



**“Integrated manufacturing of REciclable hybrid
metalthermoplastic COmposites for the
TRANSport sector.”**

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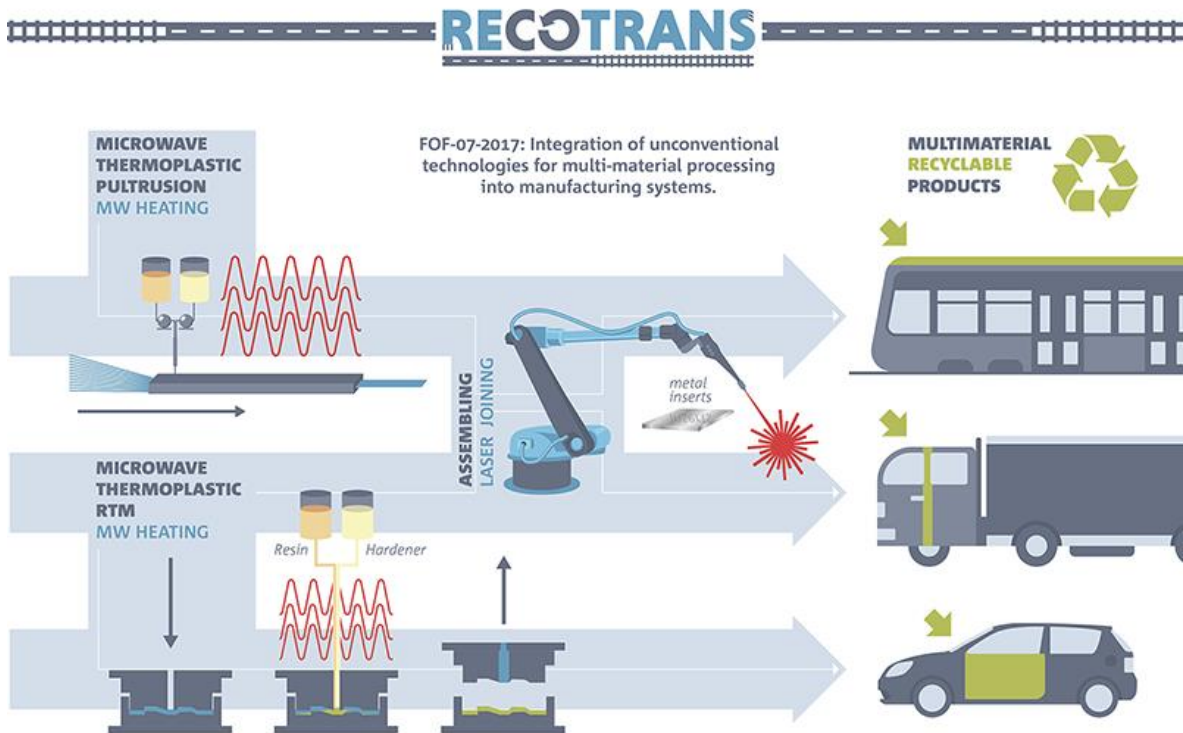
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1. RECOTRANS project

RECOTRANS project¹ will integrate unconventional manufacturing technologies such as (microwave) MW radiation and laser joining in current RTM and pultrusion production lines to be able to obtain cost-effective recyclable multi-material composites suitable for the transport industry; automotive, truck and railway sector. This integration will contribute to obtain high quality lightweight multi-materials at high production rates 2 m/min for pultrusion and 2 min/cycle for RTM, which equals to an up to 50% reduction in polymerization time; reducing production cost, energy consumption and time to market, while at the same time contributing to reduce CO2 emissions coming from vehicles; truck, automotive and railway

RECOTRANS partnership is composed by 13 organizations from 7 EU countries, having the required pan EU approach essential for achieving the objectives of the project since it is required to address the EU social and Industry needs in the field with a wide EU perspective.



The main goal of the RECOTRANS project englobes the reduction in production time, costs and energy consumption using technologies that would be easily integrated in current manufacturing facilities:

¹ RECOTRANS project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 768737

- **Production time reduction from 10 to 50%** by means of the reduction in polymerization time
- **Cost reduction up to 35%** due to weight reductions which involve a reduction in operational costs, reduction in raw materials needed for joining metal structures and reduction in maintenance cost
- **Energy saving by at least 10%** because of the reduction in the temperature losses and the reduction of cycle time.

An intelligent process monitoring system will be integrated in production line for the efficient quality and process control of the innovative processes, including a maintenance predictive system and securing in-process inspection of parts quality. All equipment will be selected from list of standard available industrial automation equipment for economic and practical reasons (fastest integration time with optimal costs). The integration of MW and laser technologies in current RTM and pultrusion processes, only involves auxiliary equipment allowing solutions available for SME uptake.

2. Regulatory, policy and standardization requirements

In the present deliverable a complete survey on regulatory issues to be treated, internal policy as well as all standardization requirements and safety issues related to the transport industry is reported. This complete compilation will be established and presented to all the partners in order to ensure that they are taken into account from the very first moment of the project execution.

Specific rail and road requirements were clearly identified. Materials and technologies determined and used in the project were subject to a scientific analysis to determine the regulatory risks associated. This study also identifies the possible issues regarding the materials to be used within the project in order to anticipate future restriction and/or "interdiction" due to regulations and risks associated with future production parts.

2.1. Standards and regulations related to automotive and truck sectors

2.1.1. European Directives/Regulations

A directive is a legal act provided in the EU Treaty. It is binding in its entirety and obliges Member States to transpose it into national law within a set deadline.

All partners in the project must be coherent with rules that are written in the European Directives related with the automotive and truck sectors.

Directives in the table 1 are listed by their number, title and the sector where they apply, regulations in whole are available on European Union Law website:

<http://eur-lex.europa.eu/homepage.html?locale=en>

Table 1 Automotive & truck sector directives

Directive No.	Directive title	Sector
2000/53/EC	End-of life vehicles	Automotive
2005/64/EC	Type-approval of motor vehicles with regard to their reusability, recyclability and recoverability and amending Council Directive 70/156/EEC	Automotive
2007/46/EC	Establishing a framework for the approval of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles (Framework Directive)	Automotive/truck
1230/2012	COMMISSION REGULATION (EU) No 1230/2012 Implementing Regulation (EC) No 661/2009 of the European Parliament and of the Council with regard to type-approval requirements for masses and dimensions of motor vehicles and their trailers and amending Directive 2007/46/EC of the European Parliament and of the Council	Automotive/ Truck
2014/30/EU	Harmonisation of the laws of the Member States relating to electromagnetic compatibility (recast) Text with EEA relevance	Automotive/ Truck

In addition to the rules and restrictions presented in the previous directives, the use of hazardous materials will be avoided and requirements stated in European regulation REACH will be fulfilled. Furthermore products of halogens and asbestos materials are totally forbidden.

The materials used may not have any acute or chronically damaging effect on man and environment or cause any annoyance during application, use, incident (fire), repair and disposal.

For example:

- No materials containing asbestos, PCV or chlorine
- No coating substances containing chromate and other heavy metals
- No substances which are carcinogenic, mutagen or toxic for reproduction
- No intensively odorous, irritating substances, mixtures of substances and materials (Prevention of fogging).

Table 2 REACH regulation

Standard	Standard Title
European regulation EC 1907/2006 as amended	Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)

2.2. UNECE Regulations

In addition to the rules that are written in the directives all partners must also be coherent with the following UNECE Regulations related with the automotive and truck sectors.

As of 2018, there are 135 UN Regulations appended to the 1958 Agreement; most regulations cover a single vehicle component or technology. In the following table are listed the regulations that applies within the scope of the project.

Regulations in Table 3 are listed by their number, title and the sector where they apply.

Table 3 List of UNECE regulations

Standard	Standard Title	Sector
ECE-R 32	Rear end collision	Automotive/truck
ECE-R 33	Head on collision	Automotive/truck
ECE-R34	Prevention of fire risk	Automotive/truck
ECE-R94	Frontal collision	Automotive/truck
ECE-R95	Lateral collision	Automotive/truck
ECE-R118	Burning behavior of materials	Automotive/truck
ECE-R 29	Protection of occupants of the cab of com.veh.	Truck

2.3. Standards and regulations related to Rail sector

2.3.1. European Directives/Regulations

All partners in the project must be coherent with rules that are written in the European Directives related with the railway sector.

Directives in the Table 4 are listed by their number and title. Directives in whole are available on European Union Law website:

<http://eur-lex.europa.eu/homepage.html?locale=en>

Table 4 Railway sector directives

Directive No.	Directive title
2014/30/EU	Harmonisation of the laws of the Member States relating to electromagnetic compatibility (recast) Text with EEA relevance
2016/797	Interoperability of the rail system within the European Union (Text with EEA relevance)
2016/798	Railway safety (Text with EEA relevance)

In addition to the rules and restrictions presented in the previous directives, the use of hazardous materials will be avoided and requirements stated in European regulation REACH will be fulfilled. Furthermore, products of halogens and asbestos materials are totally forbidden.

The materials used may not have any acute or chronically damaging effect on man and environment or cause any annoyance during application, use, incident (fire), repair and disposal.

For example:

- No materials containing asbestos, PCV or chlorine
- No coating substances containing chromate and other heavy metals
- No substances which are carcinogenic, mutagen or toxic for reproduction
- No intensively odorous, irritating substances, mixtures of substances and materials (Prevention of fogging).

Table 5 REACH regulation

Standard	Standard Title
European regulation EC 1907/2006 as amended	Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)

2.3.1.EN- DIN- ISO- Regulations

In addition to the rules that are written in the directives all partners must also be coherent with the following standards and regulations related with the railway sector.

Table 6 Railway standards regulations

Standard	Standard Title
EN 60721	Classification of environmental conditions.
EN 50125-1	Railway applications – Environmental conditions for equipment
EN 45545-2	Railway Applications. Fire Protection on Railway Vehicles. Requirements for Fire Behavior of Materials and Components.
DIN EN ISO 5659-2	Determination of optical density by a single chamber test.
EN 61373:2010	Railway applications. Rolling stock equipment. Shock and vibration tests
UNE EN 22768-1	General Tolerances
EN 12663	Railway applications – Structural requirements of railway vehicle bodies
EN 15227	Railway applications – Crashworthiness requirements for railway vehicle bodies
ISO15288	Systems engineering – System life cycle processes
EN 50126	Railway applications – The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS)
DIN 6701	Adhesive bonding of railway vehicles and parts
EN 1363	Fire resistance tests. General requirements

2.3.2. Safety issues

Past REFRESCO EU project resulted in an overview with potential hazards with catastrophic, critical or marginal consequences and possible causes and broadly unacceptable risk. Measures are necessary to control this risk. A way to minimize the probability of the hazards, is that requirements should be followed. Safety requirements, are described in the table below (note that this table is not limitative).

Table 7 List of safety issues

Hazard origin	Safety requirement	Existing Code of Practice
Fire	The carbody should be in accordance with international related fire standards	TSI LOC & PAS section 4.2.10; EN45545:2013
Fire	Fire barrier between the fire origin and the passengers or staff area	EN 45545-3:2013 EN 1363
Local accumulation of heat	The carbody should be in accordance with international related fire standards. The carbody should be able to withstand the loads in areas with local accumulation of heat.	TSI LOC & PAS section 4.2.10; EN45545:2013; Not available: Perform explicit risk analyses to define the measures for these requirements.
Heat carbon strips on roof	The carbody should be in accordance with international related fire standards	TSI LOC & PAS section 4.2.10; EN45545:2013; Perform explicit risk analyses to define the measures for these requirements.
Collision	The carbody should be in accordance with international related crashworthiness standards	TSI LOC & PAS section 4.2.2.5; EN15227
Vandalism (w.r.t. fire)	The carbody should be in accordance with international related fire standards	TSI LOC & PAS section 4.2.10; EN45545:2013
Lightning	The carbody should be in accordance with international electricity standards	TSI LOC & PAS section 4.2.6; EN50125-1, EN50124-2
Catenary breakdown (w.r.t. fire)	The carbody should be in accordance with international related fire standards	TSI LOC & PAS section 4.2.10; EN45545:2013
Design failure	The design of the carbody should be in accordance with international systems engineering principles	EN50126, ISO15288
No resistance to static & dynamic loads	The design of the carbody should be in accordance with international structural requirements	TSI LOC & PAS section 4.2.2.4; For static loads: EN12663:2010 For dynamic loads: EN12663:2010 but with adapted requirements
Ageing	The carbody should be prevented to the development of ageing, so this is monitorable in a practical way	Not available: Perform an explicit risk analysis to define the measures for this requirement (e.g. how to monitor, how often, ...)

Hazard origin	Safety requirement	Existing Code of Practice
Fatigue	The carbody should be prevented to the development of fatigue, so this is monitorable in a practical way	Not available: Perform an explicit risk analysis to define the measures for this requirement (e.g. how to monitor, how often, ...)
Cracks	The carbody should be prevented to the development of cracks, so this is monitorable in a practical way	Not available: Perform an explicit risk analysis to define the measures for this requirement (e.g. how to monitor, how often, ...)
Wrong modification	The modification of the carbody should be in accordance with international systems engineering principles	EN50126, ISO15288
Vibrations	The design of the carbody should be in accordance with international structural requirements	TSI LOC & PAS section 4.2.2.4; EN12663:2010; EN12299; ISO 2631-1, EN 61373:2010
Incorrect earthing	The total train design should be in accordance with international "earthing standards"	TSI LOC & PAS section 4.2.8.2.10 & 4.2.8.4; EN50153:2002 EN50388:2012

Safety Matrix (Source: Deliverable 2.2 REFRESCO)

2.4. Safety and health at work

Article 153 of the Treaty on the Functioning of the European Union gives the EU the authority to adopt directives in the field of safety and health at work. The Framework Directive, with its wide scope of application, and further directives focusing on specific aspects of safety and health at work are the fundamentals of European safety and health legislation.

It has to be taken into account that member States are free to adopt stricter rules for the protection of workers when transposing EU directives into national law. Therefore, legislative requirements in the field of safety and health at work can vary across EU Member States.

All partners in the project must take special care in being coherent with rules that are written in the directives and regulations related with Safety and health at work.

Directives in the Table 8 are listed by their number and title, regulations in whole are available on European Union Law website:

<http://eur-lex.europa.eu/homepage.html?locale=en>

Table 8 Safety and health at work directives

Directive No.	Directive title
90/269/EEC	Minimum health and safety requirements for the manual handling of loads where there is a risk particularly of back injury to workers (fourth individual Directive within the meaning of Article 16 (1) of Directive 89/391/EEC)
2006/42/EC	Machinery , and amending Directive 95/16/EC (recast) (Text with EEA relevance)
2016/425	Personal protective equipment and repealing Council Directive 89/686/EEC (Text with EEA relevance)
2004/37/EC	Protection of workers from the risks related to exposure to carcinogens or mutagens at work (Sixth individual Directive within the meaning of Article 16(1) Directive 89/391/EEC)
99/92/EC	Minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres (15th individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC).
92/58/EEC	Minimum requirements for the provision of safety and/or health signs at work (ninth individual Directive within the meaning of Article 16 (1) of Directive 89/391/EEC)
89/654/EEC	Minimum safety and health requirements for the workplace (first individual directive within the meaning of Article 16 (1) of Directive 89/391/EEC)
89/656/EEC	Minimum health and safety requirements for the use by workers of personal protective equipment at the workplace (third individual directive within the meaning of Article 16 (1) of Directive 89/391/EEC)
Regulation (EU) 2016/425	Personal protective equipment and repealing Council Directive 89/686/EEC
2013/59/Euratom	Basic safety standards for protection against the dangers arising from exposure to ionising radiation , and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom
90/270/EEC	Minimum safety and health requirements for work with display screen equipment (fifth individual Directive within the meaning of Article 16 (1) of Directive 89/391/EEC)
2003/88/EC	Concerning certain aspects of the organisation of working time
94/33/EC	Protection of young people at work
92/85/EEC	Introduction of measures to encourage improvements in the safety and health at work of pregnant workers and workers who have recently given birth or are breastfeeding (tenth individual Directive within the meaning of Article 16 (1) of Directive 89/391/EEC)
2006/54/EC	Implementation of the principle of equal opportunities and equal treatment of men and women in matters of employment and occupation
2002/14/EC	Establishing a general framework for informing and consulting employees in the European Community

Directive No.	Directive title
2000/78/EC	Establishing a general framework for equal treatment in employment and occupation
2013/35/EU	Minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields) (20th individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC) and repealing Directive 2004/40/EC

3. Conclusions

This complete compilation of directives, rules, regulations and recommendations will allow all partners to ensure that they comply with all the possible legal aspects regarding the integration of unconventional manufacturing technologies such as (microwave) MW radiation and laser joining in current RTM and pultrusion production lines and also during the selection and development of the demonstrators associated to each of the sectors present in the project, Automotive, truck and railway.