

**§ 725.420 Recipient microorganisms.**

The following recipient microorganisms are eligible for either exemption under this subpart:

- (a) *Acetobacter aceti*.
- (b) *Aspergillus niger*.
- (c) *Aspergillus oryzae*.
- (d) *Bacillus licheniformis*.
- (e) *Bacillus subtilis*.
- (f) *Clostridium acetobutylicum*.
- (g) *Escherichia coli* K-12.
- (h) *Penicillium roqueforti*.
- (i) *Saccharomyces cerevisiae*.
- (j) *Saccharomyces uvarum*.

**§ 725.421 Introduced genetic material.**

For a new microorganism to qualify for either exemption under this subpart, introduced genetic material must meet all of the criteria listed in this section.

(a) *Limited in size*. The introduced genetic material must consist only of the following:

- (1) The structural gene(s) of interest.
- (2) The regulatory sequences permitting the expression of solely the gene(s) of interest.
- (3) Associated nucleotide sequences needed to move genetic material, including linkers, homopolymers, adaptors, transposons, insertion sequences, and restriction enzyme sites.
- (4) The nucleotide sequences needed for vector transfer.
- (5) The nucleotide sequences needed for vector maintenance.

(b) *Well-characterized*. For introduced genetic material, well-characterized means that the following have been determined:

- (1) The function of all of the products expressed from the structural gene(s).
- (2) The function of sequences that participate in the regulation of expression of the structural gene(s).
- (3) The presence or absence of associated nucleotide sequences and their associated functions, where associated nucleotide sequences are those sequences needed to move genetic material including linkers, homopolymers, adaptors, transposons, insertion sequences, and restriction enzyme sites.

(c) *Poorly mobilizable*. The ability of the introduced genetic material to be transferred and mobilized is inactivated, with a resulting frequency of

transfer of less than  $10^{-8}$  transfer events per recipient.

(d) *Free of certain sequences*. (1) The introduced genetic material must not contain a functional portion of any of the toxin-encoding sequences described in this paragraph (d).

(i) For the purposes of this section, a functional portion of a toxin-encoding sequence means any sequence which codes for a polypeptide that has one of the following effects:

(A) It directly or indirectly contributes to toxic effects in humans. Directly contributes to toxic effects in humans means those sequences encoding polypeptides that have direct toxicity to target cells. An example of a sequence which directly contributes to toxic effects in humans is one which encodes the portion of diphtheria toxin, listed in paragraph (d)(2) of this section, capable of interacting with elongation factor 2, leading to inhibition of protein synthesis in target respiratory, heart, kidney, and nerve tissues. Indirectly contributes to toxic effects in humans means a sequence whose encoded polypeptide is not directly toxic to target cells, yet still adversely affects humans. An example of a sequence which indirectly contributes to toxic effects is the sequence which encodes the portion of the botulinum toxin, listed in paragraph (d)(3) of this section, capable of blocking the release of acetylcholine from gangliosides. Botulinum toxin affects neuromuscular junctions by its blockage of acetylcholine release, leading to irreversible relaxation of muscles and respiratory arrest.

(B) It binds a toxin or toxin precursor to target human cells.

(C) It facilitates intracellular transport of a toxin in target human cells.

(ii) While these toxins are listed (with synonyms in parentheses) in paragraphs (d)(2) through (d)(7) of this section according to the source organism, it is use of the nucleotide sequences that encode the toxins that is being restricted and not the use of the source organisms. The source organisms are listed to provide specificity in identification of sequences whose use is restricted. Although similar or identical sequences may be isolated from organisms other than those listed

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below in paragraphs (d)(2) through (d)(7) of this section, these comparable toxin sequences, regardless of the organism from which they are derived, must not be included in the introduced genetic material.

**(2) Sequences for protein synthesis inhibitor.**

Sequence Source	Toxin Name
<i>Corynebacterium diphtheriae</i> & <i>C. ulcerans</i>	Diphtheria toxin
<i>Pseudomonas aeruginosa</i>	Exotoxin A
<i>Shigella dysenteriae</i>	Shigella toxin (Shiga toxin, Shigella dysenteriae type I toxin, Vero cell toxin)
<i>Abrus precatorius</i> , seeds	Abrin
<i>Ricinus communis</i> , seeds	Ricin

**(3) Sequences for neurotoxins.**

Sequence Source	Toxin Name
<i>Clostridium botulinum</i>	Neurotoxins A, B, C1, D, E, F, G (Botulinum toxins, botulin toxins)
<i>Clostridium tetani</i>	Tetanus toxin (tetanospasmin)
<i>Proteus mirabilis</i>	Neurotoxin
<i>Staphylococcus aureus</i>	Alpha toxin (alpha lysin)
<i>Yersinia pestis</i>	Murine toxin
Snake toxins	
<i>Bungarus caeruleus</i>	Caeruleotoxin
<i>Bungarus multicinctus</i>	Beta-bungarotoxin (phospholipase)
<i>Crotalus</i> spp.	Crotoxin (phospholipase)
<i>Dendroaspis viridis</i>	Neurotoxin
<i>Naja naja</i> varieties	Neurotoxin
<i>Notechia scutatus</i>	Notexin (phospholipase)
<i>Oxyuranus scutellatus</i>	Taipoxin
Invertebrate toxins	
<i>Chironex fleckeri</i>	Neurotoxin
<i>Androctonus australis</i>	Neurotoxin
<i>Centruroides sculpturatus</i>	Neurotoxin

**(4) Sequences for oxygen labile cytolytins.**

Sequence Source	Toxin Name
<i>Bacillus alve</i>	Alveolysin
<i>Bacillus cereus</i>	Cereolysin
<i>Bacillus laterosporus</i>	Laterosporolysin
<i>Bacillus thuringiensis</i>	Thuringiolysin
<i>Clostridium bifermentans</i>	Lysin
<i>Clostridium botulinum</i>	Lysin
<i>Clostridium caproicum</i>	Lysin
<i>Clostridium chauvoei</i>	Delta-toxin
<i>Clostridium histolyticum</i>	Epsilon-toxin
<i>Clostridium novyi</i>	Gamma-toxin
<i>Clostridium oedematiens</i>	Delta-toxin
<i>Clostridium perfringens</i>	Theta-toxin (Perfringolysin)
<i>Clostridium septicum</i>	Delta-toxin
<i>Clostridium sordellii</i>	Lysin
<i>Clostridium tetani</i>	Tetanolysin
<i>Listeria monocytogenes</i>	Listeriolysin (A B)
<i>Streptococcus pneumoniae</i>	Pneumolysin
<i>Streptococcus pyogenes</i>	Streptolysin O (SLO)

**(5) Sequences for toxins affecting membrane function.**

Sequence Source	Toxin Name
<i>Bacillus anthracis</i>	Edema factor (Factors I II); Lethal factor (Factors II III)
<i>Bacillus cereus</i>	Enterotoxin (diarrheagenic toxin, mouse lethal factor)
<i>Bordetella pertussis</i>	Adenylate cyclase (Heat-labile factor); Pertussigen (pertussis toxin, islet activating factor, histamine sensitizing factor, lymphocytosis promoting factor)
<i>Clostridium botulinum</i>	C2 toxin
<i>Clostridium difficile</i>	Enterotoxin (toxin A)
<i>Clostridium perfringens</i>	Beta-toxin; Delta-toxin
<i>Escherichia coli</i> & other Enterobacteriaceae spp.	Heat-labile enterotoxins (LT); Heat-stable enterotoxins (STa, ST1 subtypes ST1a ST1b; also STb, STII)
<i>Legionella pneumophila</i>	Cytolysin
<i>Vibrio cholerae</i> & <i>Vibrio mimicus</i>	Cholera toxin (choleraegen)

**(6) Sequences that affect membrane integrity.**

Sequence Source	Toxin Name
<i>Clostridium bifermentans</i> & other <i>Clostridium</i> spp	Lecithinase
<i>Clostridium perfringens</i>	Alpha-toxin (phospholipase C, lecithinase); Enterotoxin
<i>Corynebacterium pyogenes</i> & other <i>Corynebacterium</i> spp.	Cytolysin (phospholipase C), Ovis toxin (sphingomyelinase D)
<i>Staphylococcus aureus</i>	Beta-lysin (beta toxin)

**(7) Sequences that are general cytotoxins.**

Sequence Source	Toxin Name
<i>Adenia digitata</i>	Modeccin
<i>Aeromonas hydrophila</i>	Aerolysin (beta-lysin, cytotoxic lysin)
<i>Clostridium difficile</i>	Cytotoxin (toxin B)
<i>Clostridium perfringens</i>	Beta-toxin; Epsilon-toxin; Kappa-toxin
<i>Escherichia coli</i> & other Enterobacteriaceae spp.	Cytotoxin (Shiga-like toxin, Vero cell toxin)
<i>Pseudomonas aeruginosa</i>	Proteases
<i>Staphylococcus aureus</i>	Gamma lysin (Gamma toxin); Enterotoxins (SEA, SEB, SEC, SED SEE); Pyrogenic exotoxins A B; Toxic shock syndrome toxins (TSST-1)
<i>Staphylococcus aureus</i> & <i>Pseudomonas aeruginosa</i>	Leucocidin (leukocidin, cytotoxin)
<i>Streptococcus pyogenes</i>	Streptolysin S (SLS); Erythrogenic toxins (scarlet fever toxins, pyrogenic exotoxins)
<i>Yersinia enterocolitica</i>	Heat-stable enterotoxins (ST)

**§ 725.422 Physical containment and control technologies.**

The manufacturer must meet all of the following criteria for physical containment and control technologies for