



March 17, 2023

U.S. Nuclear Regulatory Commission  
ATTN: Document Control Desk  
Washington, D.C. 20555-0001

Subject: 10 CFR Part 21 Report – Inconsistent crimping of motor leads to ring terminal connectors and Failure to Comply. Trillium Valves USA Part 21 Evaluation I211003

Trillium Valves USA is providing this written notification in accordance with the requirements of 10 CFR 21.21(d)(3)(ii). This notification pertains to the inconsistent crimping of motor lead ring tongue terminal connectors attached to quick disconnect connectors for SMB actuators and failure to comply.

The failure to comply concerns failure to provide initial notification within 2 days and written notification within 30 days.

Sincerely,

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Attachments:

1. Evaluation of ring tongue terminal connectors (8 pages)
2. List of affected orders (3 pages)
3. Reportable condition per 21.21(d)(4) (2 pages)



*Limitorque*

LIMDOC-2022-004

July 1, 2022

**Subject: Inspection of terminal samples returned from Trillium Valve**

Photo # 1 provided by Trillium Valve shows five ring tongue terminal connectors removed from the actuator identified as serial #L983445. Two of these terminals were returned to Limitorque from Trillium Valve. The returned samples, designated as RS1 and RS2 are shown in photos # 2 & 3. The terminals were forwarded to the engineering special test lab for evaluation. For comparison purposes, Flowserve QA also provided the lab with three samples of terminal connectors that were installed and crimped by the Lynchburg production wiring department. These are shown in photo #4.

Comments from Lab Inspection:

- Terminal RS1, identified as the terminal with the longest wire protruding, showed no continuity initially but when the end of the wire was manipulated continuity was intermittent. The wire appears to have been partially pulled out of the connector evident by the crimp impression in the wire insulation below the terminal and, also evident by the wire conductor not extending to the end of the barrel on the terminal side. Also, the wire did not appear to be firmly held when the wire was manipulated for the continuity test. The wire conductor was approximately 0.045" short of reaching the end of the terminal barrel.
- Terminal RS2, identified as the terminal with the short wire protruding, initially checked good continuity however manipulation of the wire caused continuity to drop on at least one occasion. The wire appears to be still firmly held by the crimp however there is very little wire protruding from the terminal to make this evaluation. The wire conductor was approximately flush with the end of the terminal barrel.
- The terminals provided by QA for comparison have an obviously different impression from the crimp tool than the samples returned from the customer. Also, the wire extends well beyond the end of the crimp barrel on these samples. Numbering on these terminals is different than those received from the Customer. (Regarding this comment, the terminals received from the customer are T & B part # RB863 which has a hole for a #8 screw typically used on the control and power Marathon terminal strip. The samples provided by QA are a T & B part # RB873 which has hole for a #10 screw typically used on the geared limit switch and torque switch terminals. Otherwise, the terminals are identical.)


Discussion:

The crimping tool used by Limitorque (reference photo # 6) has jaws that crimps the connector in two places simultaneously. The primary crimp compresses the serrated barrel (reference Figure 1 and Photo #7) onto the wire conductor. The secondary crimp compresses the funnel entry barrel onto the outer wire insulation.

The three comparison samples shown in photo #5 are uniform in appearance. In contrast, the terminal connectors shown in photos #1, 2, 3, & 4 show inconsistencies in the location of the crimp and the extent of deformation of the barrel and insulator.

Conclusion:

Limitorque's inspection has determined that the root cause of the intermittent continuity at the wire conductor to terminal connection is likely attributable to a workmanship error resulting in inconsistent crimping of the lead wire to the terminal. On sample RS2, the conductor was not fully inserted into the terminal barrel prior to crimping. On samples RS1 & RS2, the crimping tool was not positioned properly on the terminal barrel prior to the crimp. The other terminals shown in photos 1 & 2 exhibit similar inconsistencies.

Prepared By: 

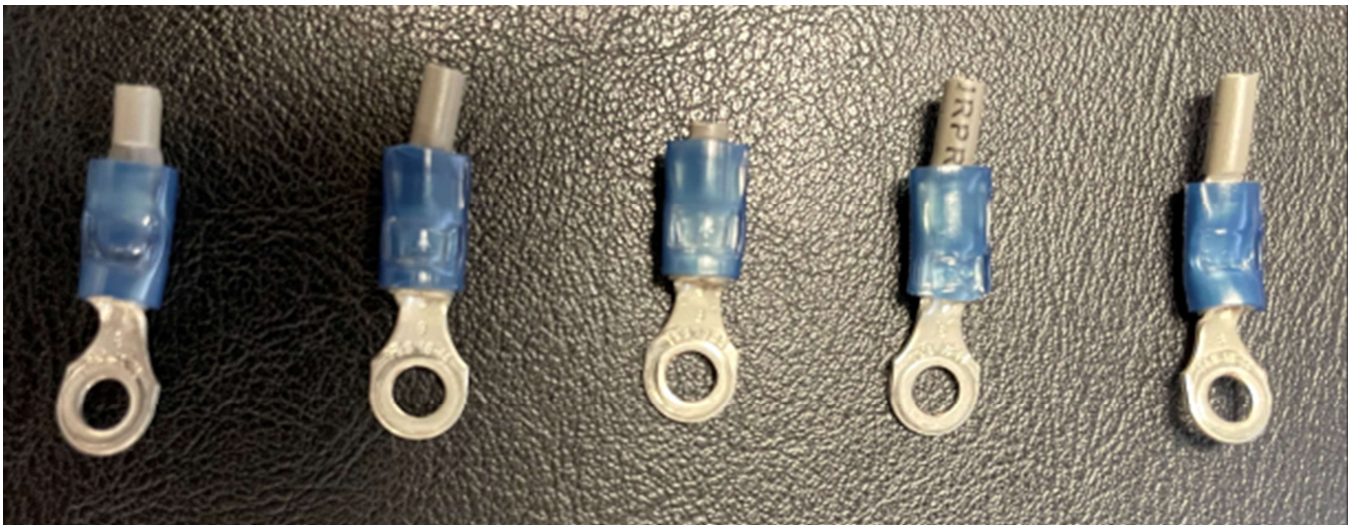
Kyle Ramsey, Principal Engineer, Flowserve Limitorque

Reviewed By: 

Nathan Sochor, Special Test Lab Supervisor, Flowserve, Lynchburg VA



**Photo # 1: Five Terminals Removed from Actuator**



**Photo # 2: Five Terminals Removed from Actuator**



**Photo # 3: Samples Returned for Evaluation**

RS1: Secondary crimp partially on the wire insulation rather than the terminal insulator

RS2: Primary crimp not positioned correctly over the barrel of the terminal housing the conductor

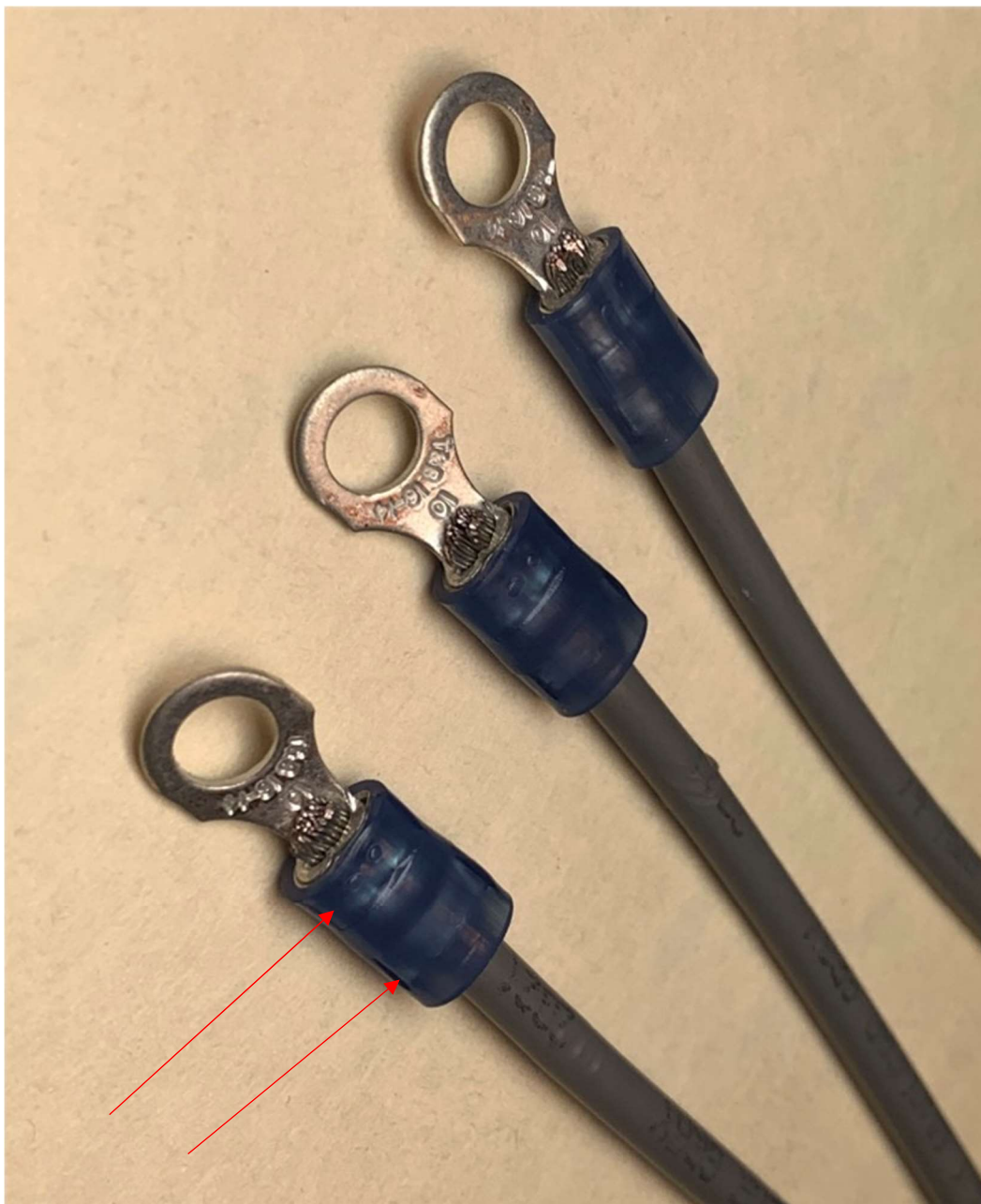




**Photo # 4: Samples Returned for Evaluation**

RS2

RS1



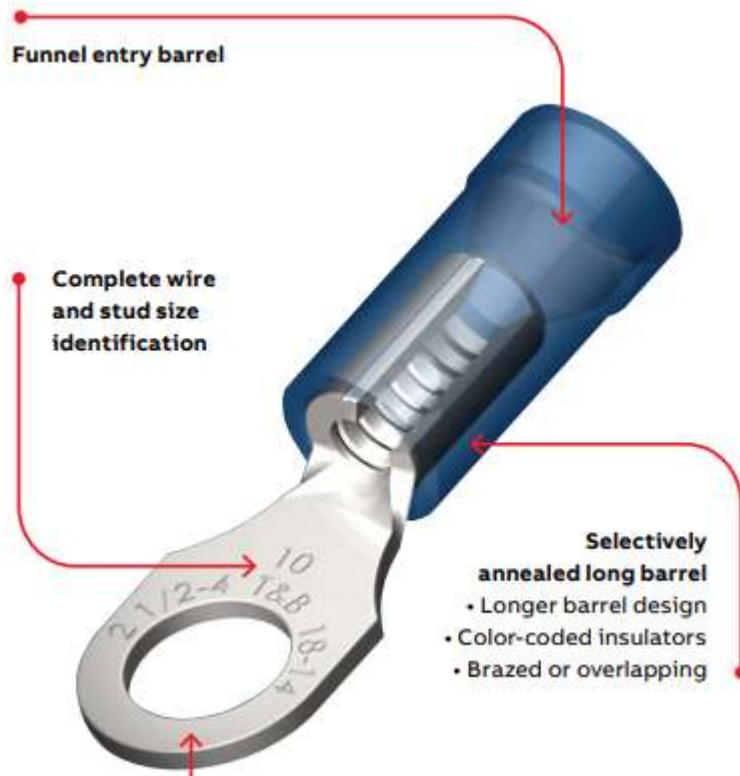
**Photo # 5: Samples Provided for Comparison**

Photo # 5 comment: There are two visible compression marks from the crimping tool. One crimp mark is directly over the barrel housing the conductor while the second crimp mark is over the barrel that clamps on the insulation of the wire.



**Photo # 6: Crimping Tool**





**Figure 1: Details of Terminal**



**Photo # 7: Uncrimped Terminal with Blue Insulator Removed**

**ATTACHMENT 2**

List of affected orders  
SCAR No IR-2022-7477

WEC PO 4500292480		Sanmen - 1			
WEC Item	Data Sheet	Qty per unit	Valve Serial Number	Location	Limitorque Serial Number
68	APP-PV11-ZOD-120	1	1-54536-J	Aux	L868152
69	APP-PV11-ZOD-121	1	1-54536-K	Aux	L868156
70	APP-PV11-ZOD-122	1	1-54536-L	Aux	L868159
70	APP-PV11-ZOD-122	1	2-54536-L	Aux	L868158
101	APP-PV11-ZOD-123	1	1-54536-W	Cont	L871810
102	APP-PV11-ZOD-124	1	1-54536-Z	Cont	L871811
77	APP-PV11-ZOD-145	1	1-54536-S	Aux	L879937
77	APP-PV11-ZOD-145	1	2-54536-S	Aux	L879938
124	APP-PV11-ZOD-245	1	3-54536-S	Aux	L879936
124	APP-PV11-ZOD-245	1	4-54536-S	Aux	L879935
76	APP-PV11-ZOD-140	1	1-54536-R	Aux	L879944
76	APP-PV11-ZOD-140	1	2-54536-R	Aux	L879943
105	APP-PV11-ZOD-119	1	1-54536-V	Aux	L890503
105	APP-PV11-ZOD-119	1	2-54536-V	Aux	L890504
118	APP-PV11-ZOD-141	1	1-00088-20	Aux	L918547
118	APP-PV11-ZOD-141	1	2-00088-20	Aux	L918546

WEC PO 4500292480		Haiyang - 1			
WEC Item	Data Sheet	Qty per unit	Valve Serial Number	Location	Limitorque Serial Number
87	APP-PV11-ZOD-120	1	1-54537-J	Aux	L868153
88	APP-PV11-ZOD-121	1	1-54537-K	Aux	L868154
89	APP-PV11-ZOD-122	1	1-54537-L	Aux	L868161
89	APP-PV11-ZOD-122	1	2-54537-L	Aux	L868162
103	APP-PV11-ZOD-123	1	1-54537-W	Cont	L871809
104	APP-PV11-ZOD-124	1	1-54537-Z	Cont	L871812
96	APP-PV11-ZOD-145	1	1-54537-S	Aux	L879940
96	APP-PV11-ZOD-145	1	2-54537-S	Aux	L879942
126	APP-PV11-ZOD-245	1	3-54537-S	Aux	L879939
126	APP-PV11-ZOD-245	1	4-54537-S	Aux	L879941
95	APP-PV11-ZOD-140	1	1-54537-R	Aux	L879946
95	APP-PV11-ZOD-140	1	2-54537-R	Aux	L879945
106	APP-PV11-ZOD-119	1	1-54537-V	Aux	L911178
106	APP-PV11-ZOD-119	1	2-54537-V	Aux	L911179
119	APP-PV11-ZOD-141	1	1-00088-21	Aux	L918548
119	APP-PV11-ZOD-141	1	2-00088-21	Aux	L918549

WEC PO 4500309727		Vogle - 3			
WEC Item	Data Sheet	Qty per unit	Valve Serial Number	Location	Limitorque Serial Number
21	APP-PV11-ZOD-140	1	1-55022-R	Aux	L911115
21	APP-PV11-ZOD-140	1	2-55022-R	Aux	L911116
11	APP-PV11-ZOD-120	1	1-55022-J	Aux	L911614
12	APP-PV11-ZOD-121	1	1-55022-K	Aux	L911615
13	APP-PV11-ZOD-122	1	1-55022-L	Aux	L911617
13	APP-PV11-ZOD-122	1	2-55022-L	Aux	L911618
51	APP-PV11-ZOD-245	1	2-55022-Z	Aux	L911621
51	APP-PV11-ZOD-245	1	1-55022-Z	Aux	L911624
44	APP-PV11-ZOD-119	1	1-55022-X	Aux	L911629
44	APP-PV11-ZOD-119	1	2-55022-X	Aux	L911630

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22	APP-PV11-ZOD-145	1	1-55022-S	Aux	L912774
22	APP-PV11-ZOD-145	1	2-55022-S	Aux	L912776
46	APP-PV11-ZOD-123	1	1-55022-V	Cont	L912777
48	APP-PV11-ZOD-124	1	1-55022-W	Cont	L912782
58	APP-PV11-ZOD-141	1	1-00188-320	Aux	L983444
58	APP-PV11-ZOD-141	1	2-00188-320	Aux	L983445

WEC PO 4500309727		Vogle - 4			
WEC Item	Data Sheet	Qty per unit	Valve Serial Number	Location	Limitorque Serial Number
62	APP-PV11-ZOD-141	1	2-00188-360	Aux	L1003458
62	APP-PV11-ZOD-141	1	1-00188-360	Aux	L1003459
42	APP-PV11-ZOD-140	1	3-55022R	Aux	L911111
42	APP-PV11-ZOD-140	1	4-55022R	Aux	L911112
43	APP-PV11-ZOD-145	1	3-55022S	Aux	L911622
53	APP-PV11-ZOD-245	1	4-55022Z	Aux	L911623
43	APP-PV11-ZOD-145	1	4-55022S	Aux	L911625
53	APP-PV11-ZOD-245	1	3-55022Z	Aux	L911627
33	APP-PV11-ZOD-121	1	2-55022K	Aux	L912764
32	APP-PV11-ZOD-120	1	2-55022J	Aux	L912766
34	APP-PV11-ZOD-122	1	3-55022L	Aux	L912768
47	APP-PV11-ZOD-123	1	2-55022V	Cont	L912778
49	APP-PV11-ZOD-124	1	2-55022W	Cont	L912781
45	APP-PV11-ZOD-119	1	3-55022X	Aux	L912787
45	APP-PV11-ZOD-119	1	4-55022X	Aux	L912788
34	APP-PV11-ZOD-122	1	4-55022L	Aux	L979720

WEC PO 4500309289		Summer - 2			
WEC Item	Data Sheet	Qty per unit	Valve Serial Number	Location	Limitorque Serial Number
21	APP-PV11-ZOD-140	1	1-55023R	Aux	L911113
21	APP-PV11-ZOD-140	1	2-55023R	Aux	L911114
11	APP-PV11-ZOD-120	1	1-55023J	Aux	L911613
12	APP-PV11-ZOD-121	1	1-55023K	Aux	L911616
13	APP-PV11-ZOD-122	1	2-55023L	Aux	L911619
22	APP-PV11-ZOD-145	1	2-55023S	Aux	L911626
44	APP-PV11-ZOD-119	1	1-55023X	Aux	L911631
44	APP-PV11-ZOD-119	1	2-55023X	Aux	L911632
13	APP-PV11-ZOD-122	1	1-55023L	Aux	L912767
51	APP-PV11-ZOD-245	1	2-55023Z	Aux	L912769
51	APP-PV11-ZOD-245	1	1-55023Z	Aux	L912770
22	APP-PV11-ZOD-145	1	1-55023S	Aux	L912772
46	APP-PV11-ZOD-123	1	1-55023V	Cont	L912780
48	APP-PV11-ZOD-124	1	1-55023W	Cont	L912784
58	APP-PV11-ZOD-141	1	1-00211-570	Aux	L983442
58	APP-PV11-ZOD-141	1	2-00211-570	Aux	L983443

WEC PO 4500309289		Summer - 3			
WEC Item	Data Sheet	Qty per unit	Valve Serial Number	Location	Limitorque Serial Number
62	APP-PV11-ZOD-141	1	1-00211-610	Aux	L1003460
62	APP-PV11-ZOD-141	1	2-00211-610	Aux	L1003461
42	APP-PV11-ZOD-140	1	3-55023R	Aux	L911117

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42	APP-PV11-ZOD-140	1	4-55023R	Aux	L911118
34	APP-PV11-ZOD-122	1	3-55023L	Aux	L911620
53	APP-PV11-ZOD-245	1	4-55023Z	Aux	L911628
32	APP-PV11-ZOD-120	1	2-55023J	Aux	L912763
33	APP-PV11-ZOD-121	1	2-55023K	Aux	L912765
43	APP-PV11-ZOD-145	1	4-55023S	Aux	L912771
53	APP-PV11-ZOD-245	1	3-55023Z	Aux	L912773
43	APP-PV11-ZOD-145	1	3-55023S	Aux	L912775
47	APP-PV11-ZOD-123	1	2-55023V	Cont	L912779
49	APP-PV11-ZOD-124	1	2-55023W	Cont	L912783
45	APP-PV11-ZOD-119	1	4-55023X	Aux	L912785
45	APP-PV11-ZOD-119	1	3-55023X	Aux	L912786
34	APP-PV11-ZOD-122	1	4-55023L	Aux	L979719



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ATTACHMENT 3: Reportable Condition per 21.21(d)(4)

**1. Name and address of the individual or individuals informing the Commission.**

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Ipswich, MA 01938-1119

**2. Identification of the facility, the activity, or the basic component supplied for such facility or such activity within the United States which fails to comply or contains a defect.**

Butterfly Valves with SMB motor actuators supplied to Westinghouse Electric Company from 2010 to 2016.

**3. Identification of the firm constructing the facility or supplying the basic component which fails to comply or contains a defect.**

Trillium Valves USA  
29 Old Right Road  
Ipswich, MA 01938-1119

**4. Nature of the defect or failure to comply and the safety hazard which is created or could be created by such defect or failure to comply.**

Inconsistent crimping of motor leads caused lack of continuity and intermittent function, or non-function of the actuator motor preventing the butterfly valve to close on demand.  
See Attachment 1.

**5. The date on which the information of such defect or failure to comply was obtained.**

July 1, 2022, See Attachment 1.

**6. In the case of a basic component which contains a defect or fails to comply, the number and location of these components in use at, supplied for, being supplied for, or may be supplied for, manufactured, or being manufactured for one or more facilities or activities subject to the regulations in this part.**

The butterfly valves with motor actuators were supplied to Westinghouse Electric Company under orders identified in Attachment 2. Westinghouse was notified of the affected orders via their SCAR No IR-2022-7477 on March 6, 2023.





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**7. The corrective action which has been, is being, or will be taken; the name of the individual or organization responsible for the action; and the length of time that has been or will be taken to complete the action.**

- (1) Trillium Valve USA's Approved Suppliers List has been updated to add restriction for any repairs or service of safety related equipment must be completed at the supplier's facility. No service or repair of safety related equipment at Trillium site.  
This action was completed on March 2, 2023.
- (2) The failure to comply with initial notification and written notification has been initiated under Trillium Valves USA Corrective Action Program. Corrective actions will include additional training on the implementation and reporting requirements under 10CFR21.  
This action will be completed by March 31, 2023.

**8. Any advice related to the defect or failure to comply about the facility, activity, or basic component that has been, is being, or will be given to purchasers or licensees.**

Trillium Valves USA recommends the inspection of these actuators listed in Attachment 2 for the lack of continuity at the motor leads which may be impacted by inconsistent crimping of the lead wire to the ring tongue terminal.

**9. In the case of an early site permit, the entities to whom an early site permit was transferred.**

Not applicable.