

Safety request form – ESS-0063691

Type of request: List of allowed/not allowed materials to be incorporated in equipment to be installed in the accelerator tunnel

Location: Accelerator tunnel (G01)

A recurrent question was raised by the different accelerator work packages regarding existing requirements on allowed/not allowed materials to be incorporated in equipment to be installed in the ESS Accelerator tunnel (G01).

Documents provided by the requestor: N/A

SAFETY DOMAIN CONCERNED

- | | | |
|---|--|--|
| <input type="checkbox"/> Biological
<input type="checkbox"/> Chemical
<input type="checkbox"/> Cryogenic
<input type="checkbox"/> Electrical and electromagnetic
<input type="checkbox"/> Emergency | <input checked="" type="checkbox"/> Environment
<input type="checkbox"/> Ergonomics
<input checked="" type="checkbox"/> Fire
<input type="checkbox"/> Mechanical
<input type="checkbox"/> Non-ionizing radiation | <input checked="" type="checkbox"/> Radiation protection
<input type="checkbox"/> Structural
<input type="checkbox"/> Workplace
<input type="checkbox"/> Worksite
<input type="checkbox"/> Other (Specify) |
|---|--|--|

ANSWER TO THE REQUEST

At the moment, there are no requirements at ESS regarding the use of specific materials for the equipment to be installed in the Accelerator Tunnel, except for electrical cables (ESS-0034035). However, a combination of various recommendations apply when selecting materials in order to reduce the impact on fire safety, radioprotection as well as to the environment. The details and relevant documentation per domain are listed below:

Fire Safety [1]

Purpose: mitigate the consequences of a potential fire on the Safety of personnel and equipment by prohibiting the use of halogenated plastics that emit carbon monoxide (CO) as well as dense, toxic and corrosive smokes during their combustion.

The selection of plastics and non-metallic materials to be used in the Accelerator Tunnel should be done according to the table in Annex 1 of the present document [1].

Sustainability [2]

Purpose: replace, as far as possible, hazardous substances that can have an impact on safety and on the environment by alternatives materials should be selected according to Appendix 1 of ESS-0011452 [2].

Radiation resistance [3], [4] and [5]

Purpose: provide guidance on the selection of rad-hard materials to be used in the accelerator tunnel in order to reduce beam down-time periods and a list of a materials to be avoided due to their high radiological hazard.

ESS-0007659 [3] can be used as a guideline for the selection of materials with respect to radiation resistance. In addition, a complementary document (ESS-0060208) [4] provides operational and accidental absorbed dose values in various locations of the accelerator tunnel and at various beam energy ranges. Finally, Annex 2 [5] provides a list of materials to be avoided as far as possible due to their high radiological risk.

In the event of ambiguity or contradiction between the above-mentioned recommendations and documentation, these should apply in decreasing order of priority, starting from the top.

Documents related to the answer:

[1] CERN Safety Instruction 41 – The use of plastics and other non-metallic materials at CERN with respect to

fire safety and radiation resistance, [EDMS 335806](#)

[2] ESS Procedure for sustainable selection of materials, [ESS-0011452](#)

[3] Material classification to radiation resistance in the ESS linac tunnel, [ESS-0007659](#)

[4] A Guideline to Operational and Accidental Absorbed Dose Rates in the ESS Accelerator Tunnel, [ESS-0060208](#)

[5] Radiological hazard classification of material in CERN's accelerators, [EDMS 1184236](#)

TRACEABILITY

Reference No.: (where applicable)	CHES No.: ESS-0063691
Requested by: AD WP Leaders	Date: 12.07.2016
Answered by: D.Phan (AD Safety Group)	Date: 13.07.2016
Reviewed by: L.Tchelidze (AD Safety Group Leader)	Date: 13.07.2016
Approved by: M.Lindroos (AD Division Head)	Date: 13.07.2016
Distribution list: AD Group Leaders, AD WP Leaders, F.Jörud (ES&H Fire Safety Engineer), P.Jacobsson (ES&H Division Head), M.Conlon (AD Quality Manager)	

APPENDIX 1

Table 1 – List of allowed/not-allowed materials with respect to fire safety [1]

Classification	Material	Abbreviation
Suitable Base Materials	Melamine formaldehyde	MF
	Phenol formaldehyde	PF
	Polyamide imide	PAI
	Polyarylate	PAr
	Polybenzimidazole	PBI
	Polyether ether ketone	PEEK
	Polyether imide	PEI
	Polyimide	PI
	Urea formaldehyde	UF
Suitable only with incorporation of fire retardant NOT containing halogen, sulphur and phosphorus	Epoxy resin	EP
	Ethyl acrylate rubber	EAR
	Ethylene propylene diene	EPDM
	Ethylene propylene rubber	EPR
	Ethylene vinyl acetate	EVA
	High density polyethylene	HDPE
	Low density polyethylene	LDPE
	Polyamide	PA
	Polyaryl amide	PAA
	Polybutylene	PB
	Polybutylene terephthalate	PBT
	Polycarbonate	PC
	Polyethylene terephthalate	PET (PETP)
	Polyisocyanurate	PIR
	Polyphenylene ether	PPE
	Polyphenylene oxide	PPO
	Polypropylene	PP
	Polyurethane	PU
	Polyvinyl acetate	PVAC
Polyvinyl alcohol	PVA	
Silicones	SI	
Prohibited materials	Acetal	POM
	Acrylonitrile	AN
	Acrylonitrile butadiene styrene copolymer	ABS
	Acrylonitrile styrene acrylic ester copolymer	ASA
	Ethylene tetrafluoroethylene copolymer	ETFE
	Natural rubber	
	Perfluoroethylene propylene	FEP
	Polychlorotrifluoro ethylene	PCTFE
	Polymethyl methacrylate	PMMA
	Polyoxymethylene	POM
	Polystyrene	PS
	Polytetrafluoroethylene	PTFE
	Polyvinyl chloride	PVC

Classification	Material	Abbreviation
	Polyvinyl fluoride	PVF
	Polyvinylidene chloride	PVDC
	Polyvinylidene fluoride	PVDF
	Styrene acrylonitrile copolymer	SAN
	Styrene butadiene copolymer	SB

APPENDIX 2**Table 2 – List of materials considered as highly critical due to their high radiological hazard [5]**

Critical elements
Antimony
Cadmium
Cesium
Cobalt
Europium
Gold
Hafnium
Iridium
Lithium
Scandium
Silver
Strontium-90
Tantalum
Terbium
Thorium
Uranium
Xenon