European Bank
for Reconstruction and Development

Sub-sectoral Environmental and Social Guidelines: Motor Vehicle Assembly

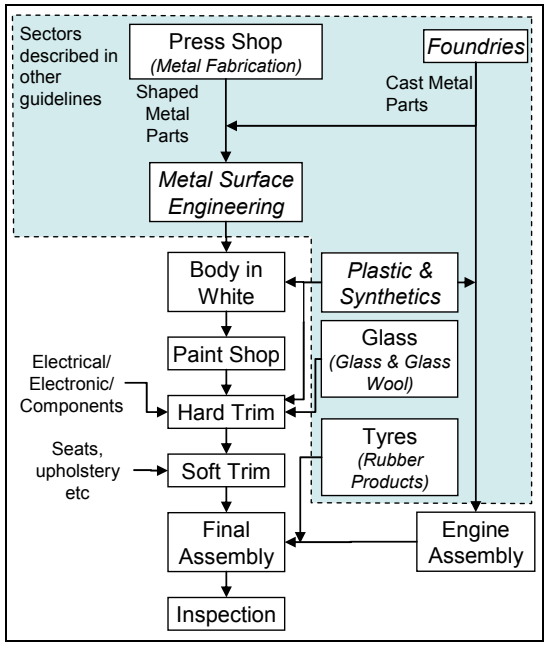
PROCESS DESCRIPTION

The manufacture of motor vehicles involves the manufacture and assembly of the final product from a number of metallic, plastic and electrical components. A wide range of processes are involved including metal cutting, pressing, polishing, grinding, welding, plating, & painting.

The vehicle industry produces many parts itself (e.g. by subsidiaries), while other parts are purchased. Engines are cast from aluminium or iron, and further processed in engine plants. Vehicle bodies are generally formed out of sheet steel, although there is a trend toward more plastic, reinforced fibreglass and aluminium parts in vehicle bodies.

There are close linkages with other metal industry sectors, particularly Foundries, Metal Surface Engineering, and Metal Fabrication (see separate Guidelines), as well as to the manufacture of plastic products, glass and textiles. It is common for the Press Shop and Metal Surface Engineering (Plating Shop) to be located on the same site and in these cases, it will be necessary to refer also to the relevant guidelines.

The vehicle manufacturing process is shown in the diagram below.



Most vehicle manufacturing facilities are more accurately described as assembly plants as they now confine themselves to producing body parts, machining the engine, final assembly and painting. All other parts are typically bought in on a "just-in-time" basis, e.g. castings/forgings, electrical/electronic equipment, wheels/tyres, instruments etc. Approximately 8,000 to 10,000 parts are assembled into approximately 100 major vehicle components[1]. Assembly plants are highly automated computer controlled assembly line operations.

The unpainted vehicle body (also known as the "body-in-white") is assembled from formed body panels joined by welding, glued and riveting. The vehicle passes by conveyor to the paint shop for:

- Pre-treatment (degreasing and anti-corrosion inhibitor);
- Priming;
- Seam sealing and underbody preparation;
- Application of filler and finishing paint coats;

[1] US EPA 1995

- Polishing, inspection and rectification;
- Undersealing and wax injection.

The Hard Trim is the fitting of items such as instrument panels, steering columns and body glass.

The Soft Trim is the fitting of seats, door pads and upholstery.

The vehicle is then fitted with the petrol tank, exhaust, and bumpers. At the same time, the engine is assembled. The engine and tyres are then fitted and the vehicle is subjected to a rigorous inspection.

KEY ENVIRONMENTAL, HEALTH AND SAFETY RISK/LIABILITY ISSUES

Air Emissions

The majority of the emissions to air generated during motor vehicle assembly are volatile organic compounds (VOCs) emitted from painting and finishing operations (paint storage, mixing, applications, and drying). The emissions are primarily organic solvents, which are used as carriers for the paint and solvents used for cleaning equipment between colour changes and to clean spray booths.

Other emissions to air include:

- VOC emissions - use of solvent based adhesives during Soft Trim;
- Isocyanates - Spray booths/ovens & paint mixing area during use of paint containing isocyanates;
- Particulates - Paint particulates from spray booths, dust from sanding. Spent filter material;
- Carbon dioxide and oxides of nitrogen where thermal or catalytic incinerators are used;
- Ozone may be released through the use of ultraviolet light curing lamps.

VOCs emissions are reduced through:

- Source control (e.g. the use of powder paints or low VOC/high solids water-based coatings),
- An increase of transfer efficiency of the application technique,
- Capturing and concentrating them (e.g. with activated carbon)
- Good housekeeping and solvent management
- Recycling and destruction (e.g. by incineration).

Hazardous Materials Storage

Hazardous chemicals and process gases should be labelled with the appropriate internationally recognised diamond shaped hazard symbol[2]. Chemicals with different hazard symbols should not be stored together - clear guidance on the compatibility of different chemicals can be obtained from the Materials Safety Data Sheet (MSDS) which should be readily available from the manufacturer and on site.

Disposal of empty drums and packaging of fuel and chemicals may pose both contamination

[2] United Nations 2007

risks to soil and groundwater, and health and safety risks. Wherever possible, packaging should be returned to the supplier for reuse.

Wastewater and Liquid Wastes (Effluent)

Under normal conditions, there should be no emissions to sewer or waters from vehicle coating and refinishing operations using solvent coatings.

The new trend towards use of waterborne paints may result in some discharge to sewer, but pre-treatment will be required and authorisation to discharge to sewer or waters must be obtained in advance from regulating authorities. The source of such emissions would be waterborne paint gun washes and spray booth wash waters. Emerging treatment for such waste water is chemical flocculation followed by filtration or sedimentation. It should be noted that such water is recyclable.

There are several areas with a potential to contaminate waters via accidental discharge to drains and sewers or onto ground. These include gun wash within the paint gun cleaning unit, residues from solvent-containing paint, waste gun cleaner, dirty water from wet filters (where used). There should be no open drains or sinks where solvent materials are being handled or stored.

Certain solvent wastes such as gun wash can be sent for recovery and reuse in another application where these facilities are available.

Other liquid wastes include paint overspray caught by emissions control devices and leftover and unused paint.

Packaging

The majority of wastes by volume generated during assembly result from packaging. Reusable packaging, e.g. metal racks, bins and containers, is returned to suppliers when empty. Disposable packaging includes wood pallets, cardboard, plastic, polystyrene and polythene film. This should be recycled wherever possible.

Large quantities of packaging may be used. Companies operating with the European Union (either as a manufacturer or as a supplier into European Union countries) will be subject to the European Union Packaging and Packaging Waste Directive (94/62/EC), which aims to reduce the amount of packaging that is being introduced into waste.

Solid Wastes

- The principal waste from the press shop is scrap metal, which is normally recycled off-site.
- The abrasive disc smoothing of welds and soldered joints generates a metal-rich dust.
- Many vehicle manufacturing plants have wastewater treatment facilities which will generate a sludge requiring off-site disposal.
- Additional wastes arise from general operations, cleaning and maintenance and the disposal of faulty equipment and parts.

Respiratory Hazards & Dermatitis

Different coating powders may affect worker health in different ways causing irritation of lungs, eyes and skin and allergic skin reactions.

Some components of coating powders can also cause long-term health effects. Some agents

may cause asthma. Other curing agents may damage genetic material, which could cause some diseases including cancer and impaired fertility.

Various organic solvents are used in degreasing. The most commonly used are chlorinated solvents such as trichloroethylene, dichloromethane (methylene chloride) and perchloroethylene. These substances may be harmful to health if inhaled. The ill-health effects from inhalation would depend on the substance in use and the concentration and length of exposure. At high concentrations all organic solvents exert a strong narcotic effect and can be fatal. Skin exposure can cause irritation and dermatitis.

Permitting

The End of Life Vehicles (ELV) Directive 2000/53/EC required that the average weight of material per vehicle/per year reused or recovered by each member state since 2006 is 85% and this will increase to 95% by 2015. In the same time frame reuse and recycling figures currently at 80% must increase to 90%. This legislation also limits the use of certain hazardous substances.

Member States must ensure that producers use material coding standards which allow identification of the various materials during dismantling in accordance with decision 2003/138/EC and that the vehicles manufactured can meet the minimum recycling targets. This has impacts for motor vehicle manufacturers that import into the EU.

Vehicle painting operations will be subject to the requirements of the Solvent Emissions Directive (1999/13/EC as amended by 2004/43/EC) which sets strict limits on the emission of VOCs in vehicle painting operations.

OTHER ENVIRONMENTAL, HEALTH AND SAFETY RISK/LIABILITY ISSUES

Energy Consumption

Motor vehicle assembly plants use energy throughout the plants for many different end-uses. The main energy types used on-site are electricity, steam, gas and compressed air.

Paint shops are the major energy-consuming centre. Energy is used to condition the air for the painting and drying steps, as well as for the drying process and for treatment of the emissions and for ventilation.

Noise and Vibration

Vehicle assembly plants can be noisy work places due to the high level of use of machinery. Those at risk include machine operators and those working nearby, e.g. maintenance staff, cleaners, forklift truck drivers and shop floor supervisors. Temporary, partial loss of hearing, which may persist for several hours, can be caused by brief exposure to high noise levels. Such exposure if repeated or prolonged may lead to permanent hearing damage.

Hand-arm vibration syndrome from the prolonged use of vibrating tools and machinery causes effects on the body's blood circulation known as 'vibration white finger' (VWF). Other damage may be caused to the nerves and muscles of the fingers and hands causing numbness and tingling, reduced grip strength and sensitivity. Pain and stiffness in the hands, and joints of the wrists, elbows and shoulders are other possible symptoms.

Appropriate PPE should be provided and good occupational health systems are required to monitor and control employee long-term exposure to noise and vibration.

Polychlorinated Biphenyls (PCBs) & Asbestos

- PCBs are a group of substances which are good electrical insulators. Typically, PCBs may be present as constituents of hydraulic oils or dielectric fluids in electrical switchgear, transformers and fluorescent light starters. PCBs are extremely toxic and become concentrated within the food chain. Any products that may contain PCBs must be disposed of by licensed contractors in accordance with national regulations.

- Asbestos was used on a large scale for many years as a fire proofing and insulation materials and may be encountered in a wide range of forms within the fabric of older buildings. Asbestos fibres, which are extremely hazardous when inhaled (causing mesothelioma and fibrous thickening in the lungs), may be released when the asbestos containing material is disturbed during maintenance or demolition.

Particular attention should be given to buildings constructed before the 1980s.

Machinery/Product Handling

Injuries resulting from the manual handling of objects and materials with sharp edges and from entanglement and entrapment in the moving parts of machinery are common in the engineering industry, particularly

- Where people are involved in handling sheet or strip metal;

- During work at presses, where small pieces of metal with sharp edges are handled frequently;

- Following accidental contact with scrap metal, banding or swarf, principally during cleaning and disposal;

- By contact with machinery blades, cutters or tools during use and when fitting, removing, cleaning or storing).

Working practices of these employees should be examined carefully to determine the level of risk and a hierarchy of control measures implemented to reduce the risk:

- Avoid direct handling of sharp edged items;

- Engineer out sharp edges and access to dangerous parts of machinery through a hierarchy of controls:
  - Permanently fixed physical barrier
  - Interlocked physical barrier
  - Physical barrier
  - Presence sensing system

- Remove sharp edges by machining;

- Cover or otherwise protect sharp edges;

- Use personal protective equipment.

Collision

Heavy loads are lifted and moved at elevated heights using hydraulic platforms and cranes presenting a serious safety hazard.

Manual Handling and Repetitive Work

Lifting, repetitive work, poor posture and carrying heavy or awkwardly shaped objects, such as large parts and heavy equipment can result in injuries.

Slips, Trips and Falls

These often occur on the same level and are primarily caused by uneven surfaces, inappropriate footwear, lighting and trailing cables especially during maintenance and cleaning activities.

KEY SOCIAL, LABOUR AND COMMUNITY RISK/LIABILITY ISSUES

Supply Chain

The environmental and social impact of vehicle manufacturing companies is heavily dependent on the performance of companies within their supply chain as the majority of components are bought in either from external suppliers or subsidiaries.

Likewise, most manufacturers operate on a "just-in-time" basis and a sudden reduction or increase in production can have serious economic consequences for suppliers.

Vehicle Use

The use of motor vehicles is responsible for greenhouse gas emissions from the combustion of fossil fuels. Many national governments have imposed fiscal and legislative measures to reduce the emissions from motor vehicles. Significant investment will continue to be required to improve engine efficiency or to develop alternative fuels/power sources.

End of Life Vehicles

Under the EU End of Live Vehicles (ELV) Directive 200/53/EC, vehicle producers must set up systems for the collection of all end-of life vehicles and, as far as technically feasible, of waste used parts removed when passenger cars are repaired. They must also meet all, or a significant part of, the costs of the implementation of this measure and/or take back end-of life vehicles.

OTHER SOCIAL, LABOUR AND COMMUNITY RISK/LIABILITY ISSUES

Dust and Odours

Public/environmental health and nuisance issues associated with dust and vented fumes can arise from production activities and may have a significant effect on neighbouring locations. This may be important if there are neighbouring residential and industrial activities in the area;

Transport

Transport of products by road can be a significant issue. This might lead to road noise and traffic congestion.

FINANCIAL IMPLICATIONS

- The last holder of an end-of-life vehicle in the EU may dispose of it free of charge ("free take-back" principle). Producers must meet all, or a significant proportion of, the cost of this measure.

- Many countries are signatories to the Kyoto Protocol and have adopted targets for the reduction of CO_2 emissions. Where Governments have set up carbon emission reduction programmes industrial processes have been required to reduce their CO_2 emissions through the setting of targets. This can result in a need for substantial investment in new/clean technologies to achieve the emission targets. These targets may be reflected in environmental permits.;

- Injuries may lead to increased payroll costs to replace skilled workers and lost production time;
- Capital investment may be required to comply with new environmental, health and safety requirements;
- Fines, penalties and third party claims may be incurred for non-compliance with environment, health and safety regulations.

IMPROVEMENTS

Environmental, Health and Safety Improvements

General

- Environment, health and safety training for all employees and contractors;
- Good housekeeping should be maintained at all times in all areas to reduce the likelihood of incidents and accidents;
- Systems should be subject to frequent and proper inspection;
- Routine plant maintenance to keep small leaks and spills to a minimum and maintain plant efficiency;
- Controls should be implemented to minimise the exposure to gases, fume, dust, noise and vibration.

Airborne Emissions

- Implement a Solvent Management Plan to monitor and control the use of solvents on the site;
- Install or upgrade of abatement technology to minimise exposure to hazardous substances and to control the release of emissions, e.g. enclosure of equipment, use of appropriate ventilation with filters, gas balancing systems, cyclones, and wet or alkali scrubbers

Noise & Vibration

- Enclose noisy machines to isolate people from the noise where practicable;
- Reduction of exposure times for people working near noisy machinery and provide personal protective equipment where people have to enter noisy areas;

Water and Wastewater

- Consider feasibility of substitution of hazardous chemicals such as solvent based paints with less hazardous alternatives;
- Consider upgrades to wastewater treatment facilities;
- Recycle treated wastewater where possible back to the processes or to secondary uses such as for cleaning;
- Maintain on site abatement equipment and wastewater treatment plant.

Storage

- Bulk containment must be:
  - Inspected regularly to prevent leakage;
  - Provided with secondary spill containment;

- Installed with automatic alarms and shut off systems.

Waste

- Return empty containers to the supplier for reuse.

Energy Efficiency

- Improve insulation to minimise heat loss;
- Potentially use heat and energy recovery techniques, such as steam rising boilers to capture hot gases and re-use elsewhere in operation or for generating energy.

Health & Safety

- Provision of personal protective equipment (PPE) that is fit for the task to prevent injury. Staff should be trained in the correct selection, use and maintenance of PPE;
- Redesign manual processes to avoid heavy lifting/repetitive activities;
- Install mechanical lifting aids where possible and rotate work tasks to reduce repetitive activities;
- Separate people from vehicles and machinery were practicable:
  - Ensure that the process layout reduces opportunities for process activities to cross paths;
  - Installation of safeguards on moving parts of conveyor belts to reduce risk of entrapment of employees;
  - Install walkways and signage to separate people from vehicle movements to reduce risk of collision.
- Route cables and pipework under walkways to prevent slips, trips and falls;
- Construct walkways of non slip materials;
- Provide the local fire department with a list and volume of products stored on the premises.

Social Community and Labour Improvements

- Implement a grievance/dispute resolution mechanism for workers and members of the community to raise issues with the Company.

GUIDE TO INITIAL DUE DILIGENCE SITE VISITS

During the initial site visit, the issues will vary according to the type of process being used and product being produced and depending on the level of environment, health and safety management already introduced.

General

- Confirm organisational responsibilities and systems for environment, health, safety and social matters; Confirm that these apply to all employees and sub contractors.
- Note signs of poor housekeeping, such as signs of spillages and high numbers of empty or partially filled drums. Note the condition of the drums. Particularly note any recent spills.
- Check the condition of any assets, facilities, equipment and production areas. What

systems are in place to monitor and maintain physical assets? What investment in asset management is planned? Look for wear and tear and poor maintenance.

Air Emissions Management

- Are there any fume control measures? Do these work and are these used? Is there any build-up of dust on machinery or other surfaces?

Noise

- Note the noise levels at the site. Is there any evidence of noise abatement measures deployed?

Water Supply & Management

- What amounts and quality of water are required? Where is the water obtained from? Is the water recycled?

Waste Water Management

- What liquid effluents are produced? What discharge control measures are employed?
- Is effluent and wastewater treated before discharge? If so, check the condition of the treatment plant and location of discharge points for effluent and wastewater from the facility.
- What does the quality of these discharges look like? Note the colour and appearance of adjacent watercourses;
- Note whether the wastewater treatment plant discharges to ground, a local watercourse or the municipal wastewater treatment works. Higher environmental risks will be associated with facilities discharging to water courses without adequate treatment prior to discharge;
- Is the water quality tested? What are the waters tested for? Where are the samples taken from, how often? Do the discharges have to meet set standards?

Solid Waste Management

- Note nature of solid waste disposal;
- Check that solid waste storage equipment is in a good condition;
- Check that waste storage areas are clear of debris and that skips are covered to prevent waste escaping, for example, check that waste containers have lids or are stored in an area with a roof;
- Check for flora/vegetation zones near storage sites that are not growing very well as this will indicate the possibility of pollution.

Transport of Finished Product from the Site

- Is this by rail, road or water or a combination of these?
- Does road haulage cause excessive traffic through any neighbouring residential areas?

Fuel and Storage of Materials in Bulk

- What fuels and materials are stored in bulk on site?
- To gauge the potential for spillages and leaks consider the following:
  - Are there any underground storage tanks?

- Are surface storage tanks and usage areas hard surfaced and bunded? Are these in good condition or are cracks present? Are these regularly tested for leakages?
- Is the size of the bunding adequate for the volume of the materials stored?
- Are the bunds regularly cleaned out to avoid loss of capacity due to holding rainwater etc.?

Health & Safety

- Are staff wearing PPE?
- Check signage around the site:
  - Does it convey the health and safety risks?
  - Are fire exits and/or evacuation routes clearly marked?
  - Are there demarcated routes for pedestrians and vehicles?
- Check for automatic safeguards on machinery to prevent accidental injury;

Incident Management

- Is fire fighting and first aid equipment available? Is there a trained and competent fire fighting resource on site?
- Have there been any recent (within the last three years) incidents on site such as fatalities, fires/explosions, spills?
- Assess emergency response to fires, major spills, etc.

Inspections & Regulation

- Check the conditions and duration of validity for all permits;
- What systems are in place to check and maintain assets and infrastructure?
- Have the premises been inspected recently by the regulatory authorities for health, hygiene and environment? What were their findings?
- Has the organisation been subject to environment, health and safety or quality audits by customers/insurers? What was the outcome of these audits?
- Find out what insurances are in place (health, hygiene, fire etc). Identify number and type of claims against insurance. Have insurers made any environment, health and safety audits of the facility? What were there findings and actions taken by management to address these;
- Have the premises been inspected recently (within the past 2 years) by the regulatory authorities for health, hygiene and environment? What were their findings?

Investment

- Review budgets for capital expenditure (capex) and operational expenditure to cover environment, health and safety matters. Does the business plan have line items for environment, health, safety and social improvements as well as asset management and maintenance?
- If investment or refinancing will lead to restructuring of the organisation what will be the potential impacts on health and safety at the operation and wider community? Have

these been considered and assessed by the company?

- If the company plans to invest in new technology, what will be the impacts and benefits for human resources?

Social, Labour and Community

- Check that labour standards, contracting and remuneration are in line with national law and are consistent with the average for the sector;
- Check that hours worked, including overtime, are recorded and staff should receive written details of hours worked and payment received;
- Check that wages and working hours are consistent with the average for the sector and national standards;
- Has the Company received inspections from the local labour inspectorate in the previous three years? Have these resulted in any penalties, fines, major recommendations or corrective action plans?
- Does the organisation have a grievance mechanism which allows employees to raise workplace concerns?
- Are employees free to form, or join, a worker's organisation of their choosing?

Take note/ask questions relating to any activities that address the improvements listed in the improvements section of this document

ACTION PLANS

Dependent on the individual business, select appropriate improvements from the list above to include in the action plan. As a minimum, any business should be required to have the following in place:

Environmental, Health and Safety

- Operational procedures to manage environmental, health, safety and social risks;
- Monitoring programmes;
- Improvement objectives, targets and project plans;
- Training for personnel;
- Regular inspections, checks and audits with records to demonstrate achievement of the required level of performance against legal requirements and improvement action;
- Solvent Management Plan;
- Operational procedures to manage environmental, health, safety and social risks;
- Emergency plans for environment, health and safety accidents;
- Waste management plan (waste minimisation, re-use, recycling, monitoring);
- Senior management review/demonstrated involvement in environment, health, safety and hygiene management.

REFERENCES AND ADDITIONAL SOURCES

European Bank for Reconstruction and Development (EBRD). Environmental and Social Policy May 2008. Performance Requirement 2: Labour and Working Conditions. http://www.ebrd.com/enviro/tools/index.htm

European Union 1999, Council Directive 1999/13/EC of 11 March 1999 on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain activities and installations, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31999L0013:EN:HTML

European Union 2000, Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of life vehicles - Commission Statements, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32000L0053:EN:HTML

European Union 2004, Directive 2004/42/CE of the European Parliament and of the Council of 21 April 2004 on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain paints and varnishes and vehicle refinishing products and amending Directive 1999/13/EC, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32004L0042:EN:HTML

Galitsky C, Worrell E 2008, Energy Efficiency Improvement and Cost Saving Opportunities for the Vehicle Assembly Industry: An ENERGY STAR® Guide for Energy and Plant Managers, Environmental Energy Technologies Division, Ernest Orlando Lawrence Berkeley National Laboratory, Sponsored by the U.S. Environmental Protection Agency, March 2008, http://www.energystar.gov/ia/business/industry/LBNL-50939.pdf

International Organisation for Standardisation (ISO) 2004, ISO14001:2004: Environmental Management Systems – Requirements with Guidance for use. www.iso.org

Irish Environmental Protection Agency 2005, Best Practice Guidelines for Vehicle Coating & Refinishing, http://ec.europa.eu/environment/air/pollutants/stationary/solvents/activities/pdf/d058_best_practice_vehicle_coating.pdf

United Kingdom Department for the Environment, Food and Rural Affairs 2004, Process Guidance Note 6/20(04): Secretary of State's Guidance for Paint Application in Vehicle Manufacturing, www.defra.gov.uk/environment/ppc/localauth/pubs/guidance/notes/pgnotes/pdf/pg6-20.pdf

United Kingdom Department of the Environment 1995, Engineering Works: Vehicle Manufacturing Works, http://publications.environment-agency.gov.uk/pdf/SCHO0195BJLI-e-e.pdf?lang=_e

United Kingdom Health and Safety Executive, www.hse.gov.uk

United Nations 2007, Globally Harmonized System of Classification and Labelling of chemicals (GHS), Second Revised Edition, available at http://www.unece.org/trans/danger/publi/ghs/ghs_rev02/02files_e.html

United States Environmental Protection Agency (EPA) 1995, Sector Notebook Project Profile of the Motor Vehicle Assembly Industry, September 1995
http://www.epa.gov/compliance/resources/publications/assistance/sectors/notebooks/motvehsn.pdf