



Consumers
Power
Company

James W Cook
Vice President - Projects, Engineering
and Construction

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January 30, 1983

81-01 #10

Mr J G Keppler, Regional Administrator
US Nuclear Regulatory Commission
Region III
799 Roosevelt Road
Glen Ellyn, IL 60137

MIDLAND NUCLEAR COGENERATION PLANT
DOCKET NOS 50-329 AND 50-330
UNDERRATED TERMINAL STRIPS ON LIMITORQUE VALVE OPERATORS
File: 0.4.9.47 Serial: 20680

Reference: J W Cook letters to J G Keppler, same subject:

- 1) Serial 11190, dated February 13, 1981
- 2) Serial 11976, dated April 24, 1981
- 3) Serial 12041, dated July 8, 1981
- 4) Serial 13665, dated September 11, 1981
- 5) Serial 14617, dated November 20, 1981
- 6) Serial 14690, dated February 12, 1982
- 7) Serial 17503, dated June 4, 1982
- 8) Serial 17565, dated August 6, 1982
- 9) Serial 19070, dated October 22, 1982

This letter, as were the referenced letters, is an interim 50.55(e) report concerning the terminal strip voltage ratings on Limatorque valve operators. Attachment 1 provides a status of the corrective actions in progress to resolve this problem.

Another report, either interim or final, will be sent on or before March 16, 1983.

James W. Cook

WRB/lr

Attachment: 1) MCAR 46, Interim Report #10, "Qualification Concerns for Various Components on Limatorque Valve Operators," dated December 10, 1982

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PDR ADOCK 05000329
S PDR

OC0183-0051A-MP01

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CC: Document Control Desk, NRC
Washington, DC

RJCook, NRC Resident Inspector
Midland Nuclear Plant

CBechhoefer, ASLB Panel
RSDecker, ASLB Panel
FPCowan, ASLB Panel
AS&L Appeal Panel
MMCherry, Esq
MSinclair
BStamiris
CRStephens, USNRC
WDPaton, Esq, USNRC
FJKelley, Esq, Attorney General
SHFreeman, Esq, Asst Attorney General
WHMarshall
GJMerritt, Esq, TNK&J

097626 Bechtel Associates Professional Corporation

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SUBJECT: MCAR 46 (issued 1/15/81)
Qualification Concerns for Various Components on
Limiterque Valve Operators

INTERIM REPORT 10

DATE: December 10, 1982

PROJECT: Consumers Power Company
Midland Plant Units 1 and 2
Bechtel Job 7220

Description of Deficiency

The following deficiencies are covered by MCAR 46:

- a) The use of underrated terminal blocks in Limitorque operators
- b) The use of terminal blocks without proper environmental qualification in Limitorque operators
- c) Additional concerns regarding qualification of various Limitorque operator components

These concerns are detailed below.

A. Underrated Terminal Blocks

While replacing a damaged terminal block on a Limitorque operator, Bechtel determined that some of the terminal blocks used for the termination of the leads from the 460 V motor were rated less than 460 V. These Limitorque operators, when used on safety-related valves, must function on an emergency core cooling actuation signal (ECCAS). In addition to being a personnel safety hazard, the potential exists for a short circuit/flashover, which could render the valves inoperative.

B. Environmental Qualification

During random inspection for underrated terminal blocks, it was discovered that in some cases terminal blocks from manufacturers not covered by existing qualification reports were used.

Limitorque provided the following information on environmental qualification of terminal blocks in its July 31, 1981, letter.

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The Buchanan 0524 has been qualified by analysis. To supplement the qualification by analysis, Limitorque is currently running a type test on the Buchanan 0524 terminal block. The Buchanan 0824 terminal blocks are not qualified and must be replaced.

Some of the Limitorque operators having Buchanan 0824 type terminal blocks have been used on safety-related valves located inside containment. These operators must function on an ECCAS. The potential exists for a terminal block to fail during its intended service life because of aging and radiation effects, which would render the valve inoperable and prevent proper operation of the safety-related system.

C. Additional Qualification Concerns

During June 1982, a random inspection was made of safety-related Limitorque valve operators supplied through various valve manufacturers and installed inside the reactor building. This inspection resulted in various potential concerns regarding qualification of these Limitorque operators.

Summary of Investigation and Historical Background

A. Underrated Terminal Blocks

1. The manufacturer's name was the only form of identification found on a damaged terminal block. To order a replacement for the damaged terminal block, it was therefore necessary to measure the block's critical dimensions and compare them with those for blocks listed in Marathon Catalog 10M79. This comparison indicated that the terminal blocks used for the termination of the leads from the 460 V motor could have been rated less than 460 V. Eighteen Limitorque operators on Bechtel Purchase Order (P.O.) 7220-M-132-AC were inspected and eight were found to have underrated terminal blocks (Marathon 100 Series and Cinch Jones 140 Series). Thus, Bechtel determined that some terminal blocks in Limitorque valve operators may be underrated for their intended function. The other ten operators inspected had Marathon 300 Series terminal blocks which are correctly rated for the intended service. Purchase Order 7220-M-132 is with Henry Pratt Company for the supply of nuclear service butterfly valves.

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2. Representatives from Limitorque and Henry Pratt visited the Midland jobsite on January 31, 1981. After inspecting the terminal blocks, they confirmed the results of Bechtel's investigation.
3. Random inspection was performed by Limitorque during the week of May 11, 1981, to establish the magnitude of the presence of the underrated terminal blocks in the Limitorque operators. Limitorque provided Bechtel with detailed reports of its inspection. After review of the inspection reports, Bechtel determined that underrated terminal blocks were not used on any Q-listed purchase orders except P.O. 7220-M-132(Q).
4. Seven different types of terminal blocks were identified (Buchanan 0222, 0524, and 0824; Marathon 300 Series; Beau 7600; Kulka 622; and General Electric EB-5) during the random inspection referred to in Item 3 above. All seven types are acceptable for 460 V service.
5. Arrangements were immediately made by Bechtel to inspect any unshipped valves upon receipt at the Midland jobsite for underrated terminal blocks. Inspection results are tabulated in Item B.7 below.
6. Limitorque/Henry Pratt submitted the terminal block replacement procedure and Certificate of Compliance for the terminal blocks which Bechtel project engineering approved upon review. The actual replacement of all underrated terminal blocks on Limitorque's Purchase Order 7220-M-132(Q) was undertaken by Bechtel construction personnel under the supervision of Limitorque service engineering during the second week of June 1982. The replacement work is now complete; all operators on P.O. 7220-M-132(Q) were inspected.
7. Bechtel has received the inspection/replacement report from Limitorque for the work described in Item A.6 above.
8. Limitorque's letter dated June 25, 1981 (Ref: MCAR 46, Interim Report 4, Item A.1) states that terminal block types Buchanan 0524 and Beau 7600 were previously rated for 600 V service using the breakdown voltage method of rating. A concern was raised because no documents are currently available at Bechtel to support this statement. Limitorque

has now provided additional documentation showing that the terminal blocks in question were previously rated at 750 V and 600 V, respectively.

B. Environmental Qualification

1. During the random inspection of underrated terminal blocks, referred to in Item A.3 above, Buchanan 0824 terminal blocks were found on three Limitorque operators purchased from Westinghouse on P.O. 7220-M-123A for nuclear service stainless steel valves. Voltage rating data submitted by Limitorque for these terminal blocks were found acceptable. However, these terminal blocks are unacceptable because of Limitorque's previously cited finding that these blocks "are not" environmentally qualified and "must be replaced."
2. According to Limitorque, the use of unqualified terminal block type Buchanan 0824 is limited to P.O. 7220-M-123A(Q)-AC with Westinghouse Electric, based on Westinghouse's specific requirements. These blocks are not qualified and would require replacement with properly qualified terminal blocks. Based on random inspection results, it was concluded that Buchanan 0824 terminal blocks are not used on any other P.O.
3. Of the seven terminal blocks listed in Item A.4 above, Limitorque stated that terminal blocks types Buchanan 0222, Buchanan 0524, Curtis Type L, Marathon 300 Series, and General Electric EB-5 were environmentally qualified for inside containment, but were unable to provide the required qualification documentation.
4. Limitorque presently has no specific plans for an environmental testing of the remaining terminal block types Kulka 622 and Beau 7600 for outside containment use.
5. Environmental qualification documentation for terminal block types specified in Items B.3 and B.4 above was returned to Limitorque with comments. Limitorque has resubmitted the documentation incorporating Bechtel comments. Bechtel is currently reviewing this document. Currently, the acceptability of all terminal block types remains indeterminate pending acceptance of qualification documentation.

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6. Bechtel field engineering has generated Nonconformance Report (NCR) 3780 against valves 2MO-1111, 2MO-1101B, and 2MO-1120B purchased from Westinghouse Electric on P.O. 7220-M-123A(Q)-AC, Items 4.2, 5.4, and 5.8, respectively. This NCR was initiated at the request of project engineering because of the presence of an unqualified terminal block, Buchanan 0824.
7. The following 18 operators were to be inspected upon receipt from the vendors at the jobsite for the presence of nonconforming terminal blocks. The status is as follows:

<u>P.O. Number</u>	<u>Item (Quantity)</u>	<u>Terminal Block (TB)/ Remarks</u>
7220-J-255A(Q)	23(8)	TB Kulka 622
7220-M-117(Q)	5.1(1)	Valves converted to manual; effort still under way to locate and inspect operators
7220-M-117(Q)	5.2(1)	
7220-M-117(Q)	5.3(1)	
7220-M-117(Q)	5.4(1)	
7220-M-117(Q)	5.4(1)	
7220-M-168(Q)	1.5(1)	TB Buchanan 0222
7220-M-398(Q)	1.1(1)	TB Kulka 622
7220-M-398(Q)	1.2(1)	TB Kulka 622
7220-M-398(Q)	3.1(1)	TB Kulka 622
7220-M-398(Q)	3.2(1)	TB Kulka 622
7220-M-398(Q)	3.3(1)	TB Kulka 622

All operators listed above are located outside containment. The terminal blocks' voltage ratings are acceptable. However, environmental acceptability is pending review and acceptability of the Limitorque qualification documentation described in Item B.5 above.

C. Additional Qualification Concerns

1. The motor nameplate ambient temperature rating on various motors installed on some Limitorque operators is 40C. Limitorque has verbally stated that the Class B insulation motors rated for a 40C ambient temperature have not undergone qualification testing in accordance with IEEE Std 382-1972 for the specified normal, accident, and post-accident environment. Class H insulation motors are rated for 50C ambient temperature, but the qualification testing in accordance with IEEE Std 382-1972 for these motors is presently unknown.

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2. No identification was evident on certain materials internal to the Limitorque operators (e.g., wiring, insulation, etc). It is not presently known whether these types are qualified for the service conditions.
3. Various orientations of installed operators were observed. It is not presently known whether the operators are qualified for all installed orientations.
4. Drain plugs on operators were observed to be both in place and removed. Orientation of the operators did not always result in the drain holes being at the lowest point of the installed operator. It is not presently known whether the existence of the drain plug or the orientation of the drain hole is essential to proper operation of the operator or is in conformance with the qualification tests for the operator.
5. Various Limitorque operator limit switch gear frames were observed to be made of a white metal. It is not presently known whether these gear frames are qualified for the service conditions.
6. Information obtained from purchase order files and QVDP files does not agree with the installed components.
7. It is presently not known whether space heaters are qualified or required to be qualified.
8. Various O-rings are located throughout the actuator. It is not presently known whether these components are qualified for the service conditions.
9. Unidentifiable terminal blocks (nonpower lead connectors inside the operators) were observed in other Limitorque operators. It is not presently known whether these components are qualified for the service conditions.

To discuss concerns listed above, a meeting was held at Limitorque on August 31, 1982. A purchase order has been placed with Limitorque to conduct a component qualification document search for each safety-related Limitorque operator. A follow-up meeting was held at Limitorque on November 5, 1982, to expedite the documentation search work. It is expected that Limitorque will submit these by December 17, 1982.

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Safety Implications and Reportability

1. Seven of the eight valve operators having underrated terminal blocks are located in the component cooling water and service water systems and are used on safety-related valves. These must function on an emergency core cooling actuation signal. The potential exists for a short circuit/flashover which could render the valves inoperative.

Based on the potential safety concerns, this item was considered reportable. This deficiency was reported by Consumers Power Company on January 14, 1981, to R. Sutfin, R. Cook, and R. Knop of the Office of Inspection and Enforcement, Region III, U.S. Nuclear Regulatory Commission, as a reportable deficiency for Midland Plant Units 1 and 2 in accordance with 10 CFR 50.55(e).

2. Of the concerns expressed above, it is believed that Limitorque operators having a motor rating of 40C ambient temperature and Class B insulation have not been qualified for safety-related service inside the containment. Therefore, the operators may not perform their safety functions under postulated post-accident conditions. However, this concern and the remaining concerns listed above should be regarded as indeterminate because insufficient information exists to classify them otherwise. The status of these concerns is still under investigation and is dependent on the results of the Limitorque component qualification document search. The status will be reported accordingly in future interim reports.

Probable Cause

A. Underrated Terminal Block

According to Limitorque, it does not stock Marathon 100 Series terminal blocks. However, Limitorque believes (according to its January 21, 1981, letter) that when its field service engineer visited the Midland jobsite in November 1977 to increase the number of points on the terminal blocks for 66 operators (P.O. 7220-M-132), he may have procured the subject terminal blocks locally. Limitorque further explained that an additional 20 terminal blocks (140 Series, manufactured by Cinch Jones) were shipped to Midland, to make up for quantities damaged in an earlier shipment. These blocks are similar to Marathon Series 100 blocks and may have been used by the Limitorque service engineer to terminate the 460 V motor leads. According

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to Limitorque's July 1, 1982 letter, the root cause for the presence of underrated terminal blocks was the lack of adequate training for a newly employed field service engineer.

B. Unqualified Terminal Block

According to Limitorque's July 1, 1982, letter, Buchanan 0824 terminal blocks have not been tested for environmental qualification. These terminal blocks were furnished with actuators built in 1974 to the specific requirements of an individual valve manufacturer. However, the terminal blocks were considered qualified by analysis at the time they were supplied. The Buchanan 0824 uses nylon construction, which is unacceptable in today's nuclear industry. It is Limitorque's opinion that this terminal block would pass a nuclear qualification test; however, because of the stigma attached to the use of nylon in this application, the terminal block would still be considered unacceptable.

C. Additional Qualification Concerns

The additional concerns addressed above are still being evaluated. A discussion on the probable causes of these concerns will be covered in future interim reports.

Corrective Action

A. Underrated Terminal Blocks

During Limitorque's June 1982 inspection/replacement trip to the Midland jobsite, all underrated terminal blocks were replaced by correctly rated Marathon 300 Series terminal blocks on operators purchased on P.O. 7220-M-132(Q). The reports from Limitorque and the field covering the inspection/replacement activities and documentation of terminal block types Buchanan 0524 and Beau 7600 have been accepted. Thus, this deficiency will be considered completely resolved, pending the inspection of four operators on P.O. 7220-M117(Q), listed under Item 7 on Page 5 of this report.

B. Unqualified Terminal Blocks

1. The resubmitted qualification report from Limitorque is being reviewed and is expected to be complete by December 15, 1982.

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- 2. The physical verification of the type of the terminal blocks used on each safety-related Limitorque operator will be included together with the inspection process to verify other concerns.
- 3. Bechtel project engineering is to disposition NCR 3780 by December 31, 1982.

C. Additional Qualification Concerns

Arrangements have been made with Limitorque to review the documentation of each Limitorque operator for the expressed concerns. The unqualified components/operators shall be replaced with qualified ones in accordance with the requirements. Based on the results of documentation review, further required action will be reported in future interim reports.

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for: T. Ballweg
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Supervisor

Approved by: F.M. Hughes
Ann Arbor Project
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Concurrence by: M.A. Dietrich
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LIMITORQUE CORPORATION

5114 Woodall Road • P. O. Box 11318 • Lynchburg, Virginia 24506

Telephone—804-528-4400 • Telex—82-9448

095235

November 17, 1982

Bechtel Associates Professional Corporation
 P. O. Box 1000
 Ann Arbor, MI 48106

Attention: Mr. E. M. Hughes,
 Project Engineer



Gentlemen:

11-22-82

Subject: Limitorque Operator Terminal Blocks

We have researched our files in response to your October 14, 1982, request for additional terminal block information on the Buchanan 0524 and Beau 7600. Enclosed are two sheets from Beau's Bulletin 340 printed in 1977 that shows a 600 volt rating on the Beau 76000 (currently called a Beau 7600) terminal block. We have also attached copies of two pages from Buchanan's publication G-108 which shows a 1971 copyright date.

The medium duty Buchanan terminal block is their general classification for the Buchanan 0524. The only rating found on this terminal block references a 750 volt rating in accordance with the IEEE switch gear standards.

Please contact this office if we may be of any further assistance in this matter.

Very truly yours,

LIMITORQUE CORPORATION

Daniel S. Warsing

Daniel S. Warsing
 Technical Manager

/lc

Attachments

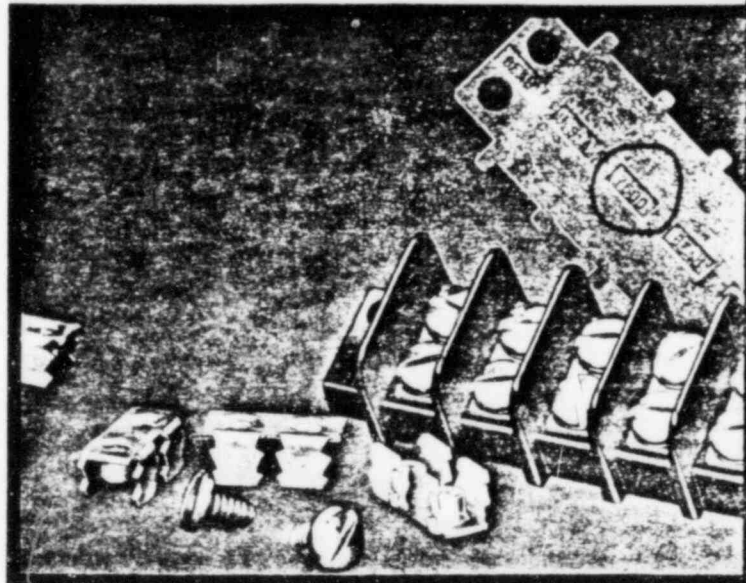
ATTACHMENTS LOCATED
 IN
 MIDLAND DOCUMENT
 CONTROL CENTER
 83-291 01

Beau® Double-Row High-Barrier Resilient Terminal Strips

500 40 20
 300 0-32

BEAU

- **Series 76000**
- Double row; 3/8" centers
- 20 amps, 600 volts
- Closed back and feed thru
- Screw terminals ultrasonically welded in
- No. 6-32 x 1/4-inch screws

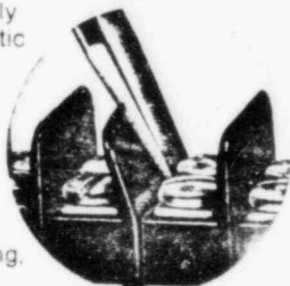


**Bulletin
340**

BRUT!

Bend barriers without breaking

Beau's flexible barrier strips reduce breakage dramatically because they are made of highly resilient glass-filled thermoplastic materials. The impact strength is many times greater than phenolic materials. Because the barriers can actually bend without breaking, production line and in-field damage are virtually eliminated. Time-consuming re-wiring, and its high cost, is no longer a problem.



Get 20 amps in the same space as 15.

These 20-ampere strips are designed to take the same panel space as any double-row 15-ampere barrier terminal strip. They are 7/8-inches wide and have screw terminals 3/8-inches on centers—just like the following strips they are designed to replace:

- BEAU:** 14000, 14000-T, 15000, 16000, 16000-T, 17000
- CINCH:** 140, 164, 240.
- CURTIS:** 1500
- ETC CANNON:** 27000, 37000, 57000, 67000
- GENERAL ELECTRIC:** CR151—Type D1 and D7
- KULKA:** 600, 600A, 620A, 670, 670A, 800.
- MARATHON:** Series 100.

Now a closed back strip with screw terminals that won't pull out

The 76000 series eliminates the problem of insecure terminal retention commonly found in closed back double-row barrier terminal strips. The eyelets and nails have been eliminated. Instead, screw terminals are used (photo above)—and they are ultrasonically welded (imbedded) into the barrier strip, making it virtually impossible to pull them out. Another result: it's a more rugged strip, and has a greater creep path.

No insulating strip needed

Because the 76000 series has a closed back, you can get the electrical rating you want—without the expense of buying and installing insulating strips.

Feed thru styles have enclosed contact tails

The 76000 series is also made in feed thru styles. But, unlike the typical thru-hole, ours is virtually the same size as the contact tail. This maximizes circuit isolation. It also eliminates entrapment of foreign matter—and reduces solder wicking.



Highest UL flame retardant rating

The thermoplastic material was selected to attain the highest flame retardant rating (self extinguishing) assigned by Underwriters Laboratories, 94V-0. The material also offers negligible water absorption, high dielectric strength and low heat transfer.

Beau® Double-Row High-Barrier Resilient Terminal Strips (cont'd)

SPECIFICATIONS 097832 097629

Electrical rating: 20 amps; 600 v

Size: 7/8" w x 5/8" h

Terminal centers: 3/8"

No. of terminals: 1 to 30 (molded to length; no rough cut ends)

Base style: Closed back or feed thru

Mounting: With or without mounting ends

Terminal styles: #6-32 x 1/4" binding head screw (standard)
Wire clamp plate, self rising
Quick connect tab (1 to 6 terminations per circuit)
Solder terminal, single or double
Feed-thru solder, long and short
Feed-thru PC, long and short
Feed-thru wire wrap
Z terminal, over-the-side PC

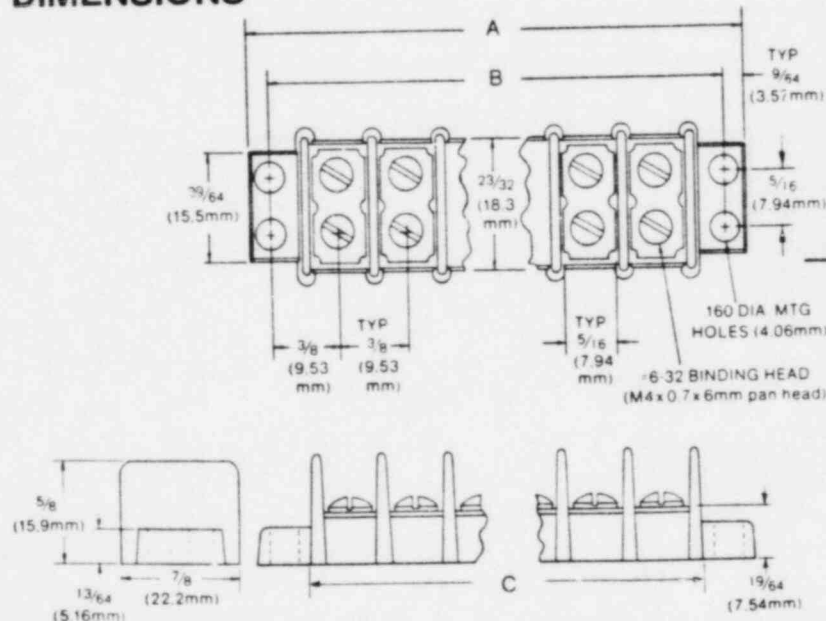
Wire usage: With binding head screw-1 #14 Awg
With wire clamp-1-2 #14 Awg
With quick connect tab-1-6 #16 Awg

Materials: Insulator-glass-filled thermo-plastics; U.L. flame retardant rating of 94V-0; color, black
Terminals-high strength copper alloy, nickel plated
Screw and wire clamp-steel, bright cadmium plated
Quick connect tab-brass, cadmium plated
Solder terminal (single or double)-brass, hot tin dipped

Marking: Imprinting available, directly on base or on vulcanized fiber marker strips

U.L. RECOGNIZED. C.S.A. CERTIFIED.

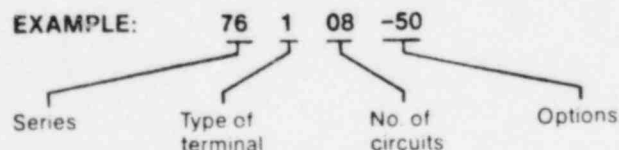
DIMENSIONS



NO OF CIRCUITS	A		B		C	
	Inch	(mm)	Inch	(mm)	Inch	(mm)
2	1 13/32	(35.7)	1 1/8	(28.6)	27/32	(21.4)
3	1 25/32	(45.2)	1 1/2	(38.1)	17/32	(31.0)
4	2 5/16	(54.8)	1 7/8	(47.6)	1 19/32	(40.5)
5	2 17/32	(64.3)	2 1/4	(57.2)	1 31/32	(50.0)
6	2 29/32	(73.8)	2 5/8	(66.7)	2 11/32	(59.5)
7	3 9/32	(83.3)	3	(76.2)	2 23/32	(69.1)
8	3 21/32	(92.9)	3 3/8	(85.7)	3 3/32	(78.6)
9	4 1/32	(102)	3 3/4	(95.3)	3 15/32	(88.1)
10	4 13/32	(112)	4 1/8	(105)	3 27/32	(97.6)
11	4 25/32	(121)	4 1/2	(114)	4 7/32	(107)
12	5 5/32	(131)	4 7/8	(124)	4 19/32	(117)
13	5 17/32	(140)	5 1/4	(133)	4 31/32	(126)
14	5 29/32	(150)	5 5/8	(143)	5 11/32	(136)
15	6 9/32	(160)	6	(152)	5 23/32	(145)
16	6 21/32	(169)	6 3/8	(162)	6 3/32	(155)
17	7 1/32	(178)	6 3/4	(171)	6 15/32	(164)
18	7 13/32	(188)	7 1/8	(181)	6 27/32	(174)
19	7 25/32	(198)	7 1/2	(191)	7 7/32	(183)
20	8 5/32	(207)	7 7/8	(200)	7 19/32	(193)
21	8 17/32	(217)	8 1/4	(210)	7 31/32	(202)
22	8 29/32	(226)	8 5/8	(219)	8 11/32	(212)
23	9 9/32	(236)	9	(229)	8 23/32	(221)
24	9 21/32	(245)	9 3/8	(238)	9 3/32	(231)
25	10 1/32	(255)	9 3/4	(248)	9 15/32	(241)
26	10 13/32	(264)	10 1/8	(257)	9 27/32	(250)
27	10 25/32	(274)	10 1/2	(267)	10 7/32	(260)
28	11 5/32	(283)	10 7/8	(276)	10 19/32	(269)
29	11 17/32	(293)	11 1/4	(286)	10 31/32	(279)
30	11 29/32	(302)	11 5/8	(295)	11 11/32	(288)

HOW TO ORDER

Beau Terminal Strips can be ordered by means of a 5-digit catalog number as shown below. To obtain options, simply add as many "dash numbers" as needed after the 5-digit number.



Terminal types (3rd digit):
0 Binding head screws only
1 One-sided solder
2 Two-sided solder
3 Feed-thru solder, short
4 Feed-thru PC, short
5 Feed-thru solder, long
6 Feed-thru PC, long

7 Feed-thru wire wrap
8 Z terminal, over-the-side PC

Number of circuits (4th & 5th digits):
01 to 30

Options (dash numbers):
-C Without mounting ends
-M With metric screws

-10A Imprint (style 10A)
-49 Nickel/brass binding head screws, #6-32 x 1/4"
-50 Sems screws/rising surface clamp
-51 Sems (int lock washer) screw
-52 Sems (ext lock washer) screw
-58 Barrier supplied without screws
-59 Screws supplied, unassembled
-66 Marker strip bonded to barrier

MEDIUM DUTY

Terminal Blocks

Ordering Information

Tubular Contacts are listed by UL as "pressure cable connectors" for the following combinations:

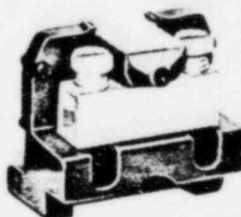
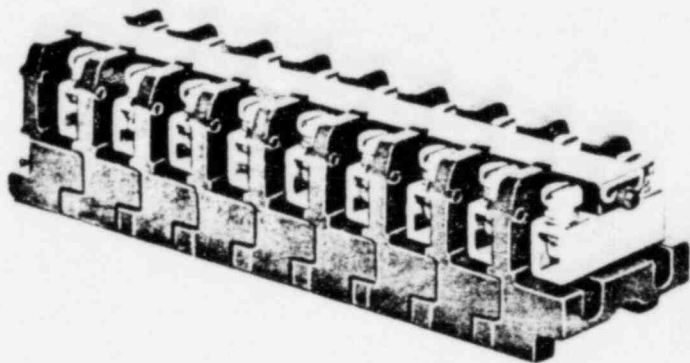
Tubular Screw Type
(Contact Cat. #199)

1 #14 to 1 #8 AWG.
2 or 3 #12 AWG.
2 to 4 #14 AWG.
1 to 4 #16 AWG.
1 to 5 #18 AWG.

Tubular Clamp Type
(Contact Cat. #299)

1 #18 to 1 #10 AWG.
2 #12 AWG.
2 or 3 #14 AWG.
2 to 4 #16 AWG.
2 to 5 #18 AWG.

UL does not list clamp bearing connectors for smaller than #18. Blocks are listed by Canadian Standards Association.



FEATURES

Packaging: Contact sections are packaged in pre-assembled lengths of 20 per box. End sections are packaged separately — 25 per box.

Factory assembled flat base blocks containing up to 12 circuits are standard catalog items.

Factory assembled channel mounted blocks containing up to 156 circuits in a 6-ft. channel — 74 circuits in a 3-ft. channel — are standard catalog items.

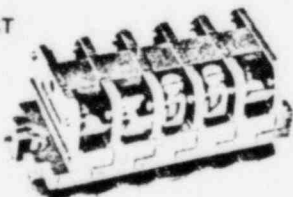
Choice of four contact types: tubular screw, tubular clamp, strap screw, and "Quick Connect." All contacts are plated to resist corrosion.

No lugging with tubular clamp and tubular screw contacts. Simply insert wire and tighten screw.

Tubular clamp contact screws cannot shake loose. Clamp is captive to the screw; screw is captive to the contact.

Four marking methods available: Plain marking area, painted marking area, slide-in vinyl marking strip, and pressure sensitive marking tape (roll or sheet).

"Quick Connect" blocks simplify the making of connections between circuits. Furnished with various combinations of "Quick Connect" contacts and tubular screw contacts, these blocks combine speed and flexibility.

QUICK CONNECT
BLOCK

SPECIFICATIONS

Wire Range: #22-#8 AWG or equivalent combinations.

Voltage Rating: Blocks withstand voltages greatly in excess of IEEE switchgear standards for 750 volts.

Temperature Rating: Blocks operate safely at temperatures to 302°F.

Center-To-Center Spacing: $\frac{7}{16}$ ". Allows 26 circuits per foot.

Moldings are medium impact phenolic (CFG per MIL-M-14). Resist heat, moisture, solvents, shock. Other MIL-M-14 compounds available on special order.

Strap screw contacts have #6 binding head screws with concentric ridges under head for tighter gripping. Maximum width of lugs — $\frac{5}{16}$ ".

"Quick Connect" contacts are blade type (250" x .032"). Accept $\frac{1}{4}$ " female tab type terminals.

Accessories simplify job: Available for use with the MD blocks are steel and prepunched aluminum channel for mounting up to 156 blocks; mounting clamps to hold the blocks in the channel; slide-in and pressure sensitive marking strips for identifying circuits; holding plugs for the slide-in strips; see-thru covers for dead front safety; ganging rods for the covers; jumpers to make adjacent contacts common; and marking pens especially designed for use on vinyl, nylon, and polypropylene surfaces. For complete ordering information see foldout page 56.

NOMINAL DIMENSIONS OF ASSEMBLED FLAT BASE BLOCKS*

(For Standard Factory Assembled Channel Mounted Blocks, Add $1\frac{1}{2}$ " to C and $2\frac{1}{4}$ " to L)

NO. OF CKT'S.	DIMENSIONS—INCHES		NO. OF CKT'S.	DIMENSIONS—INCHES	
	C	L		C	L
1	$\frac{3}{8}$ "	$1\frac{1}{2}$ "	14	$6\frac{1}{8}$ "	$6\frac{7}{8}$ "
2	$1\frac{1}{4}$ "	$1\frac{3}{4}$ "	15	$7\frac{1}{8}$ "	$7\frac{3}{4}$ "
3	$1\frac{5}{8}$ "	$1\frac{7}{8}$ "	16	$7\frac{3}{8}$ "	$7\frac{7}{8}$ "
4	$2\frac{1}{8}$ "	$2\frac{1}{8}$ "	17	$7\frac{7}{8}$ "	$8\frac{1}{4}$ "
5	$2\frac{1}{2}$ "	$2\frac{3}{8}$ "	18	$8\frac{1}{8}$ "	$8\frac{3}{4}$ "
6	$3\frac{1}{2}$ "	$3\frac{1}{8}$ "	19	$8\frac{3}{8}$ "	$9\frac{1}{8}$ "
7	$3\frac{3}{4}$ "	$3\frac{1}{4}$ "	20	$9\frac{1}{8}$ "	$9\frac{1}{2}$ "
8	$3\frac{1}{2}$ "	$4\frac{1}{8}$ "	21	$9\frac{3}{8}$ "	$9\frac{3}{4}$ "
9	$4\frac{3}{8}$ "	$4\frac{1}{4}$ "	22	$10\frac{1}{8}$ "	$10\frac{3}{8}$ "
10	$4\frac{7}{8}$ "	$5\frac{1}{8}$ "	23	$10\frac{3}{8}$ "	$10\frac{7}{8}$ "
11	$5\frac{1}{4}$ "	$5\frac{3}{8}$ "	24	$11\frac{1}{8}$ "	$11\frac{1}{4}$ "
12	$5\frac{3}{4}$ "	$5\frac{7}{8}$ "	25	$11\frac{3}{8}$ "	$11\frac{3}{4}$ "
13	$6\frac{1}{4}$ "	$6\frac{1}{2}$ "	26 and over	Use Formulas	

*SEE DIMENSIONAL DRAWINGS ON PAGE 19.

MEDIUM DUTY

Sectional Terminal Blocks

Ordering Information

FOR USER'S ASSEMBLY / Snap-Fit Sections
 Complete with Factory Installed Contacts (Shipped in Multiples of Standard Package Quantities Only)

CONTACT	STD. PKG.	FLAT BASE for direct mounting						DOVETAIL BASE for channel mounting					
		SECTION	Shipping Weight Lbs./M (approx.)	PLAIN MARKING AREA*		PAINTED MARKING AREA		SECTION	Shipping Weight Lbs./M (approx.)	PLAIN MARKING AREA*		PAINTED MARKING AREA	
				Catalog Number	List Price/Ct	Catalog Number	List Price/Ct			Catalog Number	List Price/Ct	Catalog Number	List Price/Ct
Type SS Strap Screw Wire: #8 or smaller	20		24	511	\$30.05	521	\$31.35		28	0511	\$31.15	0521	\$32.45
Type TS Tubular Screw Wire: #18 - #8	20		30	514	32.05	524	33.40		34	0514	33.15	0524	34.50
Type TC Tubular Clamp Wire: #22 - #10	20		31	515	39.30	525	40.65		35	0515	40.40	0525	41.75
2 Quick Connect Wire: #12 and smaller	20		18	510	27.85	520	29.15		22	0510	28.95	0520	30.25
3 Quick Connect Wire: #12 and smaller	20		21	516	29.05	526	30.35		25	0516	30.15	0526	31.45
4 Quick Connect Wire: #12 and smaller	20		24	517	30.25	527	31.55		28	0517	31.35	0527	32.65
1 Tubular Screw 1 Quick Connect Wire: #12 and smaller	20		25	518	31.45	528	32.80		29	0518	32.55	0528	33.90
1 Tubular Screw 2 Quick Connect Wire: #12 and smaller	20		26	519	32.65	529	34.00		30	0519	33.75	0529	35.10
None End Section	25		12	530	22.00	530	22.00		17	0530	23.30	0530	23.30

*For use with separate marking strips, for marking directly on blocks, or where no marking is required.
 † SEE INSIDE FRONT COVER FOR DISCOUNTS, TERMS, CONDITIONS

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Features & Specifications

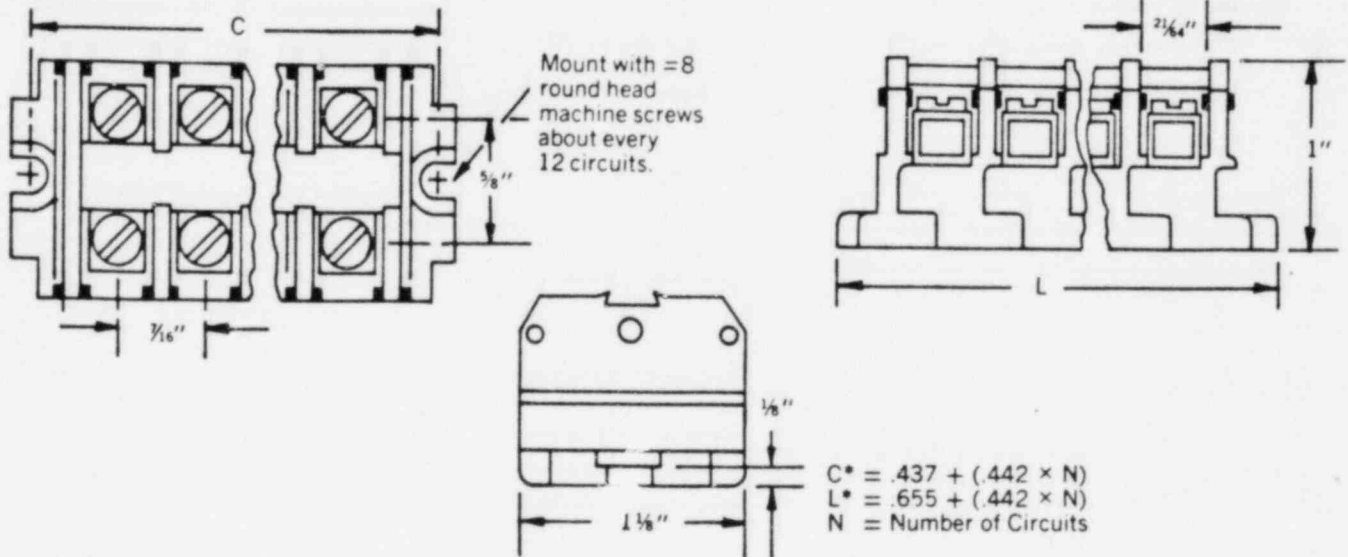
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MEDIUM DUTY

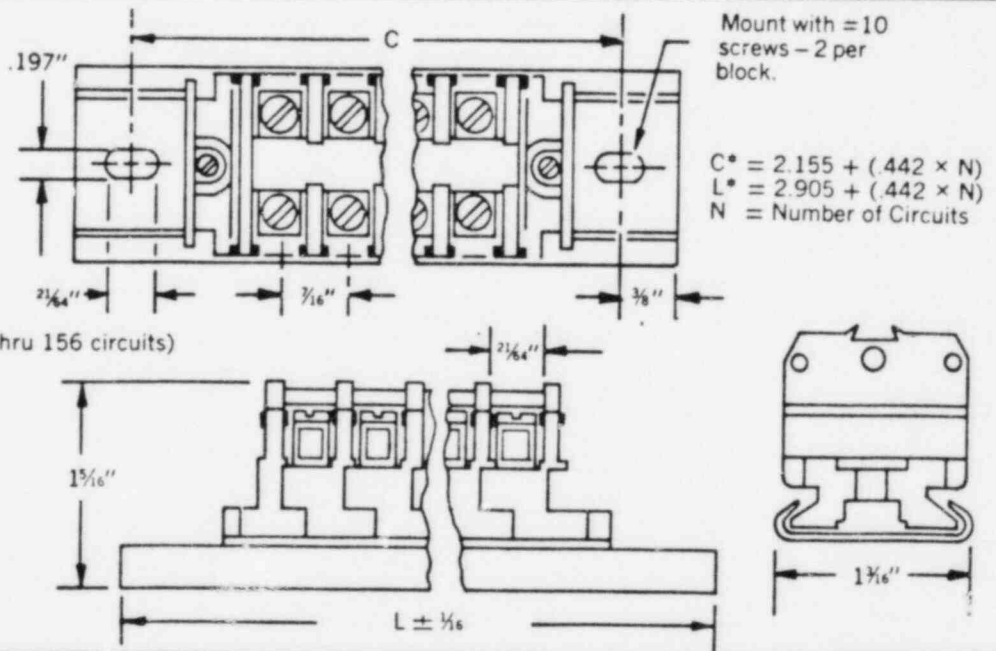
Sectional Terminal Blocks

FLAT BASE

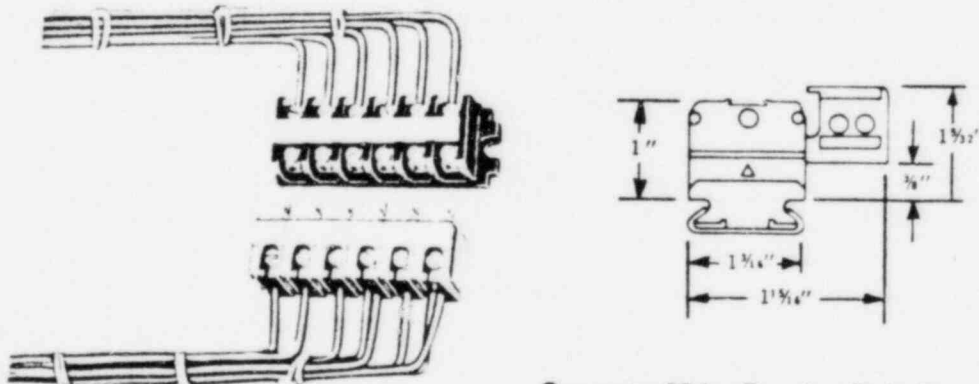
DIMENSIONAL DRAWINGS



CHANNEL MOUNTED



SECTIONAL FANNING STRIPS



See page 55 for Fanning Strip Features.