

## Service Bulletin-33

# Analysis of Failed Vacuum Capacitors

### 1 General

Our ability to conduct an in depth technical investigation in a systematic way within a relatively short period of time is of crucial importance to the relationship with our customers. When a customer returns a failed capacitor for investigation, important information is fed back to us from the field. Based on this, we want to give the customer an objective and unbiased analysis.

The analysis is valuable for both the customer and COMET. This is especially true in case of repeated problems in a specific system or during the development of new systems.

We invest skills, expertise, experience, time and money into the investigation work. This investment is for the mutual advantage of our clients and us: For the customer and his quality assurance system, our investigation may give valuable clues about design weaknesses. Of course the same holds true for COMET. There have been many instances where we were able to improve the quality and/or performance of our products based on failure analysis work.

### 2 Procedure

Our analysis can only be as good as the input we get. It is of utmost importance that we receive the Service Report Form (see also Service Bulletin [SB-10](#)) duly filled in and that the capacitor is packaged well before shipping (for more detailed information see instructions on second page of Service Report Form).

Once the failed unit has arrived in our plant, our specialists will proceed step by step with their examinations, using a check list as guideline.

A lot of special equipment is used during the technical investigation, including HV tester, automatic capacitance and torque measuring machine and leak detector. In addition we always have a look at the factory documents of the original production which we keep for at least 10 years.

Based on the results of the technical investigation, the final Failure Analysis Report will be generated as a summary of the findings (see enclosure).

### 3 Costs of Technical Investigation

As mentioned above, an investigation includes a lot of activities and essential equipment. Therefore, COMET reserves the right to charge the incurring costs to the customer in case of abuse. For further details and the current pricing please refer to the section *Terms and Conditions* on page 2 of the [Service Report Form](#).

**Enclosure: Failure Analysis Report (example)**

Vacuum Capacitors  
**Failure Analysis Report**

RMA #: 3000nnnn	Type: CVZV-4000BC/5-BCF	Serial #: nnnnnn	Customer: Customer / Buyer
Date of Shipment ex factory: 24. Jan 2013	Date of Commissioning: ---	Date of Failure: ---	End customer, reference number
Operating Hours: unknown	Date of Analysis: 3. Jun 2016	Date of FAR: 14. Jun 2016	

**Customer Comment**  
"C1 fails at high power; sib 95/95R = 97-304j is 95/95R = 0.189 -247j.  
No warranty."

**COMET Findings**  
Condition of packaging: ok (original)

<b>Outside of capacitor</b>	
Silver plating: oxidised	Capacitance at receipt: 4013.8 pF
Ceramic: ok	C-max: 4013.8 pF
Collars: ok	C-min: 18.3 pF
Mounting plates: ok	Electrical properties: gas
Guiding system: ok	Leak test: no leak found
Drive mechanism: ok	

<b>Inside of capacitor</b>	
Generally: oxidised	Bellows leak test: leak bellows - brazing joint
Ceramic: contamination with vaporized metal due to plasma	Bellows inside (visually): ok
Variable electrode: ok	Guiding tube: ok
Fixed electrode: ok	Shaft: ok
Bellows outside: ok	

**Analysis**  
The primary reason for the failure of the capacitor was a fatigue crack at the brazing joint from collar to bellows. This caused loss of vacuum and consequently led to the failure observed. No evidence has been provided about operational conditions and operating hours.

**Corrective Action, Recommendation**  
The capacitor cannot be repaired. No replacement on warranty, analysis will be charged.

**Signature**

Attachment: CMR of 21. Jan 2013 (final inspection)  
CMR of 3. Jun 2016 (incoming inspection)  
3 pictures

**COMET**  
COMET AG Herrengasse 10, CH-3175 Flamatt  
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**COMET AG CAPACITANCE MEASUREMENT REPORT**

Herrngasse 10, CH-3175 Flamatt, Switzerland  
Item no. 10003052-001  
Nomname CVZV-4000BCIS-BCF  
Serial no. nnnnnn  
Test Date 21.01.2013 08:04:08  
Type Screw  
Dimension 14F-20.2g  
Test Equipment KAMAVAR003

C-Curve C 0033

C-Curve	C <sub>low</sub>	C <sub>low</sub>	C <sub>high</sub>	C <sub>measured</sub>	T <sub>low</sub>	T <sub>low</sub>	T <sub>high</sub>	T <sub>measured</sub>	Status
C-min mechanical	24.88	28.00	28.13	28.19	-0.72	-0.65	-0.58	-0.65	Passed
C-ref	109.90	109.00	109.10	109.00		0.00			Passed
	703.14	781.27	850.40	789.30		2.00			Passed
	1329.17	1454.93	1500.09	1429.30		4.00			Passed
	1914.84	2127.00	2340.36	2093.00		6.00			Passed
	2521.62	2781.80	3081.96	2789.30		8.00			Passed
	3130.20	3478.00	3826.80	3427.00		10.00			Passed
C-max nominal	3380.00	4000.00	4020.00	4005.00	10.40	11.55	12.72	11.73	Passed
C-max mechanical				4005.00				11.74	

Linearity deviation: 0.46 %  
Slope: 332.19 pF/T

**Torque Measurement**  
specified 0.40 [Nm]  
measured peak 0.19 [Nm]  
-0.65 [Turns]  
Status Passed

T <sub>low</sub>	T <sub>low</sub>	T <sub>high</sub>	T <sub>measured</sub>	Status
Cref-Cmin			-0.65	Passed
Cref-Cminmech			-1.24	Passed
Cref-Cmax			11.73	Passed
Cref-Cmaxmech			11.74	Passed
Cmin-Cminmech			-0.59	Passed
Cmax-Cmaxmech			0.91	Passed
Cmin-Cmax			12.38	Passed
Cminmech-Cmaxmech			12.98	Passed

Print Date: 02.02.2016 14:36  
Name: kama  
Signature: *[Handwritten Signature]*

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**COMET 2.**

**COMET AG CAPACITANCE MEASUREMENT REPORT**

Herrngasse 10  
CH-3175 Flamatt  
Switzerland

Item no. 10003052-001  
Itemname CVZV-4000BCIS-6CF  
Serial no. 800000

C-Curve C-0039

Test Date 03.02.2016 11:48:48  
Type Screw  
Dimension 1/4"-20-2p  
Test Equipment KAMAWARDC08

C-Curve	Cur	Case	Clap	Case mech	T <sub>min</sub>	T <sub>max</sub>	T <sub>high</sub>	T <sub>mech</sub>	Status
C-min mechanical				10.36				-1.24	
C-min nominal	24.85	25.00	25.13	25.06	-0.72	-0.85	-0.58	-0.72	Passed
C-ref	103.00	109.00	109.10	109.01				0.00	Passed
	703.14	781.27	859.40	767.16				2.00	Passed
	1309.17	1454.03	1600.00	1432.48				4.00	Passed
	1914.84	2127.60	2340.36	2089.28				6.00	Passed
	2521.02	2791.80	3061.58	2786.24				8.00	Passed
	3130.20	3478.00	3825.80	3435.55				10.00	Passed
C-max nominal	3980.00	4000.00	4020.00	4002.54	10.40	11.55	12.72	11.70	Passed
C-max mechanical				4013.89				11.73	

Linearly deviation: 0.50 %  
Slope: 332.80 pF/T

Torque Measurement specified 0.40 [Nm] Status Passed  
measured peak 0.11 [Nm] -0.65 [Turns]

Turns

Turns	T <sub>min</sub>	T <sub>max</sub>	T <sub>high</sub>	T <sub>mech</sub>	Status
C-ref-Cmin				-0.72	Passed
C-ref-Cminmech	-1.70	-1.30	-0.90	-1.24	Passed
C-ref-Cmax				11.70	Passed
C-ref-Cmaxmech				11.73	Passed
Cmin-Cminmech				-0.85	Passed
Cmax-Cmaxmech				6.03	Passed
Cmin-Cmax				12.42	Passed
Cminmech-Cmaxmech				12.97	Passed

Print Date: 03.02.2016 11:48  
Signature: gero

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Picture 1: fixed electrode, intact with ceramic contaminated with vaporized metal due to plasma



Picture 2: variable electrode, intact



Picture 3: variable electrode, with bellows and guiding system (position of leak)

