

FMEA Failure Modes and Effects Analysis

Project No.: 0305

Date: 12.02.2006

Rev. by: NSI

System: Federzug (complete)

Probability interval: 10 years / once per day

cycles: 3500

ID No.	ID of item or function	a. Failure mode b. Failure cause	Failure effects a. local b. next higher level c. general function / mission	Risk index	Remarks a. failure detection methods b. corrective action/features c. other
1	housing	a. deformation b. accident during bed transportation	a. sharp burrs b. reel cannot rotate anymore c. total system failure	IV10, 14 V14, 19	a. optical b. none
2	outlet bushing	a. wear b. cord friction	a. none b. cord wear	IV19	a. optical b. none
		a. loss b. loss of lock washer	a. none b. strong wear of cord	V17	a. optical b. none
		a. loss b. break	a. none b. strong wear of cord	V17	a. optical b. none
3	sheet spring	a. deformation b. wear	a. none b. none	V17	a. optical b. none
		a. break b. overload	a. none b. no click sound anymore	V19, 20	a. acoustic b. none c. overload because of vibrations
4	bolt	a. loosening of adjusting screw b. ageing of glue	a. none b. loss of spring tension c. total system failure	V17, 20	a. optical b. none
5	tubular rivet	a. loosening of grip b. ageing	a. none b. break of sheet spring because of canting	V20	a. acoustic b. none

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6	lock washer	-	-	-	-
7	adjusting screw	a. head break b. ageing/impact	a. none b. cord reel looses bearing c. total system failure	V17, 20	a. optical b. none
		a. head wear b. wrong tool	a. sharp burrs b. adjustment of spring tension difficult or impossible c. adjustment difficult or impossible if needed	IV10, 14 V14, 19 V14, 19	a. optical b. none
		a. reduced friction b. intrusion of lubricant between head and housing	a. none b. position of bolt insecure c. possible system failure	V14, 19	a. optical b. none
8	disc spring	a. loss of tension b. ageing	a. none b. position of bolt insecure c. possible system failure	V19, 20	a. measuring b. none
16	(cable)	-	-	-	-

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10	cord reel	a. flange break b. cord drag	a. none b. cord loose c. total system failure	V17, 20	a. optical b. none
		a. wear b. bolt friction	a. none b. more clearance	V20	a. measuring b. none
11	reel hub	a. wear b. bolt friction	a. none b. more clearance	V20	a. measuring b. none
12	coil spring	a. break b. lack of lubricant	a. none b. reel loose c. total system failure	V14, 17	a. optical b. none
		a. loss of tension b. ageing/use	a. none b. reel loose c. less cord tension	V19, 20	a. measuring b. none
13	cylinder bolt	-	-	-	-
14	cord	a. break b. wear/drag	a. none b. reel loose c. total system failure	V14, 19	a. optical b. none
15	cable connector	a. break b. wear/drag	a. none b. cable loose	V20	a. optical b. none

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Risk index table:

Probability of Occurrence	Severity I Catastrophic (Death, serious injury)	Severity II Significant (Reversible serious injury)	Severity III Marginal (Inconvenience)	Severity IV Negligible (Annoyance)
I Frequent	1	3	7	13
II Probable	2	5	9	16
III Occasional	4	6	11	18
IV Remote	8	10	14	19
V Improbable	12	15	17	20

frequent = daily
 probable = once a month

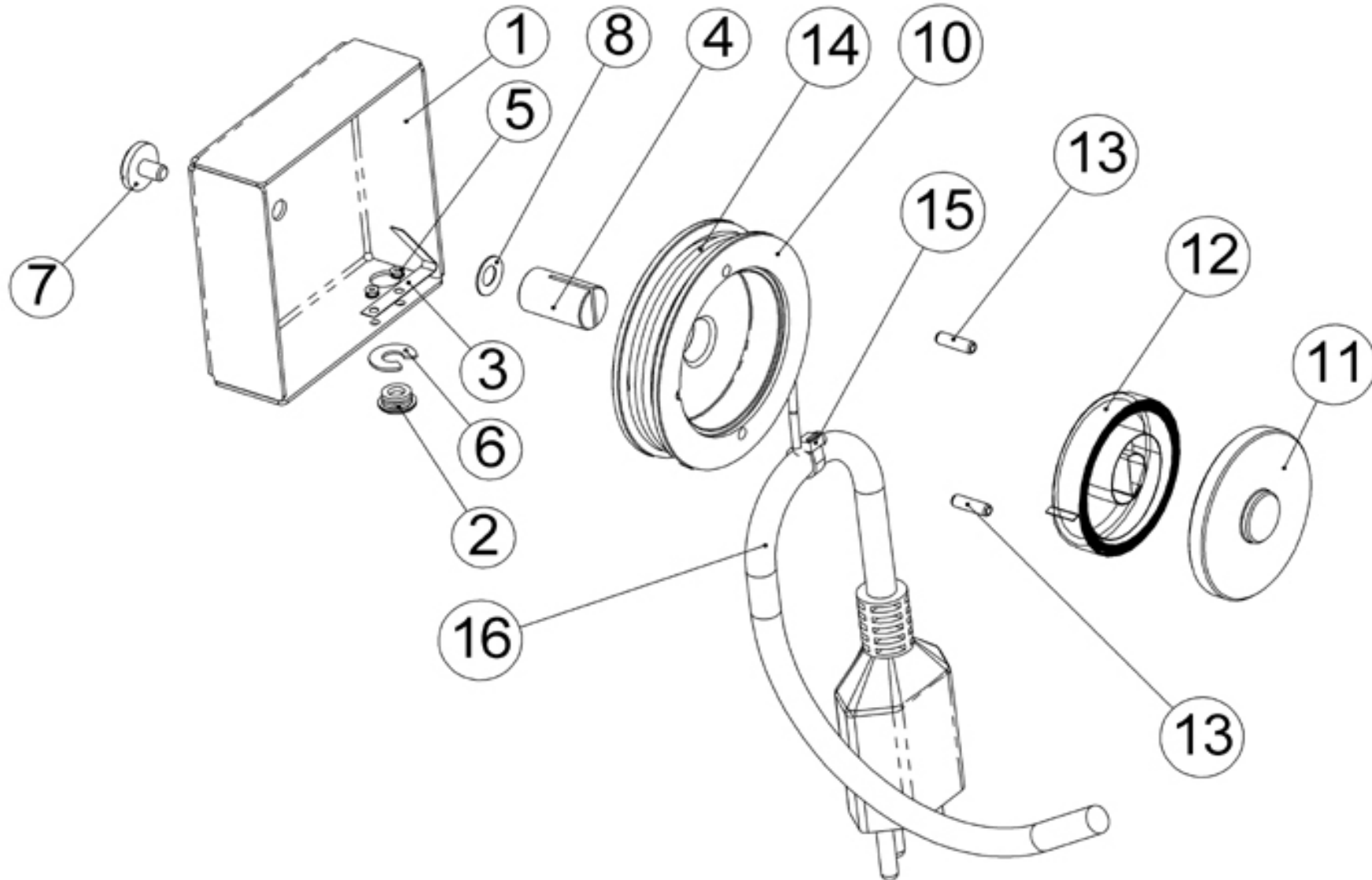
occasional = twice per year
 remote = once in 3 years

improbable = once in 15 years

what to do in a given range:

1 to 5	unacceptable
6 to 9	undesirable
10 to 16	acceptable upon completion of quality reassurance review
17 to 20	acceptable without review

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CLASSICAL FMEA QUESTIONS (for each system element):

- 1)** How (i.e., in what ways) can this element fail? (=failure mode of single points)
- 2)** What will happen to the system and its environment if this element does fail in each of the ways available to it? (=failure effect)
- 3)** What could possibly go wrong? or: What has gone wrong frequently in the past?

Fault Inability to function in a desired manner, or operation in an undesired manner, regardless of cause.

Failure A fault owing to breakage, wear out, compromised structural integrity, etc.

Failure mode The manner in which a fault occurs, i.e., the way in which the element faults.

- All failures are faults but not all faults are or result in failures. Faults can be caused by actions that are not strictly failures -

FMEA does not limit itself strictly to failures but also includes faults.

Principal Limitations and Abuses of FMEA:

- Regularly done the FMEA will find and summarize system vulnerability to SPFs (Single-Point-Failures) only. The combined effects of coexisting failures are not considered.
- Failure probabilities can be hard to obtain! Obtaining, interpreting, and applying those data to unique or high-stress systems introduces uncertainty which itself may be hard to evaluate.
- Sometimes FMEA is done only to satisfy the altruistic urge or need to "DO SAFETY".
- A strong focus on the SPFs can lead to 1) paranoia and misplaced fear and 2) loss of focus on other possibly more dangerous system threats.

Always small steps - Keep it simple!