

New Assessment Tool for AT-Fieldtest and Monitoring

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Abstract

This presentation reports about the new software tool “C- factor”. The development is driven by the need of an evaluation factor named C for testing LPG pressure vessel according to EN 12817 and EN 12819. This evaluation factor is used as a real-time control and stop criteria and is used off-line for the assessment of a vessel. MISTRAS develops a new software tool called “C- factor”. It is a free- programmable formula editor to define a “C factor”. The user is able to use all kind of AE features and informations from located sources and combine them with mathematical operators. The requirements of an evaluation factor C according to the EN rules are more than fulfilled. The software tool is able to use complex AE informations from located events in a single cluster, like Intensity Index, Activity Index and Source Amplitude. Moreover, the cluster can be fixed in size and in name. The user is able to reduce -real- time- all relevant AE information to one single value, called C- factor. The C- factor can be adapted to all kind of AE applications in the field (like rotor blade monitoring). Examples are given during the lecture.



New Assessment Tool for AT-Fieldtest and Monitoring

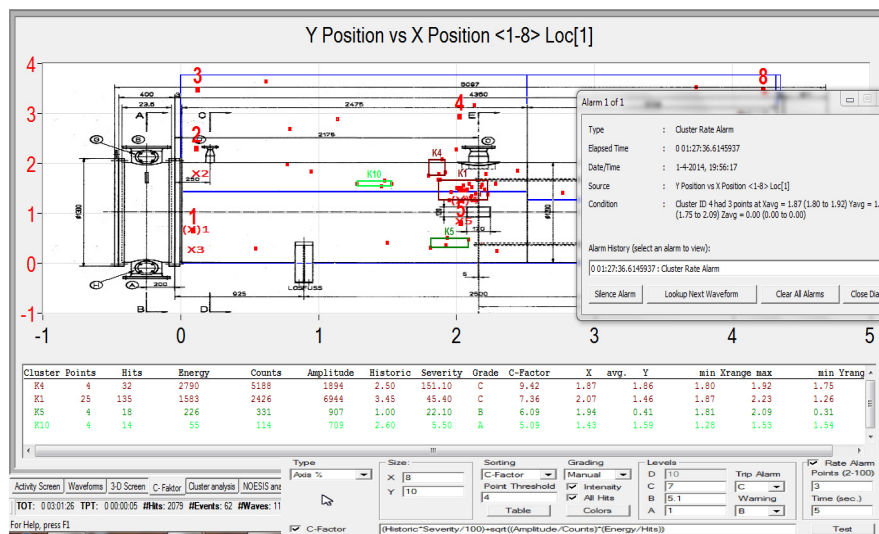
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Title

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Pressure vessel test

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C- factor is a free- programmable formula with test function:

- use 5 levels for Grading (Non relevant, A-D) with definition of warning and trip alarm
- works on every point plot with **clustering** enabled
- is calculated for each cluster
- including Intensity features (Severity and Historic Index, MonPAC Technology)
- uses the following cluster data: Points, Hits, Energy, Counts, Source Amplitude, Historic and Severity index

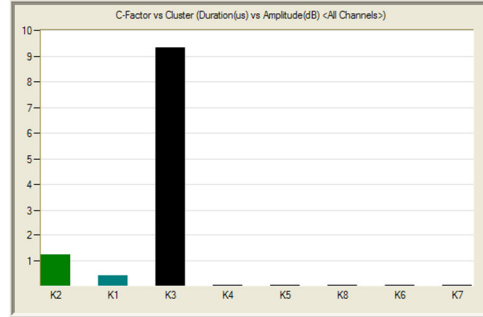
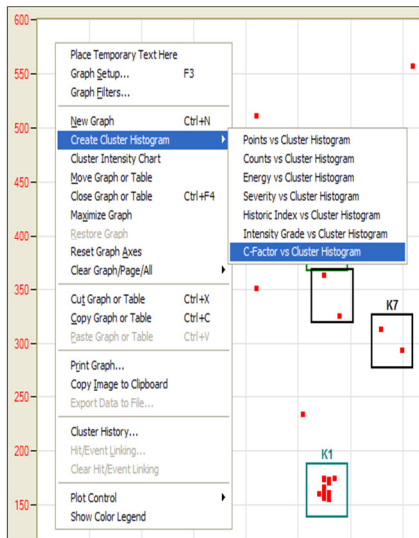
For located events: Intensity calculations and cluster data calculations can be done with the 1st hit only or with all Hits of the event



Name	Argc.	Explanation
sin	1	sine function
cos	1	cosine function
tan	1	tangent function
asin	1	arc sine function
acos	1	arc cosine function
atan	1	arc tangent function
sinh	1	hyperbolic sine function
cosh	1	hyperbolic cosine
tanh	1	hyperbolic tangent function
asinh	1	hyperbolic arc sine function
acosh	1	hyperbolic arc cosine function
atanh	1	hyperbolic arc tangent function
log2	1	logarithm to the base 2
log10	1	logarithm to the base 10
log	1	logarithm to the base 10
ln	1	logarithm to base e (2.71828...)
exp	1	E raised to the power of x
sqrt	1	square root of a value
sign	1	sign function -1 if x<0; 1 if x>0
rint	1	round to nearest integer
abs	1	absolute value
min	var.	min of all arguments
max	var.	max of all arguments
sum	var.	sum of all arguments
avg	var.	mean value of all arguments

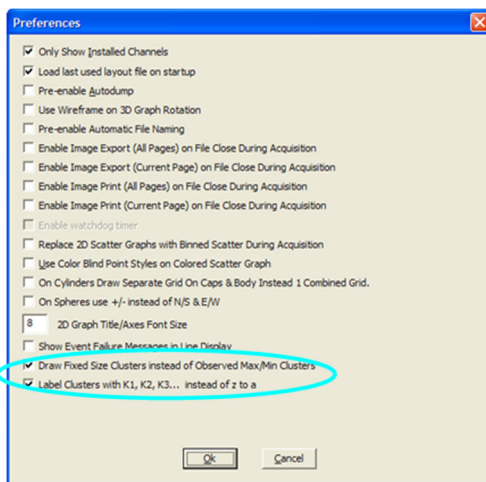
Operator	Meaning	Priority
=	assignment	-1
&&	logical and	1
	logical or	2
<=	Less or equal	4
>=	greater or equal	4
!=	not equal	4
==	equal	4
>	greater than	4
<	less than	4
+	addition	5
-	subtraction	5
*	multiplication	6
/	division	6
^	Raise x to the power of y	7

Operator	Meaning	Remarks
? :	if then else operator	C++ style syntax



C- factor is shown in the cluster list and as Histogram (see pics).

C- factor is displayed for a cluster and with the actual value.



Cluster size varies with occurrence of AE data

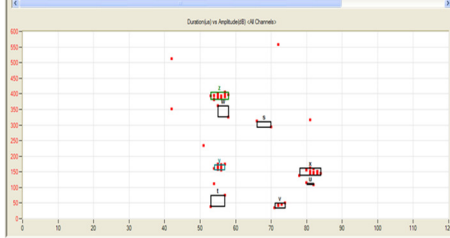
NEW: cluster size can be fixed

Cluster are labelled from z to a by sorting through Energy, C- Factor,

NEW: Cluster are labelled with K1, K2, .. sorted by appearance in time

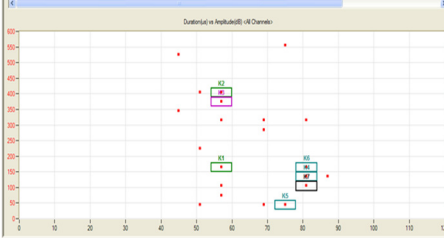


Cluster ID	Points	Size	Energy	Counts	Amplitude	Statistic	Severity	Grade	C-Factor	X	avg	Y
A	2	20	25	1019	1102	1.00	11.70	D	1.00	51.43	302.34	
V	1	20	28	60	413	1.00	3.76	A	0.01	51.00	181.33	
W	3	13	13	1206	294	1.00	52.77	B	9.30	81.42	150.23	
X	4	2	2	14	35	1.00	0.00	H	0.02	54.50	340.50	
Y	5	5	5	66	33	1.00	0.00	F	0.02	75.40	42.40	
U	8	2	2	109	33	1.00	0.00	F	0.02	81.00	111.00	
T	6	2	2	3	3	1.00	0.00	F	0.02	85.00	164.50	
H	7	2	2	13	3	1.00	0.00	F	0.02	68.00	302.50	



Cluster size varies with occurrence of AE data

Cluster Points	Size	Energy	Counts	Amplitude	Statistic	Severity	Grade	C-Factor	X	avg	Y	
A2	20	20	227	1119	1115	1.00	11.35	D	1.13	51.00	405.00	F
A1	20	18	48	413	999	1.00	3.76	D	0.00	51.00	181.00	B
A3	1	0	66	103	619	1.00	0.00	B	0.00	51.00	375.00	B
A6	1	1	469	144	371	1.00	0.00	A	0.00	51.00	185.00	F
A4	1	1	674	100	606	1.00	0.00	A	0.00	51.00	139.00	F
A5	1	1	35	25	291	1.00	0.00	A	0.00	75.00	48.00	F
A7	2	2	139	33	142	1.00	0.00	F	0.00	81.00	164.00	F



NEW: cluster size is fixed



AE testing of LPG vessels $\leq 13 \text{ m}^3$ (EN 12817) and $\geq 13 \text{ m}^3$ (EN 12819) requires a C-value for on- and off- line assessment. It should include:

1. Number of AE events/ bursts in a delta-t cluster
2. Amplitude and/ or Energy of the AE events/ bursts in a delta-t cluster
3. AE activity in a delta-t cluster during the complete test duration and/ or intervals of test duration
4. AE activity in a delta-t cluster during pressure holds

The C- factor option covers all requirements by EN 12817 and EN 12819.

Furthermore it is useful for all AE field test and monitoring purposes.

Examples will be given during lecture.