



Associação Brasileira
de Engenharia Automotiva

AEA Vehicle Material

Disposal Booklet

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1. Considerations

Considering that only 1.5% of scrap iron and steel comes from discarded automobiles;

Considering the lack of specific national legislation to encourage and regulate the recycling of vehicles;

Considering that there are on average 3,000 companies scattered throughout the country, with the technical and legal capacity to operate in this process;

Considering that the method used for separation of this material is done by shredder and magnetic collection;

Considering the current legislation of clearance and discharge of the vehicle in transit agencies is an obstacle to the recycling process;

Considering that a vehicle is composed of ferrous metals, non-ferrous metals, plastics, fluids, rubbers, glass, among others;

Considering the government projects for the control of emissions of vehicles (I/M) and vehicular safety (ITV) as a source for generating units for disposal;

Considering the creation of the 'material disposal manual' requested by the AEA Executive Board/Presidency;

Considering that all material developed in this commission will be forwarded to the Ministry of Economy, Ministry of Regional Development, Denatran and Ministry of the Environment, as the minimum necessary recommendation to adapt to international environmental standards and update the recycling process in the country.

2. Introduction

This booklet was produced by the Technical Commission for Vehicle Recycling and intends to present a technically feasible model for the management of materials of unserviceable vehicles being recyclable or not.

End-life-vehicles (ELV) vehicles are rich sources of raw materials, given their noble quantity and composition, which if properly treated can return to the production chain, adding value and reducing the environmental impacts of the whole supply chain.

This booklet aims to introduce the practice of the environmentally correct disposal of the various materials of vehicles, in accordance with the laws in force in the country, strengthening the market for the recycling of materials generated at the end of the vehicle's consumption chain.

3. Objectives

Considering that the end-life-vehicles (ELV) vehicle is not a waste but a source of raw materials, this booklet aims to:

- Reduce the socio-environmental impact of (ELV);
- Promote sustainability, with maximum use of materials, minimizing the necessity for landfills, as well as the use of natural resources;
- Promote the development of the materials recycling market.

4. Context

According to data from the National Traffic Department (Denatran), the Brazilian fleet of heavy and light vehicles is estimated at 106,5 million units [1], around 55% of which are between 6 and 15 years old.

As shown in Figure 1, the Southeast and South regions have the largest fleets in the country, with 48,3% and 19,6%, respectively. The state of São Paulo is the holder of the country's largest stock of cars [1], with a number of vehicles higher than the total of the fleets in the South and Northeast regions.

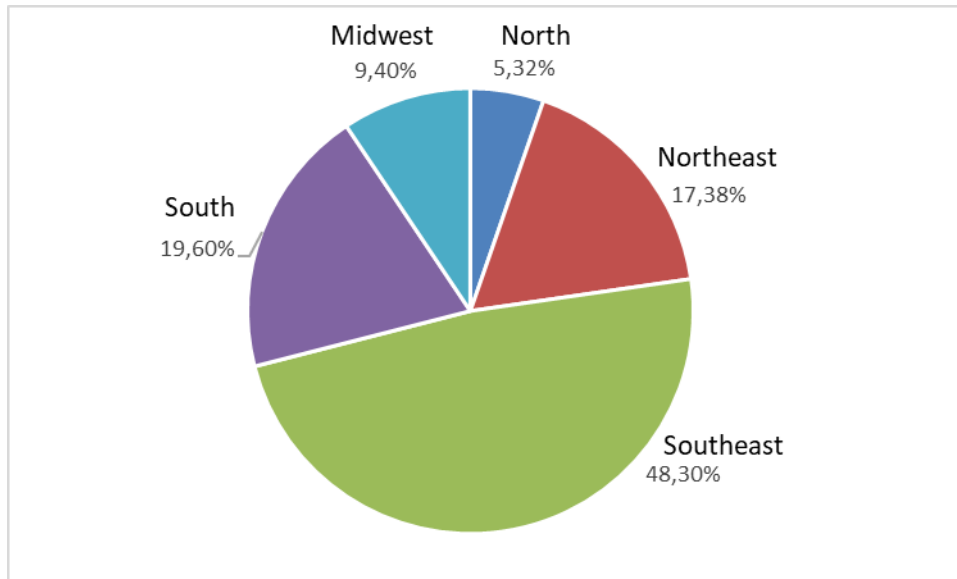


Fig. 1: Regional distribution of the total fleet.

Source: Denatran, August/2020.

The economic momentum experienced by the national economy, in expansion, especially the automobile industry, which grew by an average of 8.4% per year between 2001 and 2010 [4], reflected positively on the age of the national fleet of vehicles. In the early 2000s, only 20% of the national fleet had less than three years of use, today 28% of it has up to three years of use. During this period, the participation of the vehicles with more than 20 years of manufacturing fell from 9% to 4.4% [3] of the fleet. The relative decrease in the number of old vehicles in the fleet brings clear benefits to the whole of society.

With the implementation of this vehicle recycling model, important benefits are expected in the social, environmental and economical areas.

Of particular importance is the economic activity that will take place in the context of the recycling of ELV vehicles, from their transport to the delivery of raw materials recovered in return to the economic cycle. Although there is still insufficient data on the quantification of employed personnel and income, it can be said that it will have a significant effect on the reuse of industrial goods in environmental, technical and economic terms.

5. Composition of the vehicle

Vehicles consist of various materials, which are easily recyclable. The composition of materials has changed over time to meet the requirements of safety and energy efficiency.

Considering new vehicles, see below for the distribution of different types of materials in the vehicle.

Table 1: Approximate material composition of a typical vehicle.

Material Type	Percentage (%m/m)
Normal steel	54,8
Special steel	16,7
Pig iron	1,5
Aluminum (Al)	6,2
Copper (Cu)	0,8
Lead (Pb)	0,5
Zinc (Zn)	0,1
Other Non-ferrous	0,2
Resin	8,2
Rubber	3,0
Glass	2,5
Paint	1,4
Fabric	0,8
Wood	0,1
Others	3,2

6. Vehicle Recycling Center

Vehicle recycling centers are fundamental aspects necessary for the ELV vehicle treatment process. Vehicle Recycling Centers (CRVs) should be responsible for receiving, treating and dismantling unserviceable vehicles to ensure that all of their materials have an environmentally safe and economically favorable disposal.

In general, it can be said that in the CRVs, the vehicles collected will go through four stages: pre-treatment, dismantling, shredding and post-shredder treatment, from which separate materials and components will be destined for recycling or treatment plants. These steps will be explained below.

6.1. General flow of dismantling and recycling

The dismantling of a vehicle at the ELV begins with its depollution. At this stage, called pre-treatment, all fluids, fuel and air conditioning refrigerant gas are drained, and all environmentally hazardous components are removed, as well as other items.

The dismantling itself is based on the removal of parts and components that can be recycled or reused. After depollution (pre-treatment) and disassembly, the vehicle is sent to the shredders that shred the vehicle. After shredding, the metal fraction (ferrous and non-ferrous), which is 100% recyclable, is separated. The remainder forms a residue known as a “shredder fluff”. This waste, in turn, can be incinerated for power generation, recycled or landfilled.

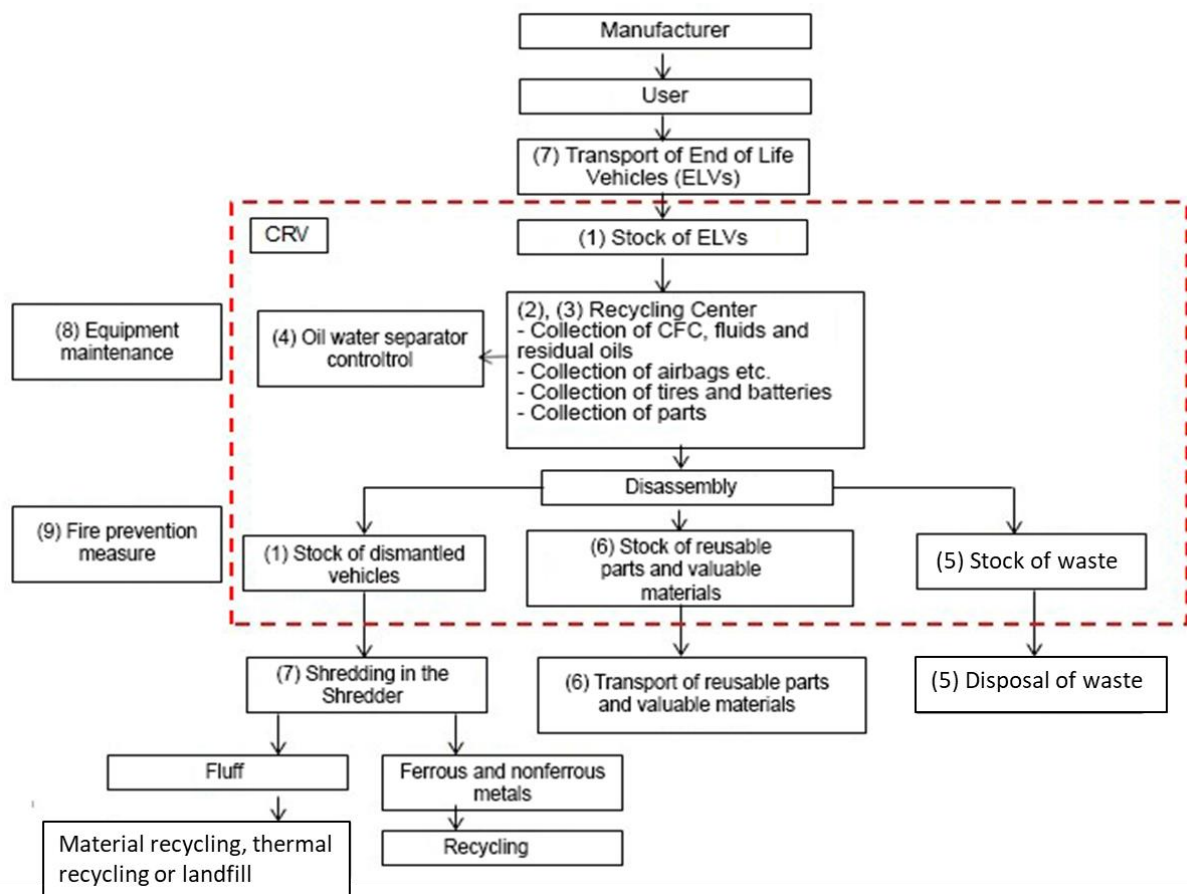


Figure 2: Disassembly and recycling flow of an ELV vehicle in the CRVs.

The flowchart shows the procedure of automotive recycling centers according to international experiences.

The following necessary items from (1) to (9) should be included in order to meet best practice from an environmental and safety point of view:

- (1) Stock method of dismantled ELVs and vehicles
- (2) Collection air conditioning fluids (or gas) and waste oil, prevent leakage at the site of operation and add inventory method.
- (3) ELV recycling center method including mandatory removal of batteries and parts.
- (4) Oil water separator control method
- (5) Treatment method of ELV waste generation.
- (6) Method of storing reusable parts, materials and other materials removed from the ELVs.
- (7) Method of transporting ELVs and dismantled vehicles
- (8) Recycling center equipment maintenance method
- (9) Precautions for fire prevention

6.2. Method for transporting ELVs

When ELVs are transported, companies must transport them appropriately according to the type and criteria of transport with waste management as regulated. In the event that ELV transport is carried out by another company, this must be realized by authorized transporters for residual solids or industrial waste.

The following is an example of a transport process:

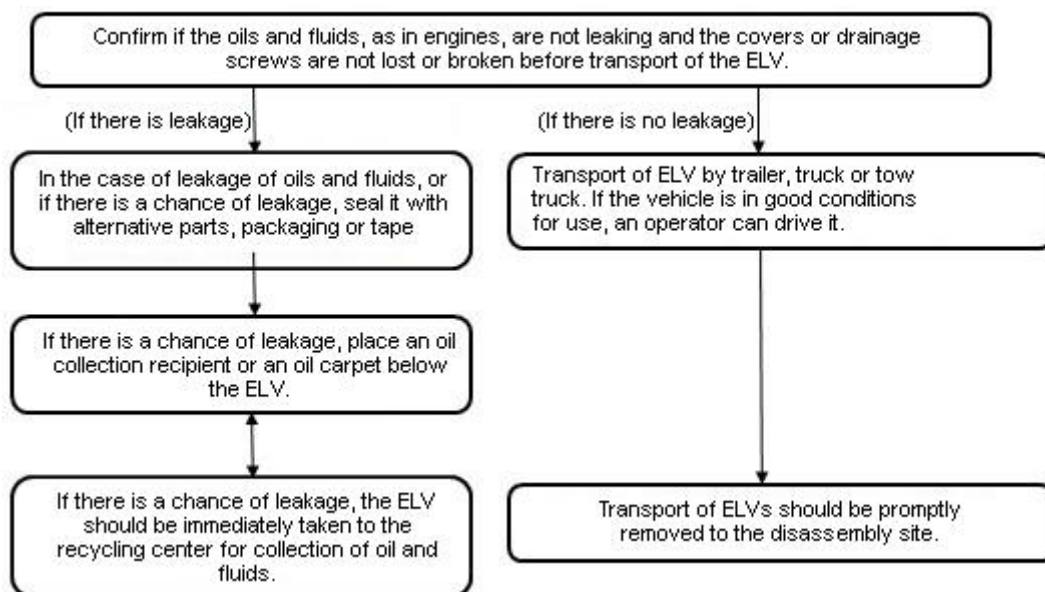


Figure 3: Example of a transport process

6.2.1 Verification of leaks

Make sure that the refrigerant cap, oil cap, and drain bolts of each part are not lost, and whether there is a malfunction or leakage of waste oil and fluids from other parts. If there is a chance of leakage, it is necessary to carry out the sealing of the leak with a casing or sealer as a preventive measure.

If the above measures do not resolve the leak, a truck with a leak collection compartment that holds the oil or leak fluid from the vehicle floor should be used, or an absorbent blanket or oil container should be placed under the vehicle in order to take preventive measures for the leak. In the event that the vehicle is severely damaged or the leakage is significant, on-site collection of oil and fluid is required.

Ideally, the vehicle should be verified as leakage existing before the transportation, since during stock, before transportation, a leakage could be happened.

6.2.3.1 If an ELV is still in good condition, an authorized driver may drive it.

6.2.3.2 A special transport vehicle such as a truck (hauler) can be used. ELVs should be completely secured with chains and belts and additional care should be taken with ELVs and storage facilities so as not to cause damage during loading or unloading.

6.2.3.3 The use of a trailer/winch applies in the case where there is no chance of oil and fluid leakage, as this may fall to the ground during transport.

6.3 Storage

For light vehicles, it is recommended, for safety reasons, for the ELVs to be stored 30 cm from the limit of the storage area. When stacking vehicles, the limit should be 3m due to the risk of falling. The maximum recommended height is 4.5 m with a triple platform being stacked in a balanced manner considering the center of gravity.

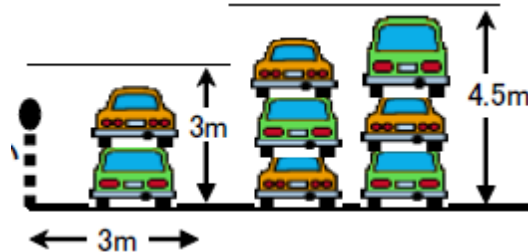


Figure 4: Storage example

It is not recommended that very large vehicles be stacked.

In cases where the floor of the storage area is not reinforced, has no drains and connections with a water/oil separator, has no cover and the ELVs may have oil or liquid leakage (e.g. vehicles that have suffered accidents), oils and fluids should be removed immediately in the fluid collection area or in the vehicle disassembly area and then receive appropriate treatment for these fluids.

Reinforcement of the storage area floor or use of an oil and water separator is not required, however, there should be periodic checking and if necessary, maintenance of the floor in case of cracks to avoid accidents. If the CRV wishes to adapt the storage site, it is recommended that it has 15 cm of floor thickness and channels for fluid collection as well as a water and fluid separator box. In this case, it will not be necessary to check periodically as 15 cm is sufficient.

For vehicles already dismantled, there is no specific location and recommendation but the vehicles must have their own location.

When moving vehicles, use cones and ropes to signal that they are moving in order to avoid accidents.

The vehicle storage limit is limited by the CRV area.

In case of ELV such as accident vehicles, oils and fluids shall be collected immediately at fuel collection area or dismantling area and stored at storage site after being proper treatment of waste oil or fluid.



Figure 5: Example of non-orderly stock

To the left, vehicles stocked in an orderly manner and, to the right, vehicles stocked in disorder, wasting working time for relocation besides the lack of security aspect.

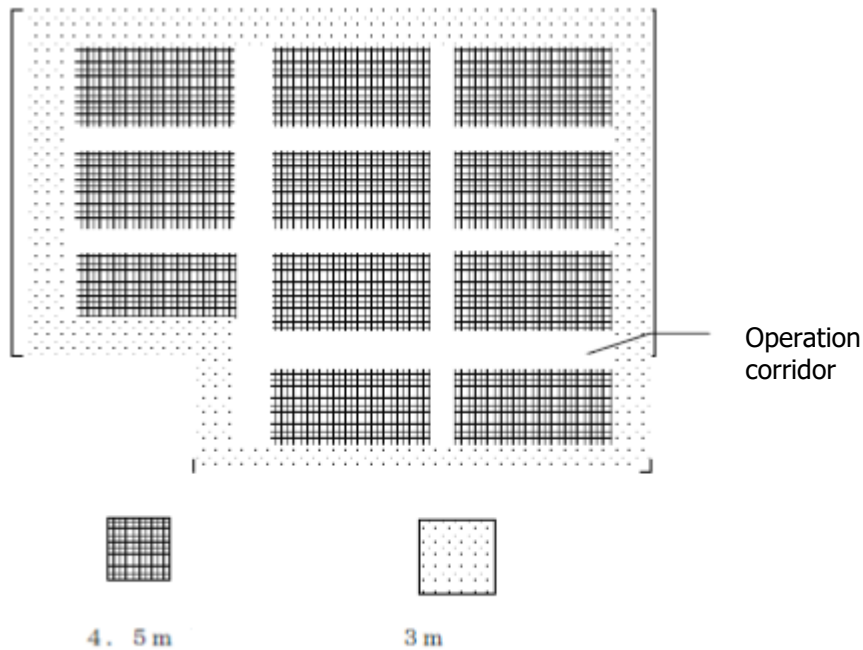


Figure 6: Height limitation

6.4 Pre-treatment

The pre-treatment step encompasses the removal of the following materials from the vehicle:

- Fluids:
 - Fuels: gasoline, hydrated ethanol fuel, diesel
 - Engine oil, trans mission, differential, hydraulic steering, shock absorbers
 - Brake fluids
 - Coolant
 - windshield wiper fluid
 - Refrigerant gas

Fluids should be collected and sorted by material type and stored properly It is suggested the separation by type of material as follows:

- Gasoline

- Diesel
- Alcohol
- Oils (engine, transmission, hydraulic steering and shock absorber)
- Brake fluid
- Coolant (radiator water) and windshield wiper fluid
- Refrigerant gas
- Oil and fuel filters

Addition of:

Neutralization of components with explosive potential (e.g. Air Bag)

In general, the pre-treatment area should be covered in order to prevent rainwater from carrying fluids and fuel, and have concrete-reinforced paving.

Rainwater must not be diverted to the oil and water separator as this can overflow and cause oil leakage.

Periodic checks are recommended to check for possible cracks that could lead to fuel leaking into the ground.

Preferably, the area should be opened to increase airflow and decrease the concentration of fluids and fuels that cause explosions easily.

In case of leakage, a water and oil separator must be installed connected to drains installed in the fuel recovery area.

Regularly check the level of the water and oil separator to check the condition of the floating oil. At the last stage of the separator, there should be no oil on the surface-, only water, so check regularly for oil in the final tank.



Figure 7: Example of pre treatment area

6.4.1 Recovery or removal area.

6.4.1.1 Remove the drain pins from the fuel tank and collect.

If the vehicle has no place to drain the fuel, remove the fuel pump for collection. If the fuel pump cannot be removed from the vehicle, drill a hole in the tank or remove the tank to collect the fuel.

6.4.1.2 Ensure that the fuel has been completely removed and the drain pins have been put back.

6.4.1.3 Place the fuel in a specific container, transfer it to a drum (tank) with good capacity

(sufficient to avoid frequent replacement, in which it will be stored on site for hazardous substances). Make sure that the drum cover is in place.

6.4.1.4 Collect gasoline, ethanol and diesel separately. Indicate which fuel is stored in each drum.

6.4.1.5 In case of accidental leakage, clean with a disposable cloth or towel and arrange in a specific drum.

6.5.1.6 Consume the fuel for own operational or equipment.

6.5.1.7 The fuel treatment area should preferably be opened.

6.5.1.8 Optionally, specific equipment may be used to remove the fuel or remove the tank.

6.4.2 Treatment area for various oils.

If the engine and transmission are sold for reuse, engine oil and transmission fluid need not be removed.

6.4.2.1 Place the oil in a large collection container or directly from the metal collection container under the vehicle.

6.4.2.2 Remove the pins from the drains and collect the oil by gravity. For hydraulic steering oil, collect oil from the oil tank under the hood using suction equipment.

6.4.2.3 Make sure that you have collected all the oil and cover the drains correctly.

6.4.2.4 Place in a specific metal drum, which will be allocated to the hazardous substances area. Be sure to close the drum.

6.4.2.5 In case of accidental leakage, clean with a disposable cloth or towel.

6.4.3 Radiator coolant storage area

6.4.3.1 Place the coolant in a large collection container or directly from the metal collection container under the vehicle.

6.4.3.2 Remove the plugs from the radiator drains and collect the liquid by gravity.

6.4.3.3 Be sure to collect all fluid and close the drains.

6.4.3.4 Place in a specific metal drum at the storage location. Be sure to close the drum.

6.4.3.5 In case of leakage, wipe and dispose in a container and then place it in the drum.

6.4.4 Collecting and storing window washer

6.4.4.1 Place a collection container or drum under the wiper fluid tank

6.4.4.2 Remove the hose from the tank and collect the cleaner fluid by gravity.

6.4.4.3 Place in a specific metal drum and place in the storage location.

6.4.4.4 In case of leakage, wipe and dispose in a container and then place it in the drum.

6.4.5 Treatment of waste oil and fluid

In cases where waste oil and fluid are not reused as self-consumption, Delegate appropriate treatment to waste treatment companies authorized as industrial waste in accordance with current legislation.

Create a waste shipment routine to the treatment company.

6.4.6 Oil water separator management

6.4.6.1 Do not place anything on the oil and water separator cover

6.4.6.2 Float the absorbent blanket in each separator and remove the floating oil.

6.4.6.3 Open the cover of each tank every day to check for oil on the surface and cracks in the separator.

6.4.6.4 If the oil on the surface is found in the final tank, replace the absorption blanket and remove the waste oil with a ladle to a single drum.

6.4.6.5 Remove waste oil and sludge frequently and delegate appropriate treatment to an authorized industrial waste treatment operator.

6.4.6.6 The collection of waste oil from the waste oil separator can be done by collection or suction equipment.

6.4.7 Collection channel management

At the end of daily operations, collect the oil from the fuel pan to a dedicated drum.

6.4.8 Storage and treatment of hazardous substances

All operations involving potential fire, such as foundry operations, should be carried out away from flammable substance storage sites.

The storage of flammable substances should be prepared for firefighting situations, such as fire extinguishers and alarm triggers.

Suitable places for smoking should be previously analyzed and follow the laws in force. Fire must not be used in operations or any other situation.

Organization and cleaning help in the prevention of accidents.

The containers for storing the substances must be analyzed so that there is no breakage, cracking or any other form of damage.

Pressurized gas stock used in operations should follow manufacturer's recommendations. Use of fire should be prohibited within a radius of 2 meters and ambient temperature should be maintained at a maximum of 40 degrees or less.

6.5 Dismantling stage

The dismantling stage is intended for the removal of parts that can be recycled or where the disposal of certain parts must be environmentally sound since the vehicle is composed of recyclable or hazardous materials and can be dismantled and sent for recycling if technical recycling solutions are available on the market or final disposal. It is suggested that the selection of parts be dismantled from the vehicle according to the following criteria:

- Ease of access and dismantle
- Composition of the material (components produced with a single material are more recyclable than components with two more types of materials)
- Technological and economic potential for the use of the component raw materials.
- Potential for environmental contamination and environmental laws

The dismantling area should preferably be covered and if this is not possible, the water and oil separator box should have sufficient capacity for installation. Rainwater should not be directed to the separator box. At the end of the day, confirm that there is no waste oil in the drain in the final separator tank and check the condition of the oil.

6.5.1 Batteries

Batteries should be stored in exclusive containers and easy to identify in case of leakage, and as soon as they reach a pre-determined quantity, an appropriate authorized contracted treatment company should remove them.

6.5.2 Tires

Remove all tires from vehicles and store them in a dry and covered place and as soon as you reach the minimum quantity determined, an appropriate authorized contracted treatment company should remove them.

6.5.3 Air bags

Air bags must be removed in accordance with the manufacturer's instructions and current legislation.

6.5.4 Collection of valuable components

Remove for shocks, hood, interior panel, seats, lamps (including interiors), engine, transmission, and chassis by hand or by machine.

Dispose of the components by separating them by type of recyclable materials and/or reusable components, if applicable.

If the storage location does not have reinforced flooring and is not covered, the components must be sealed to prevent oil and fluid leakage and then packaged.

6.5.5 Other items

Remove LPG tanks and dispose of them with an authorized company.

Ensure that the fluorescent lamps have been removed and not broken and store them.

6.6 Stock of dismantled vehicles

Signal (e.g. cones can be used) the storage location of the disassembled vehicles.

The stock should be at least 30 cm away from the railings or protection walls. In the case of stacking, which is only permitted for light vehicles, it must be 3 m from the grids/walls and 3 m high, or 4.5 m at most. In addition, the stacking angle must not exceed 45°. For better control, predetermine the number of vehicles that can be stored for material handling management.

6.8 Transport of disassembled vehicles

Transportation of disassembled vehicles must be carried out by authorized companies according to local regulations. Before starting transport, confirm that there are no fluid leaks, and that batteries, tires and lamps have been properly removed. When there is mixing of materials (more common), sending to a shredder is desirable.

6.9 Shredder

After depollution and disassembly of the vehicle, the remainder, also called the *Hulk* (semi-disassembled bodywork), goes to the *shredder*. The *shredder* is a system used on an industrial scale to reduce the dimensions of ELV vehicles and separate the materials in order to facilitate their recycling. By means of the shredding the semi-disassembled bodywork of the vehicle, the ferrous and non-ferrous metal portion can be separated and recovered, and then destined to the steel mills for use as raw material. Depending on the technology used, it is also possible to separate other valuable materials such as glass, urethane etc.

6.10. Post Shredder Treatment

The material resulting from the separation of metals, called *shredder fluff*, is mainly composed of polymers, most of which are recyclable. In this case, the use of already available separation technologies for these materials should be considered in order to send them to recycling. In addition, due to its high calorific value, the remaining waste from *the shredder fluff* can be sent to thermoelectric plants for the production of electricity or any other environmentally correct disposal.

The aim must be to return as many materials as possible to the economic cycle, in the form of raw materials or for power generation. In this way, the materials will have an environmentally safe and sustainable disposal. In all cases, however, the performance of CRVs must be monitored and controlled within the technical and environmental norms, with permanent incorporation of technological evolution.

7. Vehicle Recycling Center Maintenance Plan

It is recommended to maintain a maintenance plan for the CRV.

Below is a suggestion of a full maintenance plan.

Location	Checkpoint	Frequency	Method
1. Fence	1) Breakage / Damage 2) Lock / Security	1) Once / month 2) Daily after working hours	
2. Flooring	1) Cracking 2) Space between the steel plates (if any) and the welding points 3) Oil film	Daily before the beginning of the working day	1) Repair 2) Repair 3) Remove
3. Oil water separator	1) Oil film at the surface of the tank 2) Amount of sludge 3) Collection of residual oil waste oil in case of rain forecast	1) Random 2) Once / week 3) Whenever there is rain forecast	
4. Drainage	1) Breakage / Damage 2) Scrap / dust	Once / week	1) Repair 2) Remove
5. Well	1) Breakage / Damage 2) Accumulated fluid	Once / week	1) Repair 2) collect adequately
6. Oil storage, disassembly and collection site	1) Oil or fluid leakage 2) Mosquito or insect larvae 3) Breakage / damage to the roof, fence or walls	1) Daily after working hours 2) Once / fortnight 3) Once / week	1) Remove 2) Surveillance 3) Repair

Figure 8: Example of maintenance plan

When there is confirmation of leaks, stop operation immediately and inform the management to close the leak points with sandbags and collect waste oil with sawdust and floor cloths to prevent the oil from spreading.

Equipment used for disassembly must always be in suitable operating condition

Preferably, sump it should always be kept empty.

Note: check that all fire precautions must be in accordance with the laws in force. Special attention should be paid to fuels.

8. Final Considerations

It is expected with this Vehicle Materials Disposal Booklet, created by this AEA commission, the practice of the environmentally correct disposal of the various vehicle materials at the end of use can be introduced.

ELV vehicles are rich sources of raw materials, which if properly handled can reduce the volume of discarded materials, fostering the market for the recycling of materials.

The implementation of this process can be promising as the generation of resources and jobs for society as it gains in size and scale. However, the recycling process should only be considered if it is proven economically viable.

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For Batteries

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Resolutions

[29] BRAZIL. Resolution CONAMA 258 1999.August.26, Determines that manufactures and importers of tires are obligated to collect and dispose environmentally.

[30] BRAZIL. CONAMA Resolution 416/09 of September 30, 2009. Provides for the prevention of environmental degradation caused by unserviceable tires and environmentally sound disposal, as well as other measures. Published in the Diário Oficial da União of October 1, 2009.

Normative instructions

[31] BRAZIL. Ibama Normative Instruction No. 1 of March 18, 2010, Establishes, within the scope of the IBAMA, the necessary procedures to comply with CONAMA Resolution No. 416 of September 30, 2009, by manufacturers and importers of new tires, on collection and final disposal of unserviceable tires. Published in the Diário Oficial da União of March 19, 2010.

For catalytic converters

Resolutions

2001, Complements

[32] BRAZIL. CONAMA Resolution 282/01 of July 12,

Resolution 18/86 by establishing the minimum requirements for controlling emissions for catalytic converters produced specifically for replacement. *Establishes the requirements for catalytic converters intended for replacement, and makes other provisions*, published in the Diário Oficial da União nº 220 of November 19, 2001, Section 1, pages 93-95