"WHAT YOU SEE IS WHAT YOU GET"
OR
HOW TO MAKE A PROPER F-CONNECTOR

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ABSTRACT

The most widely used part of a CATV system undoubtedly is the F-connector; yet consistent, accurate information on the correct preparation of its center conductor length is usually lacking.

Here, we take a careful look at the connector--jack assembly and note the changes over the years. We propose a standard for the center conductor length which will eliminate a significant number of field failures.

THE F-CONNECTOR PROBLEM

One of the things we all absorb from the first day we get involved with CATV is that we are dealing with a SYSTEM. In practical terms this means that EVERY PART must work, without exception, no matter how small for the whole system to work. Every tech can tell us horror stories about the loose screw or the cracked washer which caused an entire system outage. Let us, then, examine one aspect of the reliability of what is probably the single most commonly used component in the CATV system -- namely, the F-connector.

After all, tens of millions are used each year. A generic fault would have major consequences in CATV. Our suspicions are aroused when we look through the log books of the systems' repair crews. If we count the percentage of trouble calls due to F-connectors, we find anywhere from 25 to 90 percent of all repairs are to tighten "loose" connectors or to re-make an intermittent or open one or wrench-tighten a termination.

When we found the same problem on our laboratory bench, we took the opportunity to look into it carefully. After all, it is the lowly F-connector which brings the RF signal from our carefully constructed system from the tap, through the ground block to the subscriber's TV set. Every single one of these connections must make secure and reliable electrical contact, regardless of temperature, wind or rain, or, as far as the subscriber is concerned, the system is down.

Adding to the problem is the fact that widely varying instructions as to what length to cut the center conductor exist among technicians. These range all the way from slightly below flush to 1/16" above flush and no idea of what the tolerance should be.

Let's start by examining precisely how the F-connector center contact is supposed to work by looking at Fig. 1, which shows a cross-sectional view of the female or port connector. In the center is shown the two contacting springs which, at their closure point, are supposed to make the connection with the center conductor of the male F-connector. As the male connector, shown in Fig. 2, is threaded onto the port, the center conductor is carried to meet the spring contacts' closure point.

Obviously, only if the center conductor is long enough will it penetrate the spring contacts' closure and establish a reliable pressure contact.

To see exactly how well and how reliably this works, we set up a simple test, as shown in TABLE 1. We counted how many half-turns (approximately 180 degrees hand/wrist rotation) it took to have a termination make contact. We cut the center conductors of the terminators to four lengths, 0 or flush, 1 mm. or 0.04", 2.5 mm. or 0.10", and 4 mm. or 0.16". We used 5 well-known tap brands and found that all of them took between 6 1/2 to 7 turns to "bottom" the male connector. This is graphically shown in Fig. 1 by the bracket labeled "6 1/2 turns."

The first column of the test, 0 or flush, shows that the distance which the male connector travels axially is about equal to the distance from the contact closure to the outside of the port. This is shown by the fact that three of the 9 sample did not make contact at all, (N/C); three just barely did (7 turns which is bottomed); while four did make contact in 5 turns. Out tests confirm that if the center conductor in the male F-connector is cut off flush with the outer shell face, it will have only just about reached the contact closure!

ONLY THE LENGTH OF CENTER CONDUCTOR PROTRUDING ABOVE THE SHELL FACE MAKES CONTACT WITH THE CLOSURE POINT. In other words, "what you see is what you get."

Depending upon tolerances, the center conductor, if cut flush with the shell face, may not contact the closure point at all, or might just touch without penetrating the closure point fully, thereby causing a lack of spring pressure on the contact. This is a condition which would cause an open or intermittent contact especially in cold weather when the cable would pull back.

Even if the center conductor were cut 1/16" above the shell face, as advised by most people, we found that the average penetration of the contact closure was only about 0.06". That much "grip" does not provide for a reliable connection given the mechanical and temperature stresses which the connection is subject to. F-connectors are notorious for loosening up which causes pull-back on the center conductor. Even corrosion might turn such a marginal connection into an intermittent one on a freezing night. No wonder that the repair logs show so many connectors being tightened or re-made!

A good rule to follow in setting the proper length of center conductor to cut is contained in "what you see is what you get." Once this is explained to the technicians as the length protruding beyond the shell, their judgement will pick a reasonable length.

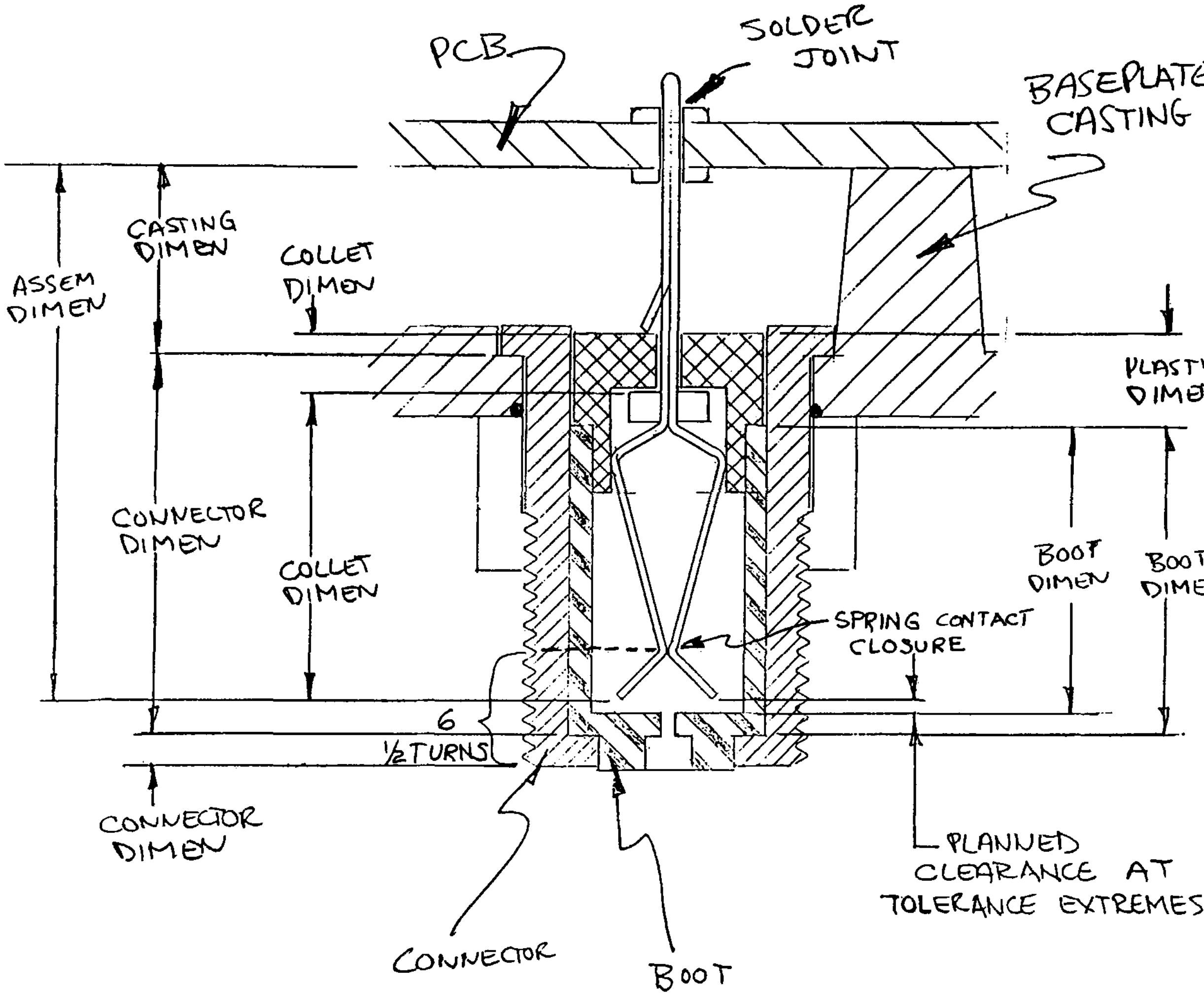
Our recommendation is that the center conductor should be cut between 1/8" to 1/4" beyond the shell. There is no danger from a conductor cut to these lengths; to the contrary, the extra length guarantees additional contact with the springs, as can be seen from Fig. 1. Every technician should understand that what is to be avoided are the barely-made connections which cause the system so much unnecessary cost and the techniciansso much unnecessary trouble.

HISTORICAL NOTE

For more than curiosity's sake, we traced the probable history of the connector and its drift to its present unsatisfactory state.

About 1980, a leading CATV manufacturer introduced the internal sealing boot which sealed the jack against moisture penetration on their taps. They carefully positioned the spring and collet assembly back from the internal boot so that they did not interfere. Otherwise the spring would have been prevented from closing freely on the center conductor; note Fig. 1 - "planned clearance of tolerance extremes." But, through the years, other companies adopted the same type of internal boot with slightly different designs, clearances and tolerances. This explains the wide variety of contact-turns listed in Table 1.

The standard we have proposed will provide a satisfactory contact with all the different types of F-type jacks.



EACH DIMEN. NOTED CARRIES WITH IT A ±.005" TOLERANCE

FIG. 1

TAP PORT CONNECTOR; Cross Section

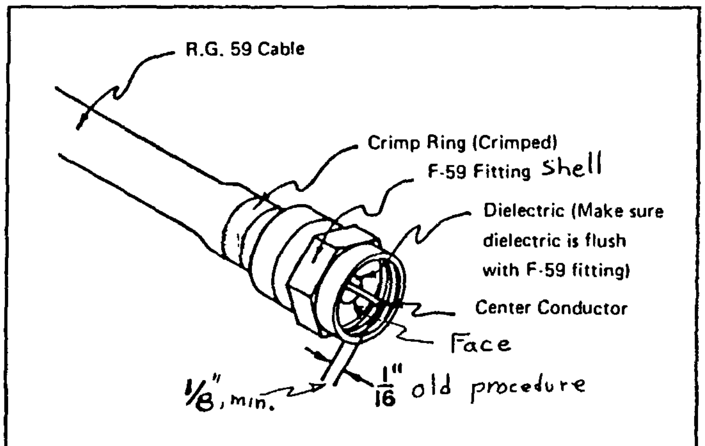


Figure 2 : Typical "F" Fitting Assembled.

		TURNS TO CONTACT			
TAP BRAND	PROJECTION ABOVE FLUSH	Ø	1 mm.	2.5 mm.	4 mm.
A		N/C	6	3	1
A		7	4	3	1
A		N/C	6	4	1
B		5	3	2	1
C		5	4	3	1
C		5	4	3	1
D		7	4	6	4
D		5	3	2	1
E		N/C	4	3	1

TABLE 1

TURNS vs. CENTER CONDUCTOR PROJECTION

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