Westinghouse Electric Corporation
Energy Systems
Box 355
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ET-NRC-91-3613
August 2, 1991

Mr. Scott Newberry, Chief
Instrumentation and Control Systems Branch
Division of System Technology
US NRC
Washington, DC 20555

Subject: Responses to Questions on Part 21 Report (NS-NRC-91-3600 6/29/91)

Dear Mr. Newberry:

The attachment to this letter provides responses to questions forwarded to Westinghouse by your letter of July 18, 1991. As noted some responses are not complete since the Westinghouse epoxy testing program has not been finished. Also Westinghouse is not able to provide a response to some questions for which the technical responsibility is with utility customers. Please contact P. J. Morris of my staff if you have any questions.

S. R. Tritch, Manager
Engineering Technology

RBM/sa

Attachment

ET-NRC-91-3613
July 30, 1991

Responses to NRC Questions on DC Coil Assembly Part 21 Report

1. How and when were all plants notified of this issue?

   All plants were notified by Westinghouse by informal communication about 6/20/91. An informal transmittal of the notification letter occurred about 6/25/91. Formal communications were completed by about 7/20/91.

2. When will licensee testing of the relay epoxy be completed? How will the results of this testing be tracked by Westinghouse?

   Westinghouse has not provided a recommended date to utility customers when epoxy testing of potentially affected devices should be complete. Westinghouse does not have a mechanism to track the result of any testing that is done to resolve this concern.

3. What provisions have been made to insure all suspect devices are tested? Is a record kept of all devices sold, to whom, and where used?

   Westinghouse records of shipped devices are complete since the formation of Replacement Component Services in 1985. Records of shipments prior to 1985 are less readily retrieved. Westinghouse records do not indicate the application for replacement parts. The majority of such devices supplied within the last several years have been supplied as replacement parts.

4. Please provide generic systems diagrams to show where these devices are typically used.

   Typical wiring diagrams showing relay applications are attached. These show functions from originally supplied relay protection and safeguards systems.

5. For devices energized to actuate, what systems/functions would require amortization followed by deenergization, during an event where this failure mode is a concern?

   For the Westinghouse safeguards systems relays are required to deenergize at a time directed by the conditions of an event. However, the time to deenergize may not be as constrained as the initiation of the function so an operator would be able to take other manual actions if a relay or contactor should not deenergize. Other examples may exist for functions which may use these devices but with which Westinghouse did not have design responsibility.

6. Since Amicon indicated that the epoxy melting temperature is variable and will change with the mixing error, why do you believe the two hour test is an adequate temperature test?

   The melting temperature is variable in the sense that it will be lower for a larger mixing ratio error. The temperature above which a properly mixed epoxy won't melt or soften is being determined by Westinghouse. The initial opinion is that the temperature is about 180^{0}F. Two hours is judged to be a conservative time, based on internal coil temperature tests, for the entire encapsulation to reach the predetermined temperature either by energization of the coil or by an oven test.

7. What procedure for mixing epoxy is called out in the factory "methods sheet"? Are there procedures in place to ensure out-of-date chemicals are not used? What are those procedures? Is the epoxy mixing machine installed in 1990 calibrated?

   Today, for most production runs, the epoxy is mixed statically through the nozzle of a commercially available epoxy dispenser. The machine is calibrated by a ratio weight check once per shift. Previously, the epoxy was ratioed by weight and mixed by hand with no procedure for the mixing.

Hand mixing may still be utilized today for smaller production runs. The high production of these commercial grade items has helped to determine that out of date materials would not be used. A more rigorous method of control has been recently employed at the factory.

8. What changes in the manufacturing methodology have been made to insure this problem does not occur in the future?

   At this time, Westinghouse plans to include an epoxy check in the commercial dedication process for these commercial grade items. This would be a check for soft epoxy after heating of the coil by energizing it or heating it in an oven. Due to the extremely low failure rate, Westinghouse does not anticipate significant changes at the manufacturing facility.

9. Describe the tests that have been done to ensure that the steady-state temperature has been reached and that it is sufficient to soften the epoxy?

   Based on opinions from epoxy engineers, if this epoxy does not soften at 180^0F, it never will. Westinghouse is performing tests on epoxy samples to determine if 180^0F is the correct temperature. Westinghouse has also recently instrumented coil assemblies for the relays and shown that the ARD coil temperature will exceed 180^0F (the 130 VDC coil peaks at 205^0F) when on the bench at about 75^0F ambient. Based on previous experience, the BFD/NBFD single coil units will be similar to the ARD. The NBFD65NR dual coil unit peaks at 155^0F and may require oven tests unless the internal rack ambient is about 100^0F or unless the Westinghouse epoxy tests demonstrate a maximum test temperature lower than 180^0F.

10. During the proposed test when the devices are energized for 2 hours, (a) what safety features are disabled during the test, (b) what is the potential for inducing a transient, and (c) and what are the plans for relay testing at power?

Westinghouse does not recommend that the two hour test be implemented while the plant is at power. To perform the test at power would require disabling safety functions for the duration of the test and could possibly lead to a plant upset and a challenge to safety systems.

11. How will the relays be energized for the proposed testing? Is there a potential for damage to the circuitry or associated circuitry? What verification process will be used to return the relays to an operable state? How will the plunger travel be verified at the plant site?

    Westinghouse does not recommend that plunger travel be verified, only that the epoxy be inspected for softening after the device has been energized. How each test is specifically implemented will depend on the individual circuits and the testing preferences of each utility customer.

12. How will this issue be handled by plants designed by NSSS vendors other than Westinghouse?

    Westinghouse anticipates that plants other than those with a Westinghouse Nuclear Steam Supply System will handle the issue in a similar manner.

13. Has a program been developed for finding future defective devices? What is the confidence level for identifying these devices, and how is that level justified?

    At this time, Westinghouse plans to include an epoxy check in the commercial dedication process for these commercial grade items. This would be a check for soft epoxy after heating of the coil by energization or in an oven. When this check is implemented, each device will be included so that the confidence level will be 100% based on using results from the Westinghouse research program to establish time and temperature. Depending on the success of the epoxy check, it may evolve into a sampling program.

14. Since these devices are manufactured as commercial grade items, what percent of the total number of relays manufactured are used in nuclear applications?

    Based on present day production, approximately three percent of those manufactured are processed through the Westinghouse program to dedicate them for nuclear safety related service.

15. What failure reporting, tracking method, or data base is used to determine the failure rate of safety related devices and those used in commercial applications? How many failures have there been?

    Westinghouse has compiled the failures reported directly to the nuclear divisions with data obtained from the Nuclear Plant Reliability Data System. This totals about 15 failures for safety related devices. Warranty information is the only source of data for commercial applications. Three were reported in the time frame of the original issue in 1982 and none since.

16. What is the present dedication process and how will Westinghouse change it?

    The current dedication process consists of a visual inspection and contact overtravel measurements followed by electrical tests, i.e., coil resistance, dielectric test, and pick-up and drop-out measurements. At this time, it is planned that an epoxy check at an elevated temperature for an established period of time will be added to the program.

17. What efforts have been made by Westinghouse to determine the failure frequency rate? What are the up-to-date results in terms of X failures in Y total population that have been studied? How does that population compare with, (a) the total number of safety related in nuclear plants; (b) the total number in nuclear plants, and (c) the total number shipped since 1975?

Westinghouse has reviewed Nuclear Plant Reliability Data System data and combined with failures reported directly to Westinghouse, the total is about 15. Since the utilities received notification of this issue, no reports of previous failures have been forwarded to Westinghouse. Westinghouse does not have a record of the total number of these items in nuclear power plants or in safety related applications. Extrapolating the replacement parts provided through the Westinghouse commercial dedication process over the last few years yields a total supplied of over 12,000 since 1975. Since the 15 failures have occurred over the last ten years a failure rate for that period of time based on replacement parts would be 15 out of 8000 or approximately 0.2%.

18. What is known about the minimum time and temperature combinations that can cause flowing?

The minimum temperature to prove that an epoxy mix and cure is acceptable has been estimated to be 180^0F. The minimum time to obtain epoxy softening on the returned items has been about twenty minutes. Westinghouse has conservatively based the acceptance criteria on soft epoxy and soft epoxy does not mean that it will flow and cause degraded performance of the device. The testing program that Westinghouse has begun will determine time and temperature combinations required to soften various epoxy mix ratios.

19. Please provide drawings or accurate sketches of affected models.

Attached please find product literature for the five items under question. If the NRC determines that more detailed information is necessary, proprietary drawings are available for review at Westinghouse.

20. Do these relays still meet the environmental qualification requirements of 10 CFR 50.49?

These relays are to be used in a mild environment only and therefore do not meet qualification requirements outlined in 10CFR50.49. A relay with properly processed epoxy still will meet its performance requirements for its service condition, i.e., seismic and abnormal ambient conditions. Flowing epoxy could cause the same performance concerns during a seismic event that could occur during normal service conditions.

21. Provide a justification as to Why this failure mode is not a batch problem and describe the ability of the licensee's current surveillance methods to determine relay operability of operating reactors for both energized and deenergized applications. What modifications should be made to enhance these methods? Why is this problem only limited to the BNL-type relays?

    The number and random nature of the reported failures indicates that the failures are not batch related. At this time, Westinghouse believes that a poor epoxy mix could lead to the situation. Other potential deficiencies would tend to lead to batch issues and more reported failures. The Brookhaven National Laboratory was supplied with a special run of 12VDC relays since none were available from stock. It is possible that hand mixed epoxy was used and that the flowing epoxy from this batch is due to a different mechanism than the relays produced from a typical production run. The results of the evaluation of samples from the returned relays may help to confirm this. Westinghouse is not familiar with the testing and surveillance methods used by all utility customers and, therefore, cannot address the ability of the methods used to identify devices affected by this issue.

22. Describe the research program and testing to be done by Westinghouse and the expected results. Include the number of devices to be tested at each set of test conditions. Will the tests be conducted in accordance WCAP-8370 (that is, using calibrated test equipment, approved test procedures, documentation of results, etc.)?

Several analytical methods are being used to determine glass transition temperatures, cure time vs. compound mix ratio, and gelation times vs. mix ratio vs. temperature. Other methods will identify the compounds present in the returned failed relays. Typically, three samples will be utilized for each phase of the program. Tests are conducted using calibrated test equipment following procedures for that equipment and the results will be documented in proprietary report form.

23. What will be the origin of the test samples and what assurance will there be that the samples are representative of what is in the field?

The primary goal of the research program is to provide guidance for testing of devices both in the field and for the Westinghouse dedication process. Toward this end, samples are prepared with various mix ratios from new materials in order to establish/confirm time and temperature for the epoxy check. Additional information may be gained through the identification of the compound materials from returned field failures.

24. Please provide us with a copy of your research program and the test results.

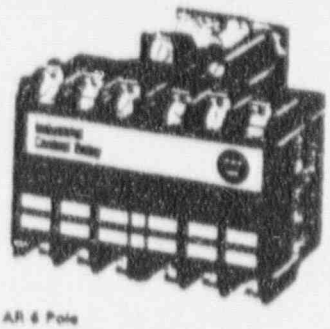
The results of the research program will be shared with the NRC.

25. What efforts have been made by Westinghouse, or are known to Westinghouse, to seek out additional reports of defective relays to justify your conclusion that there have been few relay failures? What are these results?

Westinghouse has reviewed Nuclear Plant Reliability Data System data and combined with failures reported directly to Westinghouse, the total is about 15. Since the utility customers received notification of this issue, no report of previous failures have been forwarded to Westinghouse by the utilities. The manufacturer has not received any claims reflecting this issue since about 1982 for commercial grade devices, indicating that the number of failures is extremely small.

INDUSTRIAL CONTROL RELAYS
Types AR 600 Volt Ac, ARD 600 Volt Dc, Convertible Contacts

AR 4 Pole



AR 6 Pole

Application
AR/ARD relays are designed for use on machine tools, process lines, conveyors, and similar automatic and semi-automatic equipment.

AR/ARD relays are electro-mechanical convertible contact relays. AR relays are Ac devices, and the ARD is for Dc applications.

Description
Available in either 4 or 6-pole configurations, AR relays are easily converted to 8 or 10 poles simply by adding a 4-pole deck. In addition, mechanical latch and pneumatic or solid state timer attachments are available for use with 4 and 6-pole relays.

Contacts are convertible from either NO to NC to provide any combination desired, up to a maximum of 10, except that for the ARD, the number of NC poles cannot exceed **four** in any pole configuration. Wide spacing of contacts simplifies installation, contact testing, and maintenance. Contacts are electrically and mechanically isolated from each other. Overlap contacts are also available in one or two sets. These contacts should be mounted in the center pole positions. Ac and Dc contact cartridges should not be used in the same relay.

Contact Ratings
600 Volt Ac Cartridges NEMA A600

Volts	Cont Current	Max Current		Max VA	
		Make	Break	Make	Break
120	10	60	6	7200	720
240	10	30	3	7200	720
480	10	15	1.5	7200	720
600	10	12	1.2	7200	720

Dc Cartridges NEMA P600

Volts	Cont Current	Max Current	Max VA
		Make or Break	Make or Break
125	5	1.1	138
250	5	.55	138
600	5	.20	138

Resistive Load
125V Dc: 3.0 amps
250V Dc: 1.5 amps

Coil Power Requirements
Ac: 96 VA open, 14 VA close
Dc: 14 watts open, 250 volts max

Ordering Information
- Order by catalog number. AR relays listed have 120/110 volt, 60/50 Hz coils, and ARD relays have 120 volt Dc coils.
- If a different coil voltage is required, select the catalog letter from the **Coil Voltage Table** below and substitute it for the SHADED letter in the catalog number.
- AR and ARD relays listed are supplied with NO contacts which are easily converted to NC. If both NO and NC poles are required, order by catalog number. **Example:** 4 pole relay with **1** NO and **3** NC contacts, order **AR413A**. **Add $12 list** per relay.
- **SCREW Terminals** – For ring-type connectors, add Suffix R to the catalog number. Example: **AR420AR**. No additional charge.
- **OVERLAP Contacts** – Overlap contacts for AR and ARD relays are designed so that a normally open contact closes before the corresponding normally closed contact opens. Overlap contacts come in NO/NC sets of two cartridges. Add catalog letter Suffix **S** to the catalog number. **Example:** AR420AS. Specify the number of sets required: **S** for one set and **S2** for two sets. **Add $12 list** per relay.

Coil Voltage Table

AR Coils			ARD Coils	
Volts Ac	Hz	Catalog Suffix	Volts Dc	Catalog Suffix
12	60	F	12	D
24	60	I	24	L
48	60	G	48	M
110	60	V	95	B
208	60	B	110	U
240/220	60/50	W	240	T
277	60	C	250	V
440/380	60/50	H	550	S
480/440	60/50	X		
550	60	D		
600/550	60/50	E		

List Prices and Catalog Numbers
AR/ARD Relays

Number of Pole Spaces	Contacts NO	Contacts NC	Blank Cavities	AR 600 Volt Ac Relays 120/60, 110/50 Ac Coil Catalog Number	AR 600 Volt Ac Relays List Price	ARD 600 Volt Dc Relays 120 Volt Dc Coil Catalog Number	ARD 600 Volt Dc Relays List Price
4	0	0	4	AR4A	$ 48	ARD4S	$108
	2	0	2	AR420A	72	ARD420S	132
	4	0	0	AR440A	96	ARD440S	156
6	0	0	6	AR6A	48	ARD6S	108
	4	0	2	AR640A	96	ARD640S	156
	6	0	0	AR660A	120	ARD660S	180
8③	6	0	2	AR860A	120	ARD860S	180
	8	0	0	AR880A	144	ARD880S	204
10③	10	0	0	AR10100A	168	ARD10100S	228

Contact Cartridges

Type Terminal	Standard Contact Cartridges Catalog Number	Standard Contact Cartridges List Price①	Overlap Contact Cartridges Catalog Number②	Overlap Contact Cartridges List Price②
600 Volt Ac Cartridges				
With Clamp Terminals	ARC	$12	AROC	$24
With Screw Terminals	ARCR	12	AROCR	24
600 Volt Dc Cartridges				
With Clamp Terminals	ARDC	12	ARDOC	24
With Screw Terminals	ARDCR	12	ARDOCR	24

① Standard cartridges are sold in cartons of 4 cartridges. Catalog number and list price are for single cartridge.
② Overlap contact cartridges are sold in sets of 2 cartridges. Catalog number and list price are for sets of 2.
③ Will not accept top mounted latch or timers.

FURTHER INFORMATION
Discount C10-S12
UL File No. E19223
CSA File No. LR39402-6, LR54517 and

INDUSTRIAL CONTROL RELAYS
Types AR 600 Volt Ac, ARD 600 Volt Dc
Convertible Contacts

Four Pole Top Deck Adder

- Increases contact capacity from four/six poles to eight/ten poles.
- Mounts on top of basic relay using three screws.
- Will not interfere with wiring, testing or converting cartridges.
- Screw terminals for ring connectors available; to order add Suffix R to catalog number of adder.

List Prices

No. of Pole Spaces	Contacts N.O.	Contacts N.C.	Contacts Blank Cavities	Catalog Number	List Price
With 600 Volt Ac Cartridges					
4	2	0	2	ARA20	$24
	4	0	0	ARA40	48
With 600 Volt Dc Cartridges					
4	2	0	2	ARDA20	24
	4	0	0	ARDA40	48

ARPT Pneumatic Timer

For AR Relays

- Includes 1 N.O. and 1 N.C. non-convertible timed contacts.
- Mounts on basic four or six pole AR Relay. Not for use on Dc.
- Field convertible between On Delay and Off Delay.
- Repeatability accuracy: ± 15%

List Prices

Timing Range Seconds	Catalog Number	List Price
2-20	ARPT-20	$168
4-60	ARPT-60	168
20-200	ARPT-200	168

Contact Ratings: NEMA A600

Ac Volts	Normal Load Break (Amps.)	Inrush and Interrupting Capacity (Amps.)
120	6.0	60
240	3.0	30
480	1.5	15
600	1.2	12

ART Solid State Timer

- Mounts on basic four or six pole relay using two screws.
- Has one N.O. Solid State Contact.
- On Delay or Off Delay applications.
- Will switch 120 volt Ac and Dc coils.
- ARTD is field convertible to 24 or 48 volts Dc.

List Prices

Voltage	Time Delay Seconds	Catalog Numbers On Delay	Catalog Numbers Off Delay	List Price
Ac	1-30	ART-ON	ART-OF	$258
Ac	30-60	ART-DNB	ART-OFB	288
Dc	1-30	ARTD-ON	ARTD-OF	288

Electrical Ratings

Input: 120 Volts Ac, ±10%, 50/60 Hz
120, 48, 24 Volts Dc, ±10%
Power Required: Ac, Dc, 2 VA max.
Contact Ratings: Ac, 2 amps inductive (1.3 amps max. inrush.)
Dc, will switch 4, 8, and 10 pole ARD relays:
48 Volts Dc, .25 amp.
24 Volts Dc, .5 amp.
Repeatability: Ac ±2% with 10% voltage variation, ±7.5% with 15°C temperature variation;
Dc, ± 1% with 10% voltage variation, and 15°C temperature variation
Ambient Temp. Range: – 20°C to + 70°C
Duty Cycle: Ac, Dc: 150 Operations/minute max.
Reset Time: ART and ARTD
On Delay: ART, 50 ms Max; ARTD, 100 ms independent of time setting and duty cycle.
Off Delay: Instantaneous

ARML Permanent Magnet Latch

For AR/ARD Relays

By energizing the relay coil, the latch attachment "sets" (when the base relay's armature/crossbar assembly has closed) holding the relay "On", even after the relay coil has been de-energized. The clearing coil on the latch is energized to release the armature/crossbar assembly.

- Field mountable to four and six pole.
- Latch plunger is adjustable.

- Latch coil continuously rated.
- Unlatching power requirement:
  Open Gap: 24 VA
  Closed Gap: 7 VA
  Burden: 4 Watts Ac, 6 Watts Dc

List Prices – Permanent Magnet Latch

For Ac Control Circuits

Operating Volts	Coil Hz	Catalog Number	List Price
24	60	ARMLJ	$84
48	60	ARMLG	84
120	60/50	ARMLA	84
240	60/50	ARMLW	84
220	60	ARMLB	84

For Dc Control Circuits

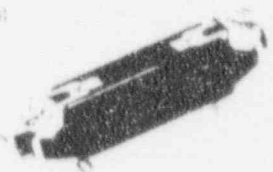
Coil Volts	Catalog Number	List Price
24	ARMLL	$111
48	ARMLM	111
120	ARMLS	111
240	ARMLT	111

Mounting Strip for AR/ARD

No. of Relays 4 Pole	No. of Relays 6 Pole	Catalog Number	List Price
4	2	ARMSA	$12.00

ARSS Surge Suppressor

For AR Relays:



- Mounts in contact cavity of AR relays.
- Limits high transient voltages resulting from de-energizing relay coil or other electro-mechanical devices.
- Protects sensitive instruments and solid state devices.
- 120 Volts Ac max. Not for use on Dc.
- For noise suppression, see Cat. No. SS-56 starter-mounted surge suppressor, p. 313.

Catalog Number: ARSS. List Price: $24

FURTHER INFORMATION

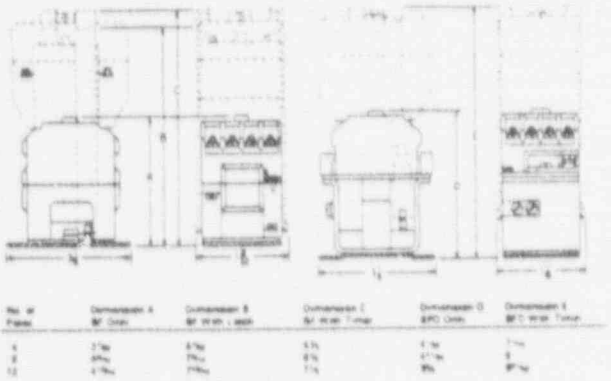
IL 14510, IL 14485: ART, ARTD
IL 14846: ARPT
Renewal Parts, Page 545
Enclosures, Page 375
UL File No. E19223
CSA File No. LR39402-6, LR54517, and LR54520

INDUSTRIAL CONTROL RELAYS
Dimensions and Weights

Dimensions

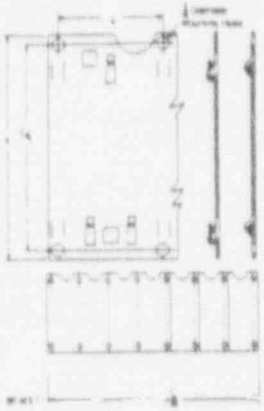
In Inches *Not to be used for construction purposes unless approved.*

BF Relay With Permanent Magnet Latch and Solid State Timer



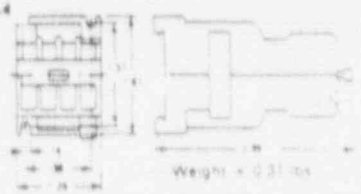
BFD Relay With Solid State Timer

BF Mounting Strip Dimensions, Inches

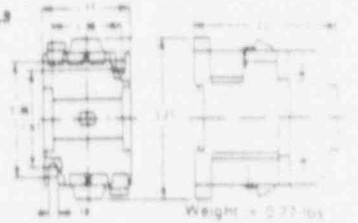


IEC Control Relays

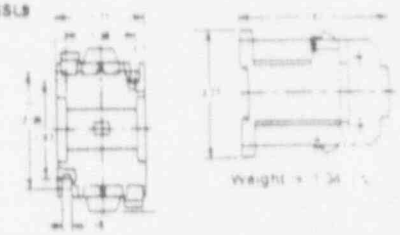
DSL4



DSL9



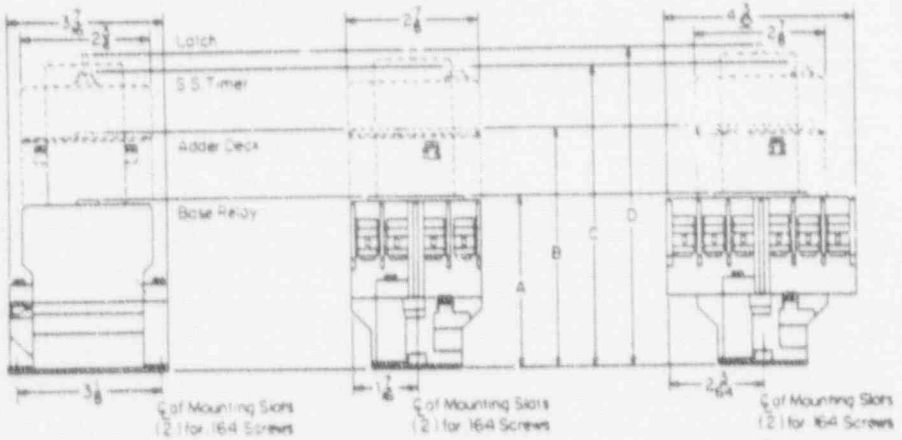
DGSL9



Auxiliary Devices	Dimensions H	W	D	Weight Lbs
SF, SV	2.06	1.77	1.38	.220
ZF, ZA	1.89	1.77	2.13	.022

AR/ARD Relays and Accessories

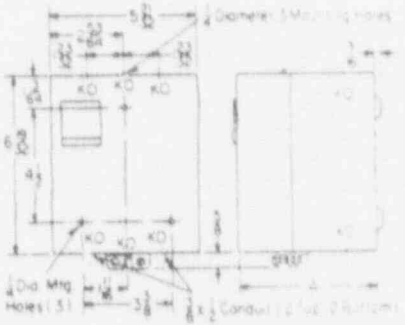
4 and 6 Pole Relays with 4 Pole Adder, Solid State Timer and Mechanical Latch



End View, 4 and 6 Poles — Side View, 4 Pole — Side View, 6 Pole

Description	Dimen.	AR	ARD	Description	Dimen.	AR	ARD
4, 6 Pole Relays	A =	3	4	Relay w/Timer	C =	5	7
Relay Adder	B =	4	5	Relay w/Latch	D =	6	7

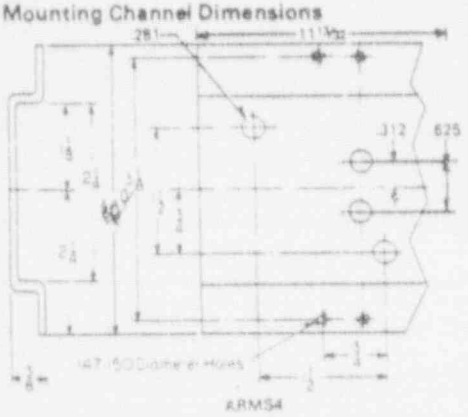
Enclosures
NEMA 1 for BF, BFD, AR, ARD, VSR



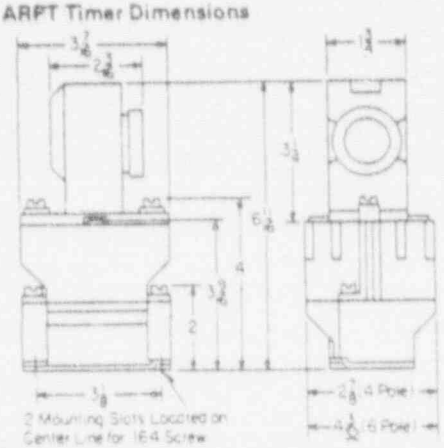
Relays w/o Attachments	Poles	Dim. A NEMA 1
BF, AR, ARD, VSR	All	5
BFD	4-8	5
BFD	10, 12	11

Relays w/ Attachments	Poles	Dim. A NEMA 1
BF, AR, ARD	All	7

Mounting Channel Dimensions



ARPT Timer Dimensions



Instructions for Class DPCK 250 Ampere Magnetic Contactor, Non-reversing, 2 or 3 Pole

I.L. 14495C

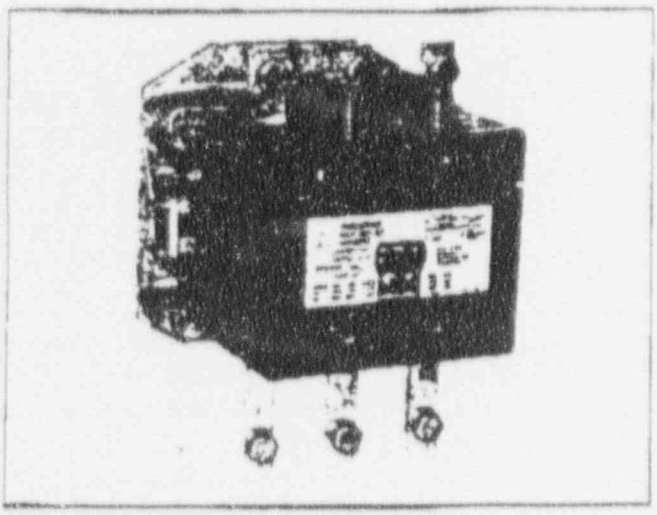


Fig. 1 250 Ampere DPCK Contactor

THE CONTACTOR

DPCK contactors are designed for the control of inductive or non-inductive loads at voltages between 120 and 1500 AC. The units are suitable for mounting on either steel or insulated panels. All parts are front removable. Contactors should be protected against short circuits by branch circuit protective devices selected in accordance with the National Electrical Code (NEC).

This industrial type control is designed to be installed, operated, and maintained by adequately trained workmen. These instructions do not cover all details, variations, or combinations of the equipment, its storage, delivery, installation, check out, safe operation, or maintenance. Care must be exercised to comply with local, state, and national regulations, as well as safety practices, for this class of equipment.

CONTACTOR RATINGS

Volts, 1 or 3 Phase	Full Load Current, Amperes	Locked Rotor Current, Amperes	Resistive Load, Amperes	Lighting Load, Amperes	Maximum Inrush Current Peak Amperes (incl. offset)
120	250	1500	250	250	3200
240	250	1250	250	250	3200
480	250	1000	250	250	3200
600	250	1000	250	250	3200
1000	220	1000			
1500	150	900			

Two-pole contactors have the same current ratings as 3 pole devices but are not suitable for controlling three-phase motors.

OPERATION

Each DPCK Contactor is equipped with an AC to DC coil. The power applied is normal AC voltage but the coil has an internal rectifier that converts AC power to hum that occasionally comes with AC coils. Do not use any previous model AC coils with controllers marked "Model B". A coil clearing interlock Catalog No. L56X is supplied with each contactor and with replacement coils. This combination provides transition from pull-in power to holding power. If replacement is needed, do not substitute an interlock with another catalog number. The coil is wired per Figure 3

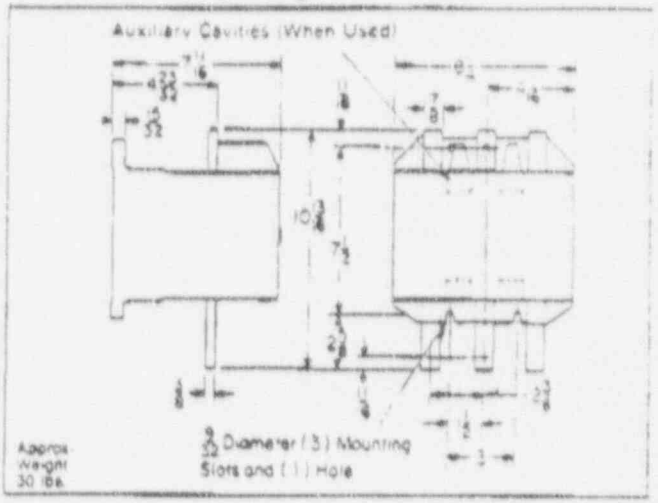


Fig. 2 Dimension Drawing (Dim. in inches)

AC/DC Coil Data	Inrush VA	Sealed VA	Sealed Watts
	1000	40	5

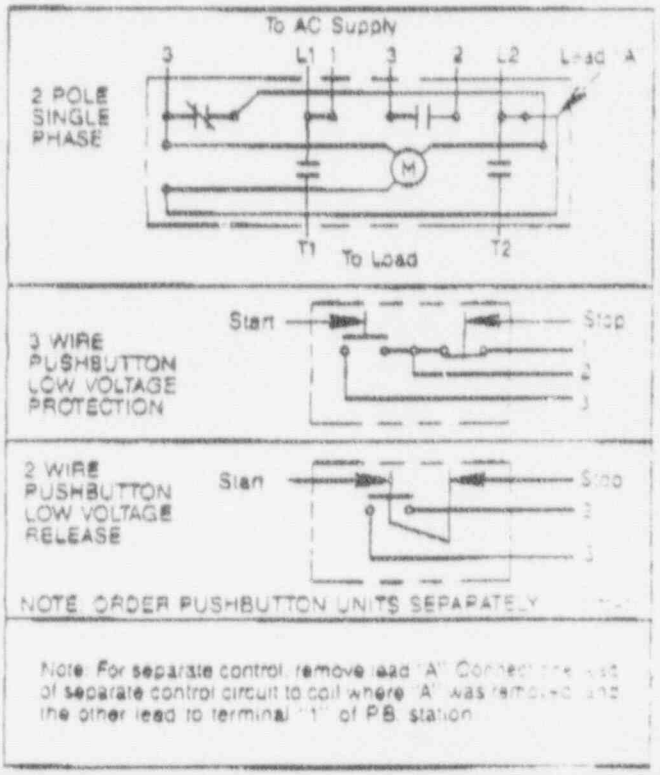


TABLE I — REPLACEMENT COIL KITS	
Voltage, 50/60 Hz	Kit Part No.
110	5249C90G01*
220-240	5249C90G02*
440-480	5249C90G03*
550	5249C90G05*

* Includes L56X coil clearing interlock

TABLE II — PARTS KITS	
Description	Kit No.
Contact Replacement, 2 Pole	672B839G23
Contact Replacement, 3 Pole	672B839G22
Auxiliary Contacts, 1 NO and 1 NC	L56
Line, Load Terminal Kit, 1 Pole	TK250A†

† [illegible]

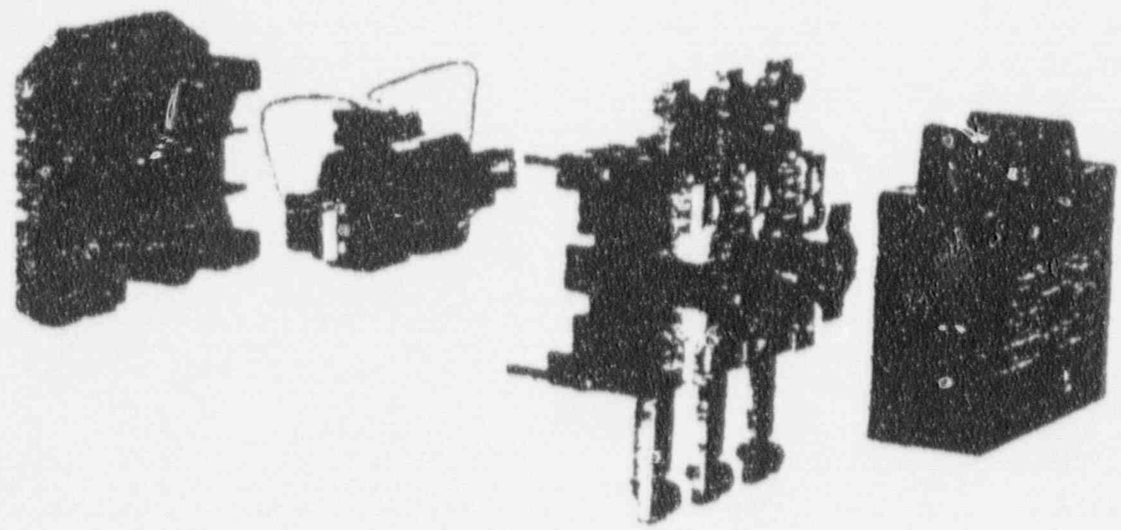


Fig. 4 250 Ampere DPCK Magnetic Contactor (Exploded View)

MAINTENANCE — First Turn Off Power

To Inspect Contacts

Refer to Figure 4. Loosen the four arc box cover screws (7) located immediately above and below the nameplate and remove the arc box (8). Contacts (5) are visible. Retighten the screws per Table III.

To Replace Contacts

After removing the arc box and with replacement contacts at hand, remove the moving contact and contact carrier (3) by pulling the saddle (4) outward, and displacing the damping spring (2) and moving contact (5) from the crossbar (6). Remove the retaining screw (11) and lift out the stationary contact assembly (12).

To replace contacts, reverse the above procedure making sure that stationary contacts are secure, (see Table III) moving contacts are free to move, overtravel springs are seated and the crossbar moves freely when the arc box is in position.

The silver cadmium oxide contact buttons need NO dressing or lubricant throughout their life.

Important — Replace all contacts and springs as a group to avoid misalignment.

To Replace The Coil

Refer to Figure 9. Loosen the four assembly screws (10) located at the corners of the base of the contactor. Disconnect the coil leads. Pull the loosened upper base structure (9) forward. Pull the coil (1) from the lower base, plug in a new coil, replace the upper base structure and check the auxiliary contacts for secureness when repositioning the upper base. Tighten the assembly screws referring to Table III.

Magnet — Armature Assembly

Self alignment and permanent air gap features of the magnet armature make replacement unnecessary. Mating pole face surfaces should be kept clean.

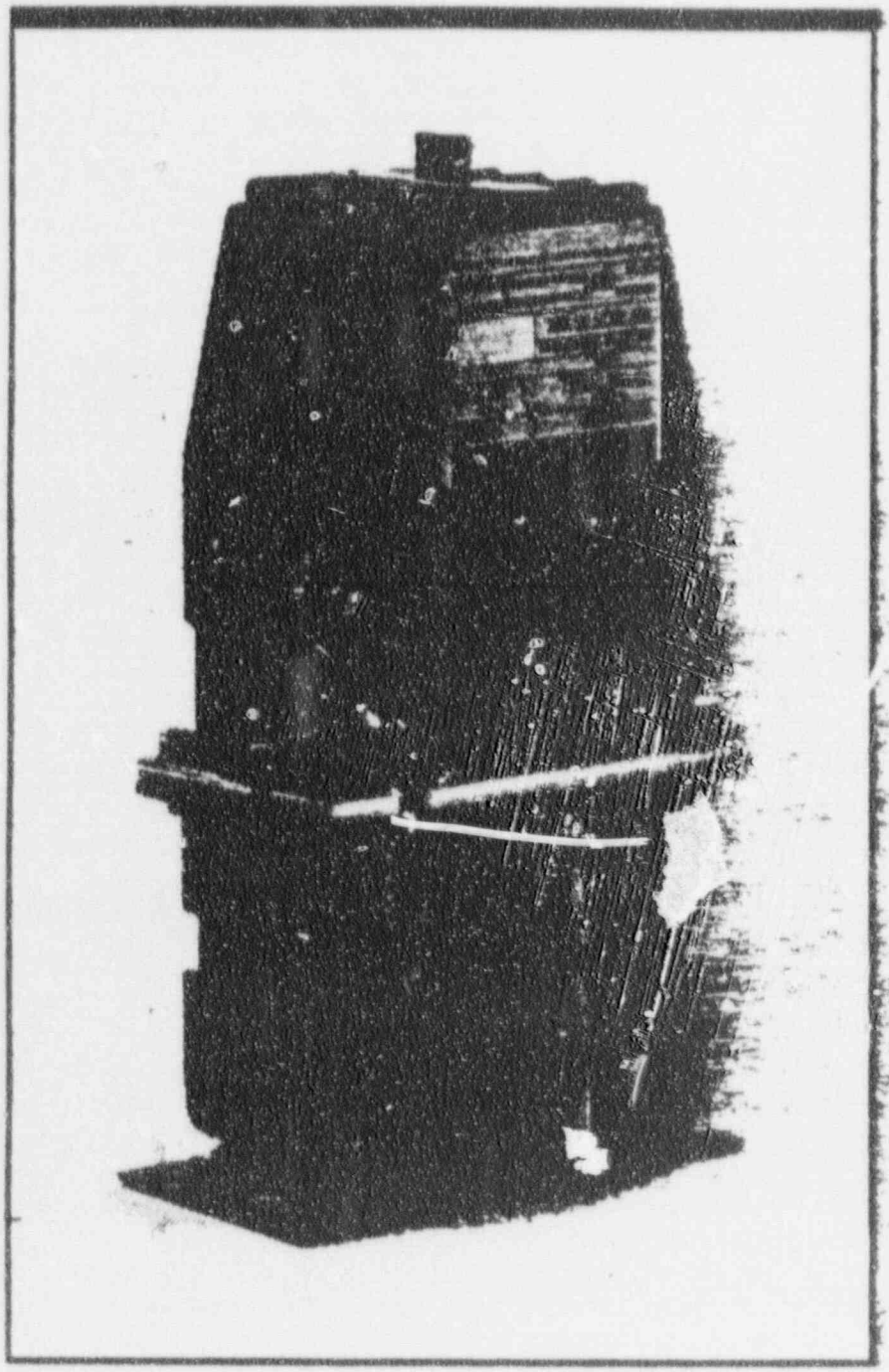
Arc box must be in place when the contactor interrupts a circuit.

TABLE III — RECOMMENDED DRIVING TORQUE		
Location (Qty.)	Driving Torque (lb.-in.)	Fig. 4 Item
Arc Box Cover Screw (4)	18— 21	7
Coil Wire Connector (2)	9— 12	13
Stationary Contact Screw (2/pole)	25— 30	11
Main Power Connector (2/pole)	75—100	14

Westinghouse

Replacement
Component
Services

Class 1E
NBFD Nuclear Control Relays



Replacement Components Services (RCS) has developed a seismically qualified nuclear control relay that effectively replaces all former NBFD models. This single replacement relay can contribute to reducing plant inventory needs, paperwork, administration effort and costs.

These newly manufactured relays feature several design enhancements. A reduction in the moving-parts mass and increased spring force enhance seismic performance. The relay dual coil is designed to help reduce heat generation and run cooler under continuous operating conditions.

... We're PARTicular

DESCRIPTION

The NBFD66NR relay is an 11-pole, 125V DC nuclear control relay that can be substituted, one for one, for all 4-pole and most 8- and 12-pole relays.

Mechanical Specifications

Pole Configuration	6 NO and 5 NC, 10 amp contacts (1 NC contact used for coil control)
Mounting	Same as Westinghouse NBFD relay family
Reduced Heating	Dual coil designed to reduce coil heating under continuous operating conditions
Reduced Coil Burden	Dual coil designed to minimize operating coil load
Qualified Service	20 years in mild power system environments
Seismic	Enhanced seismic performance (>2.0 ZPA)
Contact Service	100,000 operations - AC loads 15,000 operations - DC loads
Contact Terminals	Suitable for ring terminations

Electrical Specifications

Operating Voltage	
Minimum	100 VDC
Maximum	145 VDC (continuous for 4 to 8 hours)
Average	125 VDC (rated voltage)
Drop-Out	>12.5 VDC
Pick-Up Time	<50 milliseconds
Drop-Out Time	<20 milliseconds
Coil Burden	<9 watts
Contact Rating	10A thermal rating
NEMA A300	7200 VA make/720 VA break @ 600 VDC
NEMA P300	1.1 amp make/break @ 250 VDC

Environment

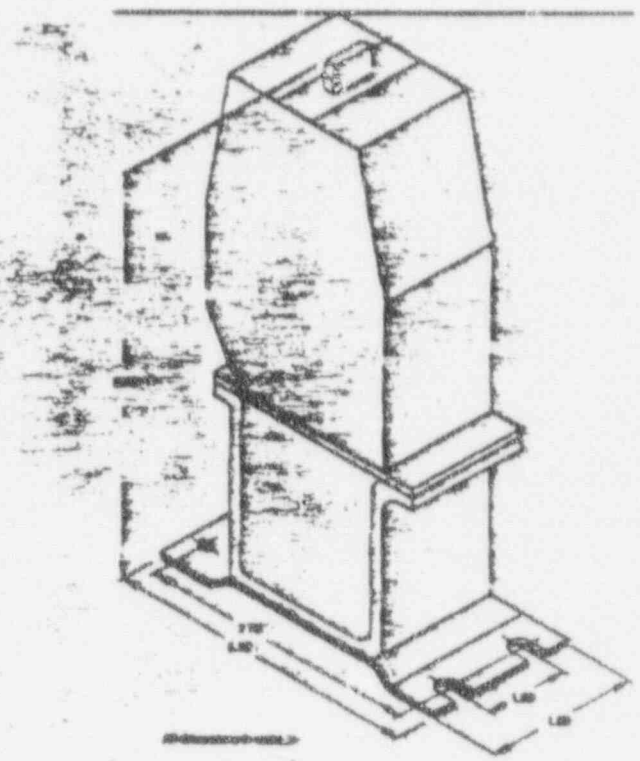
Operating Temperature	40°F to 120°F
Operating Relative Humidity	40% to 95%
Seismic Qualification	>2.0 ZPA

Applicable Standards

NEMA ICS 2-212
IEEE 323-1974
IEEE 344-1975

RELAY REPLACEMENT

Part Number Old	Part Number New	Catalog Number Old	Catalog Number New	Contacts NO	Contacts NC	Number NBFD Reqd.
5072A48G01	9084A70G01	NBFD11a	NBFD66NR	1	1	1
02	"	NBFD02a	"	0	3	1
03	"	NBFD31a	"	3	1	1
04	"	NBFD22a	"	2	2	1
05	"	NBFD33a	"	3	3	1
06	"	NBFD24a	"	2	4	1
07	"	NBFD62a	"	6	2	1
08	"	NBFD44a	"	4	4	1
09	"	NBFD64a	"	6	4	1
10	"	NBFD120a	"	12	0	2
11	"	NBFD84a	"	8	4	2
12	"	NBFD66a	"	6	6	2
13	"	NBFD67a	"	5	7	2
14	"	NBFD48a	"	4	8	2
15	"	NBFD75a	"	7	5	2
16	"	NBFD40a	"	4	0	1
17	"	NBFD60a	"	6	0	1
18	"	NBFD80a	"	8	0	2
19	"	NBFD13a	"	1	3	1
20	"	NBFD53a	"	5	3	1
5076A01G01	"	NBFD04a	"	0	4	1
02	"	NBFD08a	"	0	8	2
03	"	NBFD42a	"	4	2	1
04	"	NBFD55a	"	5	5	2
05	"	NBFD62a	"	6	2	2



FOR MORE INFORMATION
Please contact your local Westinghouse representative.
Or call RCS direct at 800-458-2206.

Supplementary Instructions for DC Actuated Contactors Size 00, 0, 1, 2, 3 or 4

I.L. 13629D

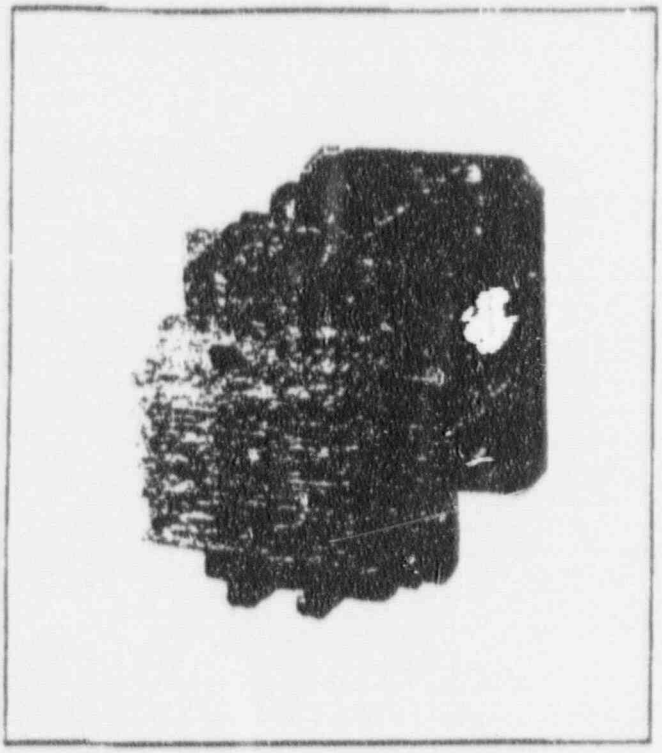


Fig. 1 Size 2, DC Actuated Contactor

THE CONTACTOR

The current carrying portion of a DC actuated contactor is identical to that of an AC actuated contactor and therefore the same ratings apply, except for the coil. Class A201 DC actuated contactors are combined with overload relays to create Class A200 starters (controllers). See the appropriate instruction leaflet for connection diagrams, ratings, accessories and wiring instructions.

TABLE I — INSTRUCTION LEAFLETS		
AC Device Size	AC Actuated Contactor I.L. Number	AC Actuated Controller I.L. Number
00, 0, 1	I.L. 16960	I.L. 16958
2	I.L. 16961	I.L. 16959
3, 4	I.L. 13238	I.L. 15465

This industrial type control is designed to be installed, operated, and maintained by adequately trained workmen. These instructions do not cover all details, variations, or combinations of the equipment, its storage, delivery, installation, check-out, safe operation, or maintenance. Care must be exercised to comply with local, state, and national regulations, as well as safety practices, for this class of equipment.

AUXILIARY CONTACTS

A J20 auxiliary unit with two normally-open poles is supplied as the holding circuit auxiliary and is mounted in the upper left hand corner cavity of the contactor. A maximum of four Type J auxiliary units can be installed in the cavities of each non-reversing contactor. These may be mounted with the terminals in line with the power poles or may be mounted with the terminals in a right angle relationship to the power poles. They mount by means of a spring clip which snaps into locations provided in the contactor. To remove the J20 loosen the retainer screw several turns (counterclockwise) and slide the auxiliary unit out of the contactor cavity.

TYPE J AUXILIARY CONTACTS	
Contact Type	Catalog No.
2 Normally-Closed	J02
2 Normally-Open	J20
1 Normally-Open and 1 Normally-Closed	J11
1 Normally-Open and 1 Normally-Closed Delayed Break	J1C

TYPE J CONTACT RATINGS (A600, R300)			
Voltage	Continuous	Make	Break
120-600 VAC	10A	7200VA	720VA
72-120 VAC	10A	60A	720VA
28-72 VAC	10A	60A	10A
28-300 VDC	1.0A	28VA	28VA

COIL REPLACEMENT

Order replacement coil by voltage and part number shown in Table II.

TABLE II — REPLACEMENT COILS		
	Replacement Coil Part Numbers	
DC Voltage	Sizes 00, 0, 1 and 2 (2 and 3 Pole Only)	Sizes 3, 4 (2 and 3 Pole Only)
24	1268C86G04	1255C68G04
48	1268C86G05	1255C68G05
125	1268C86G02	1255C68G01
250	1268C86G01	1255C68G02
125/250*	1268C86G03	1255C68G03

*Dual voltage. Use only on contactors or starters originally supplied with a dual voltage coil.

SIZE 00, 0, 1 AND 2 - COIL REMOVAL AND REPLACEMENT

1. **First turn off all power.** Refer to Figure 2.
2. Loosen the appropriate wiring to allow the top section of the contactor to be removed.
3. Loosen the two screws (6) located between the two center poles of the Size 00, 0 or 1 contactor, or at the sides of the arc box of the Size 2 contactor, and lift off the section of the contactor assembly.
4. Remove the kickout springs (2) and the two screws located in the cavity (12) adjacent to the kickout springs and withdraw the molded coil structure (3).
5. Replace the coil and parts in the opposite order, making sure that the auxiliary contacts, if used, are properly seated, and that with the arc box (11) mounted, the crossbar (9) moves freely without binding when manually actuated.

SIZE 3 AND 4 - COIL REMOVAL AND REPLACEMENT

1. **First turn off all power.** Refer to Figure 2.
2. Loosen the appropriate wiring to allow the top section of the contactor to be removed.
3. Loosen the two screws (6) located at the sides of the arc box (11) and lift off the top section of the contactor.
4. Remove the four screws (2) attaching the coil (3) to the base (1), and withdraw the molded coil.
5. Replace the coil and parts in the opposite order making sure that the auxiliary contacts, if used, are properly seated, and that with the arc box (11) mounted, the crossbar (9) moves freely without binding when manually actuated.

TABLE III — CONTACT RENEWAL KITS

Size	Pole Arrangement	Part Number
00	3 or 4 Poles	3738331G18
0	3 or 4 Poles	3738331G04
1	3 or 4 Poles	3738331G09
2	3 Poles	6725758G19
3	3 Poles	6268187G13
4	3 Poles	6268187G17

CONTACT REPLACEMENT

Order replacement contacts by part number shown in Table III.

SIZE 00, 0 AND 1 - CONTACT REMOVAL AND REPLACEMENT

1. **First turn off all power.** Refer to Figure 2.
2. Loosen the two captive screws (10), and remove the arc box (11).
3. Change the bridging contact (7) as follows:
   a. Lift one keeper and spring (8) together (preferably by using a flat tool or screwdriver blade).
   b. Rotate the bridging contact (7) approximately 45 degrees.
   c. Withdraw the bridging contact (7) from crossbar (9).
   d. Replace the bridging contact (7) by repeating steps a and b, then inserting the bridging contact (7) into the crossbar (9), making sure that the centering lug on the contact (7) detents into the keeper.
4. Change the stationary contact (4) as follows:
   Note: The stationary contact and line or load terminal comprise one assembly.
   a. Remove all leads connected to terminals.
   b. Remove the screw (5) holding the contact assembly strap to the molded base.
   c. Replace the assembly in the opposite order.

SIZE 2, 3 AND 4 - CONTACT REMOVAL AND REPLACEMENT

1. **First turn off all power.** Refer to Figure 2.
2. Loosen the two captive screws (10) and remove the arc box (11).
3. Change the bridging contacts (7) as follows:
   a. To remove a bridging contact, compress the overtravel spring (8), and displace the bridging contact (7) from the crossbar (9).
   b. To replace a bridging contact (7), compress the overtravel spring (8) and slip the bridging contact (7) into position in the crossbar (9). Make sure the locating lug on the bridging contact (7) detents in the spring coil.
4. Change the stationary contacts (5) by loosening the retaining screw (4) and sliding the stationary contact out.

PRECAUTIONS

1. Replace all contacts as a group to prevent misalignment.
2. Do not apply any electrical power when any part of the contactor is disassembled.
3. Use the appropriate DC polarity as marked on the side of the coil.
4. Do not connect any AC power source to either coil terminal or to any portion of the control circuit which is connected to a DC source.

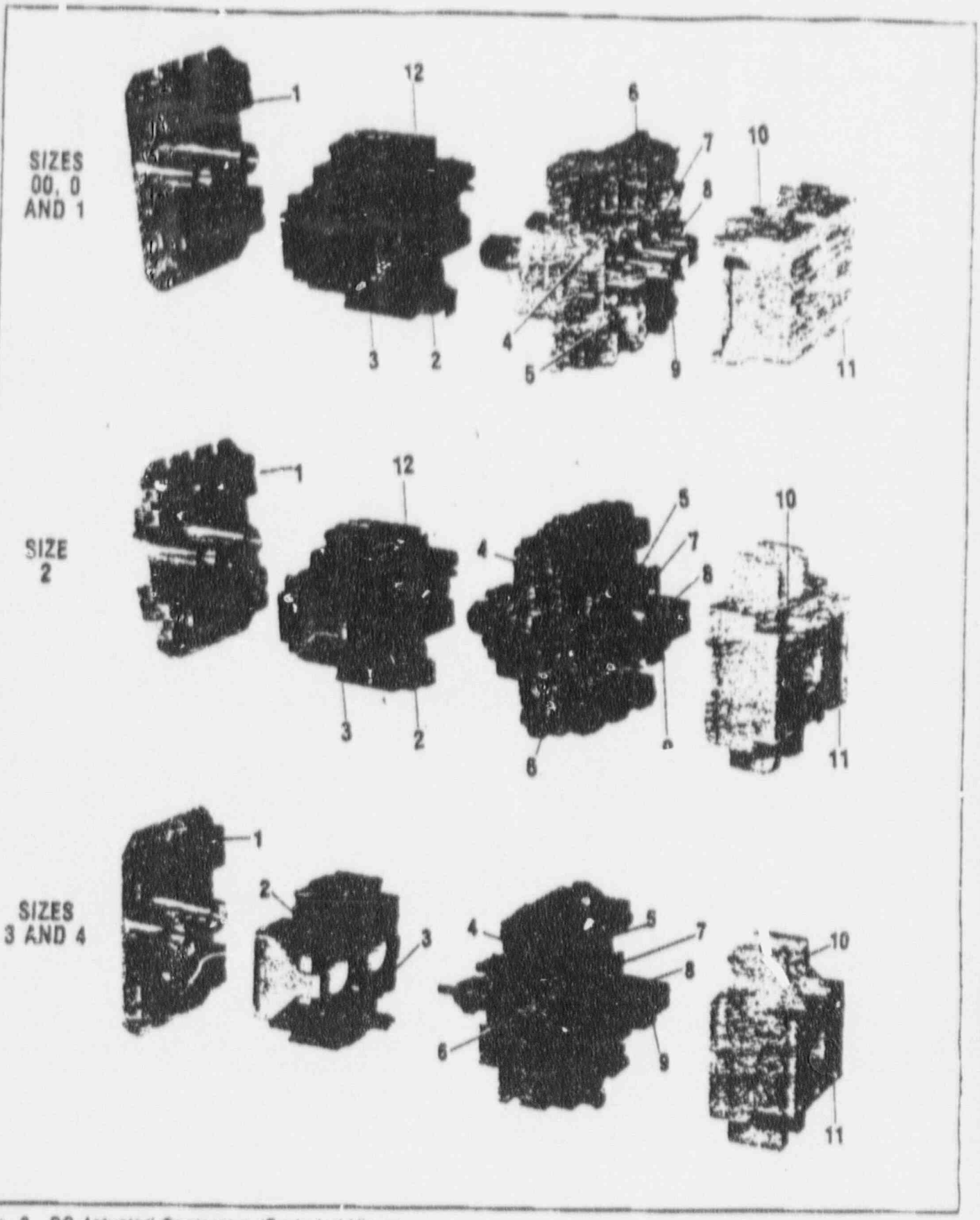


Fig. 2 DC Actuated Contactors (Exploded Views)

INDUSTRIAL CONTROL RELAYS

Type BF, 300 Volts Ac, Fixed Contacts
Type BFD, 250 Volts Dc, Fixed Contacts

Type BF

Type BFD

Type BF and BFD relays are compact industrial control relays ideally suited for machine tool and similar applications where size is a factor. Type BF is Ac operated, 300 volts maximum, and the BFD is Dc operated, 250 volts. Fixed contact relays are available in any combination of NO and NC from two to twelve poles. The NO and NC contacts are electrically isolated and both can be used without regard to polarity.

BF and BFD relays have captive clamp terminals fully accessible from the front, a molded coil with low operating temperature, and silver alloy contacts suitable for low voltage circuits. Overlap contacts are available. All contacts feature the exclusive knife-edge design which provides a "self-wiping" action on every closure.

Universal Contact Relays
These standard BF and BFD relays, shown in bold print below, are the most frequently ordered relays. In general, these relays have equal number of NO and NC contacts, or "poles", where each pole is an isolated Form A (NO) or Form B (NC) contact. Each of the Universal Relays are specially priced to provide one normally open and one normally closed contact at **no additional charge**. These relays can be ordered without knowing the exact contact configuration (NO versus NC) until the last minute – without having to pay extra for the additional contacts. The universal relays are also more cost-effective when contact configurations are known in advance.

Filler Relay
This is an empty relay case for mounting a timer, on a BF Mounting Strip (BFMS), when other relays cannot be used. Catalog Number: **BF00**.

UL and CSA Listed
All BF and BFD relays are UL and CSA Listed:
UL File No. E19223
CSA File No. LR39402-6, LR28548-10, 11

BF Relay Electrical Ratings
Ac Rating – NEMA A300

Volts	Maximum Current			Maximum VA	
	Cont.	Make	Break	Make	Break
120	10	60	6	1200	720
240	10	30	3	1200	720

Hp Ratings (UL Recognized)

Phase	Ac volts	
	115	230
1	1/2	1
3		1

Dc Rating – NEMA P300

Volts	Maximum Current			Maximum Make or Break VA
	Cont.	Make	Break	
125	5.0	1.1	1.1	138
250	5.0	0.55	0.55	138

Resistive Rating
125V Dc: 3 amps
250V Dc: 1.5 amps

Coil Power Requirements
Ac: 72 VA open, 12 VA closed
Dc: 12 watts, 250 volts max.

Electrical Characteristics

- Order by catalog number. BF relays listed have 120/110 volt, 60/50 Hz coils, and BFD relays have 120 volt Dc coils.
- If a different coil voltage is required, select the catalog letter from the **Coil Voltage Table** below and substitute it for the SHADED letter in the catalog number.
- **FASTON Terminals** – All relays are available with FASTON (Trademark of Amp, Inc.) push-on terminals. Add letter F to catalog number after relay type; example: **BFF22F** or **BFDF22S**. **Add $1.50 list per pole per relay.**

Examples: BFF11F, add $3.00 list (2 pole relay) or $75 list ($72 + $3). BFF66F, add $18.00 list (12 pole relay) or $150 list ($132 + $18).

- **OVERLAP Contacts** – Overlap contacts for BF and BFD relays are designed so that a normally open contact closes before the corresponding normally closed contact opens. Overlap contacts come in NO NC sets. For easy identification, these contacts are red in color. Add letter A to the catalog number. Example: BFA22A. Specify the number of sets required and **add $18 list per set.**

List Prices and Catalog Numbers

Number of Poles	Contacts		BF 300 Volt Ac Relays 120/60, 110/50 Ac Coil		BFD 250 Volt Dc Relays 120 Volt Dc Coil	
	N.O. (Form A)	N.C. (Form B)	Catalog No.	List Price	Catalog No.	List Price
2	2	0	BF20F	$ 72	BFD20S	$102
	1	1	BF11F	72	BFD11S	102
	0	2	BF02F	72	BFD02S	102
3	3	0	BF30F	84	BFD30S	114
	2	1	BF21F	84	BFD21S	114
	1	2	BF12F	84	BFD12S	114
	0	3	BF03F	84	BFD03S	114
4	4	0	BF40F	96	BFD40S	126
	3	1	BF31F	96	BFD31S	126
	2	2	**BF22F**	84	**BFD22S**	114
	1	3	BF13F	96	BFD13S	126
	0	4	BF04F	96	BFD04S	126
6	6	0	BF60F	108	BFD60S	138
	5	1	BF51F	108	BFD51S	138
	4	2	BF42F	108	BFD42S	138
	3	3	**BF33F**	96	**BFD33S**	126
	2	4	BF24F	108	BFD24S	138
	0	6	BF06F	108	BFD06S	138
8	8	0	BF80F	132	BFD80S	162
	7	1	BF71F	132	BFD71S	162
	6	2	BF62F	132	BFD62S	162
	5	3	BF53F	132	BFD53S	162
	4	4	**BF44F**	108	**BFD44S**	138
	0	8	BF08F	132	BFD08S	162
10	10	0	BF100F	156	BFD100S	186
	8	2	BF82F	156	BFD82S	186
	7	3	BF73F	156	BFD73S	186
	6	4	**BF64F**	132	**BFD64S**	162
	5	5	**BF55F**	132	**BFD55S**	162
	4	6	BF46F	156	BFD46S	186
	2	8	BF28F	156	BFD28S	186
12	12	0	BF120F	180	BFD120S	210
	8	4	**BF84F**	156	**BFD84S**	186
	7	5	BF75F	180	BFD75S	210
	6	6	**BF66F**	156	**BFD66S**	186
	5	7	BF57F	180	BFD57S	210
	4	8	BF48F	180	BFD48S	210

Coil Voltage Table

BF Coils			BFD Coils	
Volts Ac	Hz	Catalog Suffix	Volts Dc	Catalog Suffix
12	60	H	6	C
24	60	I	12	D
48	60	J	24	L
110	60	V	32	M
208	60	K	48	E
240/220	60/50	G	120	U
440	60	C	240	T

BFD22 7664479G01

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Electrical Components Division
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