SECTION VIII

MECHANICAL REQUIREMENTS

General

This section describes the mechanical requirements of AF, AG, AJ, AK, AL, and AM relays to be applied in the shop and in the field. Due to the construction of these relays, the adjusting effort in the shop is much less than that required for the U and Y relays. The shop adjustment is mostly confined to a touch-up of the back tension by adding to, or subtracting from, the balancing spring pre-tension and a mass adjustment of the contacts to meet the contact gauging requirement. On relays with critical hold and release requirements, an adjustment of the buffer spring tension and point of pickup of this spring by the card may be necessary.

Due to the greater stability of these relays, and the improved contact performance, the necessity for readjustments in the field is considerably less than for the U relays.

In general, spring sequences required for proper circuit functioning must be specified in the Circuit Requirements Table, except for EBM, EMB, PBEM, or PMEB combinations, which are checked for the sequence in the position in which these combinations appear. Where the circuit function involves preliminary contacts operating in sequence, with late contacts, it may not be necessary to specify the sequence in the Circuit Requirements Table. These conditions should be discussed with the relay requirements group.

X-75509

The ratio of the gauging value applied at the card to that applied at the stop disc, or dome, is not the same for the AF, AG, AJ, AL, AK, and AM relays. The AF and AL relays have short armatures and the AG and AJ relays have a long armature, but the stop discs, or domes, are located the same distance from the front of the armature on all four relays. The armatures on the AK and AM relays are a different design from the AF, AJ, or AL relay. The stop discs or domes will, therefore, be at different distances from the hinge on the different armatures and consequently will travel different distances for the same travel at the card. The ratios for these motions are:

	AF,AL	AG,AJ	AK,AM
Stop disc, or dome, to card	0.718	0.845	0.912
Contact to card	1.065	1.065	1.065
Stop disc, or dome, to contact	0.675	0.793	0.885

The performance and stability of the wire spring relay is controlled mainly by the following features:

Contact Gauging
Armature Travel
Contact Force
Armature Back Tension
Buffer Spring Tension and Position
Stop Discs
Armature Leg Clearance

Some of the above features are specified in the shop mechanical requirements and are to be checked on the assembled relay Others are controlled by manufacturing tolerances on the component parts and no check is made after assembly.

Contact Gauging

Contact gauging values provide the minimum and the maximum points in the armature stroke at which the contacts may be actuated. The gauging requirements for these relays are shown in Table VIII-1. Some relays may have special contact gauging to facilitate meeting the current flow requirements; these special gauging values must be shown in the Circuit Requirements Table. All gauging values are relative to the center leg of the core on AF, AG, AJ, and AL relays.

It should be noted that, using the readjust values with adverse gauging limits, the interval that guarantees that a sequence is provided is small. With the test values, there is a negative sequence interval. The interval may refer to transfer or continuity contacts, which are in the same position on the relay, or it may refer to a contact in one position with respect to contacts in other positions, such as any early contact with respect to any late contacts. Different gauging values are specified in Table VIII-1 for different purposes as outlined in the following paragraphs. The contacts should not be actuated on the maximum values shown.

M Specification Gauging Values

These values are specified by the Apparatus Department for use in the shop. The gauging may be made either at the stop discs or at the card, using equivalent gauging values, depending on which is the most convenient. The gauging requirements guarantee a minimum interval of 2 mil inches, measured at the contacts (1.5 mil inches measured at the stop discs) between any contacts in different travel stages. Since the gauging requirements insure the sequences, no other check is made for the sequence.

Readjust Gauging Values

These are identical with the M specification values but are applied at the stop discs. When a relay has reached the end of its adjustment life, it may be readjusted to the original gauging values.

Wired Equipment Test Gauging Values

These values are used in the shop for wired equipment inspections and will be applied at the stop discs. They are uniformly 1.5 mils easier than the M specification values and result in a negative sequence interval of 1.5 mils. Consequently, a visual check for sequence will be made on all EBM, EMB, PBEM, and PMEB spring units with the armature operated manually. No check for other sequences will be made unless explicitly covered by notes in the Circuit Requirements Table.

Before Turnover Test Gauging Values

These are for the use of the installer prior to turnover and are identical with the wired equipment test values used in the shop.

Maintenance Test Gauging Values

These values are the "end of adjustment life" and are easier than the before turnover test values to allow for wear. The method of gauging for the "no make" point of the contact is different in that the gauge is inserted between the armature and the backstop with the relay de-energized. This method allows greater wear before rejection of relays with contacts worn in a direction to pick up the contact early in the stroke. The gauge applied between the armature and the backstop is large enough to allow for armature rebound.

A visual check without gauges will be made for all EBM, EMB, PBEM, and PMEB spring units. No check will be made for any other sequences unless the sequence is specified in the Circuit Requirements Table.

If the deterioration in contact gauging is caused by excessive card wear, the contact sequences may be restored by replacing the actuating card in the field.

Armature Travel

The armature travel is not adjustable and is controlled by the core plate and stop discs used. The core plate in turn depends on the spring combination. There will be three standard armature travels corresponding to the three stages of contact spring sequence: short, intermediate, and long. The nominal armature travels measured at the card are:

	Travel (inch)	Contact Sequence	Spring Combination Number
	AF, AG, AJ, and AL Relays		
Short	0.026	1 stage	1 to 199 and 500
Intermediate	0.044	2 stage	200 to 399
Long	0.060	3 stage	400 to 499
	AK and AM Relays		
Short	0.026	1 stage	1 to 199
Intermediate	0.044	2 stage	200 to 399

There are no specified variations in the armature travel, but the manufacturing limits on the component parts that control the travel show that they may vary ±0.005 inch.

These armature travels will not be shown in the Circuit Requirements Table, the BSP, or the manufacturing specifications. Some relays with critical adjustments, such as the AJ1 and AJ2 supervisory relays, may have special armature travels and contact gauging to aid in meeting the current flow requirements.

Contact Force

The contact force, measured at the contacts, will be nominal 12.5 grams, but for critical or sensitive relays a nominal 8-gram force may be used. A nominal 17.5-gram contact force may be used in cases where contact chatter is detrimental to circuit function. The contact force is obtained by the bend and large deflection of the twin-wire springs held in a molded block and is not adjustable once the relay is assembled. A relay, coded with a particular force adjustment, cannot be given another force adjustment as is done with older types of relays. Where any change in adjustment is required, a new code must be provided.

Armature Back Tension

The armature is held against the backstop of the core plate with a pressure of minimum 30 grams for the AF, AJ, and AK relays, minimum 45 grams for the 24-make AJ relay, and minimum 20 grams for the AG relay, unless otherwise specified on the individual relay code. A minimum of 20 grams back tension may be specified for the sensitive, marginal, or slow-releasing relays, where necessary to meet the current flow requirements. A maximum 60 grams back

tension is specified in the manufacturing specification for the speed relays (4.4-, 16-, 270-, 395-, 400-, and 700-ohm coils) to prevent increased operating times due to excessive armature back tensions. The 60-gram back tension is increased to 80 grams where nonoperate or release requirements are specified. On the 24 make AJ relay, there is a maximum back tension of 100 grams on standard relays and maximum 80 grams on the speed relays of this type. The back tension is obtained from the balancing spring, the thickness of which is selected on the basis of the number of make-contacts. (See Section IX.) The tension and offset of the balancing spring may be changed to meet the armature back tension requirement, or a nonoperate, or release. AL and AM relays have special back tension values. Consult the relay applications group for specific details.

Buffer Spring Tension and Position

A buffer spring may be provided on the AF, AG, AJ, or AL relay to obtain an additional adjustable load in the operated position. This provides a better balance between the relay pull and the operated load and permits better control of the hold and release adjustments. Relay codes that may be equipped with a buffer spring (shown in Section I, Fig. I-16) are identified by the letter suffix B following the spring combination number. However, the buffer spring may or may not be provided on individual relays of these codes, depending on whether its use was required to meet initial electrical requirements.

X-75509

The point at which the buffer spring is picked up in the operation of a relay must be controlled. It is adjusted to the gauging values shown on Table VIII-1. If the buffer spring is picked up too soon, there is a possibility of a momentary open of make-contacts caused by a hesitation of the armature when the actuating card engages the buffer spring. If the buffer spring is picked up too late, the load of the buffer spring may be dropped, on the release of the relay before the armature is far enough away from the core to prevent reclosure of make-contacts when the buffer load is dropped.

Stop Discs

The AF and AJ relays are always equipped with stop discs 0.006-inch, 0.014-inch, or 0.022-inch high, with a tolerance of -0.000-inch +0.003-inch. The 0.006-inch stop disc is used for the general purpose functions, and the 0.014-inch or 0.022-inch stop discs are used to meet marginal operating conditions. The AG and AL relays have an embossing or dome on the armature to provide a uniform point of contact between the armature and core. This minimizes the effect of varying alignment of the armature and core on the releasing time. The AK relay is equipped with a stop disc 0.005-inch -0.000-inch, +0.003-inch high, or in special cases a dome for the slow-release relays. AM relays are equipped with a domed armature.

Armature Leg Clearance - AF, AG, AJ, and AL Relays

With the relay electrically operated, there shall be a clearance of minimum 0.002 inch between the outer legs of the core and the armature. This is to prevent an iron-to-iron contact between the armature and the core legs due to stop disc wear or cocking of the armature.

Coil Replacement

A tool kit (1014B) has been provided for replacement of the coil of the AF, AG, AJ, or AK relays in the field. It was designed for replacing defective coils and is not intended for the modification of relay codes. Replacement procedures are covered in Bell System Practices 040-502-801 and 040-504-801 for AF, AG, and AJ types and the AK type, respectively. No attempt should be made to replace the coil of either the AL or AM type latching relay in the field.

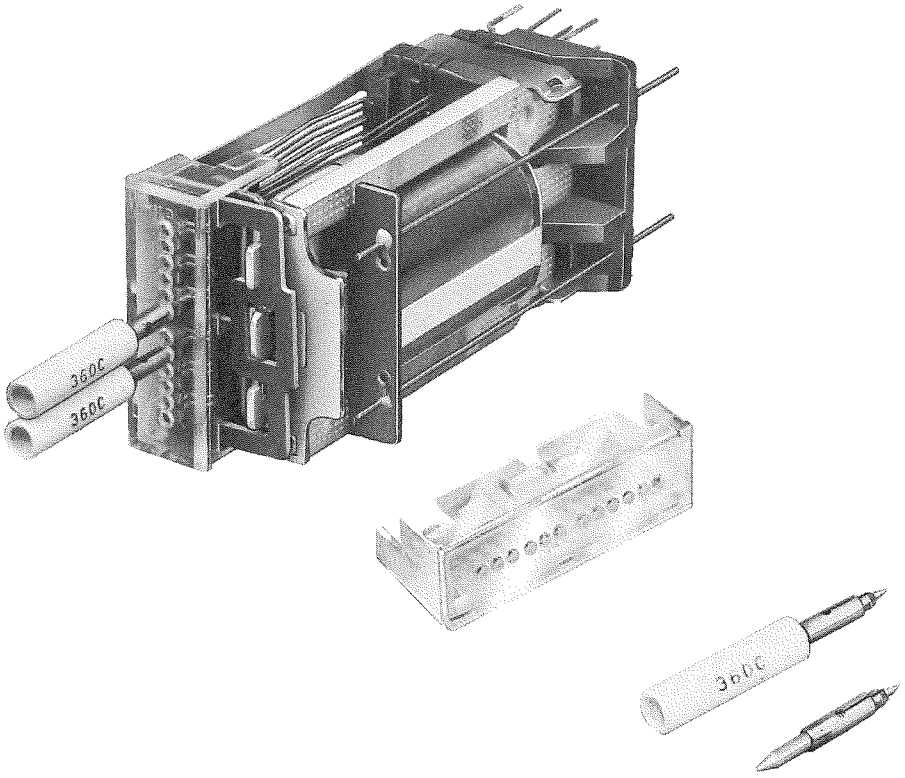

Fig. VIII-1 - Method of Connecting to Fixed Contacts

Adjusting Tools

A list of the adjusting tools required for field maintenance of the wire spring relay is shown below.

AF, AG, AJ, and AL Relays

1. Gram gauge for back tension and buffer tension (70D or 70J)
2. Armature blocking tool (No. 627A tool)
3. Contact insulator (KS-14737, List 1); tweezer to apply contact insulator (KS-8511)
4. Contact burnisher (266E) (Do not burnish contacts with gold overlay.)
5. Winding connector (624B tool)
6. Balance spring lifter (628A tool)
7. Balance spring adjuster (No. 534F, 534G, 534H spring adjusters)
8. Tools for adjusting buffer spring (No. 363 and 534E spring adjusters)
9. Tool for mass adjustment of contacts (H cabinet screwdriver)
10. Thickness gauges for contact operate point (171A)
11. Tools for removing card
    Spring holders (629A and 629B)
    Spring holder and clamp (630A)
    Spring holders (652A and 652B)
    Insulator (656A)
12. Contact welding tools
    Stripping pliers (2)
    Welders (2)
    Forming pliers
13. Tools for adjusting individual twin-contact wires (638A)
14. Tool to connect to fixed contacts (651B, 651C, or 651D and 639A) (Fig. VIII-1)
15. Cover wire bail adjuster (485A pliers)
16. Coil replacement tool kit (1014B) for AF, AG, and AJ relays only

AK and AM Relays

1. Gram gauge for back tension (70D)
2. Armature blocking tool (679A tool)
3. Contact insulator (KS-14737, List 1); tweezers to apply contact insulator (KS-8511)
4. Contact burnisher (266E) (Do not burnish contacts with gold overlay.)
5. Winding connector (624B tool)
6. Balancing spring lifter (628A tool)
7. Balance spring adjuster (534F spring adjuster)
8. Tool for mass adjustment of contacts (H cabinet screwdriver)
9. Thickness gauge for contact operate point (184A)
10. Tools for removing card
    Spring holders (675A, 675B)
    Spring holders (688A, 688B)
    Insulators (684A)
11. Contact welding tools
    Stripping pliers (2)
    Welders (2)
    Forming pliers
12. Tool for adjusting individual twin-contact wires (638A)
13. Tool to connect to fixed contacts (651D and 639A)
14. Cover wire bail adjuster (485A pliers)
15. Coil replacement tool kit (1014B) for AK relays only

X-75509

TABLE VIII-1

CONTACT GAUGING IN MILS

	M Spec or Readjust				Wired Equipment Test Or Before Turnover Test	
	At Card		At Stop Discs or Dome		At Stop Discs Or Dome	
	Min	Max	Min	Max	Min	Max
AF, AL						
M, B*	6.0	17.0	4.5	12.0	3.0	13.5†
EM, EB	19.0	30.0	13.5	21.5	12.0†	23.0
PM, PB	32.0	43.0	23.0	31.0	21.5	32.5
Buff. Spg	4.0	10.0	3.0	7.0	1.5	8.5
AG, AJ						
M, B*	6.0	17.0	5.0	14.5	3.5	16.0†
EM, EB	19.0	30.0	16.0	25.5	14.5†	27.0
PM, PB	32.0	43.0	27.0	36.5	25.5	38.0
Buff. Spg	4.0	10.0	3.5	8.5	1.5	10.0
AK, AM						
M, B	6.0	17.0	5.0	15.0	3.5	16.5†
EM, EB	19.0	30.0	16.5	26.5	15.0†	28.0
Specified in	M Spec		M Spec and BSP		BSP	

*Relays with seven or more springs and spring combinations, number 1 to 199 and 500, shall meet the following requirement: With a 0.007-inch gauge inserted between the armature and the armature backstop, the make-contacts shall not close and the break-contacts shall not break.

†Not to be checked on EBM or EMB spring combinations. A visual check for sequence is made instead. (See text.)

Armature Travel	Spring	Maintenance Test (Specified in BSP)	
		At Stop Disc	At Backstop
AF, AG, AJ, AL	Comb. No.	Min	Min
Short (6 or less spring pairs)	1 to 199, and 500	1.5	4.5
Short (7 or more spring pairs)	1 to 199, and 500	1.5	7.0
Intermediate	200 to 399	1.5	7.0
Long	400 to 499	1.5	10.0
	Buffer Spring	1.5	-
AK, AM			
Short	1 to 199	1.5	4.5
Intermediate	200 to 399	1.5	7.0