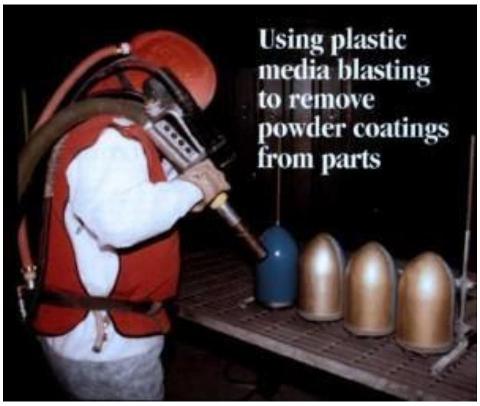
OzzyJuice® : Powerful aqueous based degreasing solutions that are pH-neutral, non-hazardous, non-flammable, non-caustic and non-toxic. Armed with superior cleaning capability, these OzzyJuice solutions will match or surpass the performance from a premium solvent without all the associated risks. All OzzyJuice solutions are certified by both NSF and AQMD.

The 300 gph recirculating pump pulls the fluid from the tank sending it back through the nozzle and brush. OzzyJuice is ready to clean more dirty parts.

Your Local Distributor:

Plastic Media Blaster:

PMB technology has been in use since the 1980's, principally for stripping aircraft and aerospace components. The technology was fostered by the US Department of Defence to replace the toxic chemical strippers previously used on strategic military aircraft and aerospace parts.



PMB Powder Coating Figure 1bThe US EPA's final rule prohibiting the disposal of certain chemical solvents in landfills throughout the country, including the most effective chemical strippers containing methylene chloride and phenols, stimulated the use of PMB. An alternative disposal method — incineration — can cost up to $1,000 for a 55-gallon drum of these chemical effluents.

Because the plastic particles used in PMB are harder than the coatings but softer than the substrates underneath, they can quickly remove primers and topcoats without harming the substrate, especially substrates sensitive to deformation, such as aluminium alloy.

For example, since 1989, PMB has been used to strip a particularly tough epoxy coating from aluminium alloy bobbins that hold missile guidance wires (see photo above). The soft plastic media don't affect the aluminium alloy or the very fine wires that can be rejected for even microscopic surface irregularities. Before plastic media blasting use in 1989, rejected bobbins were scrapped.

The aluminium missile airframe shown above is another example of a part that is suitable for plastic media blasting. In its assembled state, the airframe is impossible to strip using heat or hard abrasives. Although hand sanding is possible, it removes the chemical conversion coating, which
can't be replaced economically to the assembled airframe. The plastic media remove the powder coating from the cracks, crevices, and rivet heads without damaging the substrate or removing the conversion coating.

Advanced plastic media blasting cabinets (glove boxes) are available with operator controls to rapidly adjust blast air pressure and media flow to accommodate sensitive substrates. Conversion kits are available to retrofit existing open-blasting PMB systems and PMB blast cabinets with operator remote controls for adjusting blast air pressure and media flow.

Blast Cabinet 2Low-cost plastic media blast rooms are now made of 18-gauge sheet metal, rather than the 10- to 12- gauge steel plate typical of sandblasting booths. Because PMB doesn't remove metal, these economical rooms are satisfactory for a variety of applications.

Advanced and highly efficient dust collectors that provide ventilation for blast rooms are also available now.

Some compact, energy-efficient, modular systems provide automatic reverse pulse-jet cleaning on demand, with each module having a capacity of 6,000 to 16,000 cubic feet per minute. High-density particle separation (HDPS) systems are available to remove heavy particles, such as silica sand, from otherwise recyclable plastic media. Although this isn't a major concern for many stripping applications, military and aerospace manufacturers are very conscious of the damage that can occur by this type of contamination. Under current military specifications, media having a contamination level of 0.02 percent b weight (200 parts per million) must be taken out of service until they can be effectively cleaned. Airframe manufacturers require that the plastic media be free of contaminants to within 0.03 percent. The low-profile HDPS equipment available today as on- or off-line systems exceed the requirements of the US military and airframe manufacturers.

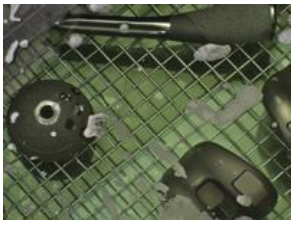
<u>Ultrasonic Cleaner:</u>

Ultrasonic cleaning is the rapid and complete removal of contaminants from objects by immersing them in a tank of liquid flooded with high frequency sounds waves. These non-audible sound waves create a scrubbing brush action within the fluid.

The process is brought about by high frequency electrical energy that is converted by a transducer into high frequency sound waves – ultrasonic energy. Its ability to clean even the most tenacious substances from items derives from the core of the unit: the transducer. The cleaning power of a unit stems from the transducers performance.

The efficiency of the transducer will affect both the cleaning time and efficacy achieved during the cleaning cycle. A poor quality transducer will use more power and take longer to clean items than a good transducer. This is why Ultrawave have invested in this area in such great depth, in order to provide you with a benchmark transducer.
The ultrasonic energy enters the liquid within the tank and causes the rapid formation and collapse of minute bubbles: a phenomenon known as cavitation. The bubbles rapidly increase in size until they implode against the surface of the item immersed in the tank in an enormous energy release, which lifts contamination off the surface and innermost recesses of intricately shaped parts.
It is this ability to clean box joints, hinges and threads quickly and effectively that has made ultrasonic cleaners the first choice for many industries for over 25 years.

There are many variables which need taking into account when cleaning items. Heat, power, frequency, detergent type and time all affect the cleaning process but the flexibility of ultrasonics means that these can all incorporated into the process in order to achieve the most effective results. This photograph shows Ultrasonic cleaning in action on a pair of surgical forceps. The bubbles can be clearly seen forming around the item.



As the bubbles implode and cavitation occurs, the cleaning solution rushes into the gap left by the bubble. As this fluid makes contact with the forceps, any contaminants that are present are removed.