

# Bushings Subcommittee Task force / Working Group Report

Document #: PC57.19.02

Document Title: Standard for Design and Performance Requirements for Bushings Applied to Liquid Immersed Distribution Transformers

Chair: Steve Shull Vice-Chair Ed Smith

Secretary Fred Friend

Current Draft Being Worked On: \_\_\_\_\_ Dated: \_\_\_\_\_

Meeting Date: March 27, 2018 Time: 11:00 am – 12:15 pm

Attendance:	Members	<u>28</u>
	Guests	<u>22</u>
	Total*	<u>50</u>

\* For details of attendance, please refer to AMS system of the Transformers Committee

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### **Meeting Minutes / Significant Issues / Comments:**

The meeting was called to order by the Chair at 11:00 am, the roster was circulated, followed with an introduction of members and guests. The Chair made a call for any Essential Patent Claims, and none were brought forward. A check for quorum was made and achieved. A motion was made by Dan Sauer and seconded by Dave Geibel for approval of the agenda. Phil Hopkinson asked if dead-front high voltage bushings should be added, the Chair stated at this time the working group is focused on the secondary bushings, but it will be a future consideration. The motion was unanimously approved. A motion was made by Dave Geibel and seconded by Dan Sauer for approval of the Fall 2017 meeting minutes. The motion was unanimously approved

The various Task Forces presented the results of their reviews:

#### **Table 2 – Cantilever Design Test Requirements Dan Sauer (Chair), Josh Verdell, Mike Thibault, and Marek Kornowski.**

Dan Sauer presented the Task Force an update.

The TF proposed having the bushing rigidly mounted to the transformer tank wall with the gasket and bushing clamp specified for the specific bushing and the transformer tank wall material thickness representative of the thinnest that the bushing is to be installed onto.

Table 4 – Cantilever Requirements. The discussion focused on the data shown in the table and how to illustrate the impact of the cantilever test on the transformer tank wall. Discussion continued on the differences between testing the bushing on a rigid plate verses testing on a plate simulating the transformer wall. There was also discussion on provided guidance to ensure bushing interchangeability.

Ali Ghafourian made a motion for the TF to continue their work by developing two tests: one on a flat rigid plate and one when attached to the transformer, Al Wilks seconded. The voting resulted in 16 in favor, 7 opposed, and 1 abstained. Dan to report the task force revised recommendation during next meeting.

#### **Figure 1 – Standard Stud Current Values Dave Geibel (Chair), Carlos Gaytan, Ali Ghafourian, Dan Saur, and Weijun Li.**

Dave Geibel presented an update on the Task Force research regarding standard stud/bolt sizes, associated nominal current ratings, and the resulting temperature rise of the stud/bolt.

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The nominal current ratings for each stud size were presented. The oil rise and ambient temperature ratings are already established. C57.19.00 and C57.19.01 standards do not sufficiently address bushings 1,000V and below.

Investigation continues on the temperature of the stud in contact with oil. The temperature of the stud will damage the oil if it goes over 125°C. The temperature of the bolt in contact with “plastic” components and gasket material should not adversely affect the integrity. The temperature of the air side termination does not seem to have a significant impact; the temperature of the insulation on air side cable must not damage the cable insulation due to heat from the stud/connector. A temperature limit of 115°C was proposed to protect the gaskets, bushing body, and cable insulation while allowing some margin for overload.

### **Figure 1 – Standard Stud Sizes and Figure 3 – Termination Configurations Al Traut (Chair), Ed Smith, Josh Verdell, and Marek Kornowski.**

Al Traut presented the Task Force research of information regarding standard stud sizes.

The TF proposed splitting Figure 1 into Fig 1a for internal threaded stud and Fig 1b for internal spade connection. TF would like the working group to consider removing ¼” and 1-1/8” stud sizes as a standard since they are not presently used in distribution products.

The TF proposed breaking Figure 3 into three figures:

Fig 3a – Eyebolt Terminals, use Fig 5a and Table 9 from C57.12.20

Fig 3b – Spade Terminals, consolidated from C57.12.20, C57.12.24, C57.12.34, C57.12.38

Fig 3c – In-line Spade Terminals, from C57.12.38

The external stud length on bushings with 1-1/4” studs still needs to be resolved.

### **Figure 2 – Standard Mounting Holes Martin Rave (Chair), Josh Verdell, Darren Brown, and Israel Barrientos Josh Verdell.**

Rhett Chrysler provided an update on the research regarding mounting hole information details.

There were no conflicts found with the overhead three phase dimensions.

A review of the manufacturers dimensions were analyzed with recommendations provided in Figures 2A and 2B. Figure 4 was added to show the 3 hole pattern and Figure 5 for the 4 hole pattern.

The chair requested the task force to follow up with the minimum stud lengths and tolerances for the proposed dimensions.

### **New business (brought forth by the Chair):**

A review of the current BIL ranges for power transformer bushings (current C57.19.00) and distribution transformer bushings were illustrated to identify commonality and gaps between the two with various options presented.

A short discussion on the next steps was held with Phil Hopkinson asking about the need for a higher BIL for 35 kV. The Chair stated we use IEEE 386 as the reference. Provide any recommendations to deviate from this standard to the officers for consideration.

All of the presentations are posted on the website.

The next meeting will be October 16, 2018 in Jacksonville, FL. The meeting was adjourned at 12:15 pm.

Submitted by: Fred Friend  
Date: 03/27/2018