Tubing Joints for Running Independent Strings in Dual Wells

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ABSTRACT

The purpose of this paper is to outline the types of tubing joints and combinations of tubing that are considered satisfactory for use in dual wells, completed with two or more independently hung tubing strings.

Field experience in running two or more independent strings of tubing has indicated certain running clearance requirements. The clearance can be calculated for the various dual well conditions. Many of these combinations are shown on clearance charts.

The use of two or more tubing strings in dual wells appears to offer many advantages for rod pumping, hydraulic pumping and for gas lift systems or combinations of any two of these methods.

Many of the field problems encountered, regarding proper care and handling of special tubing joints, will be discussed.

INTRODUCTION

Dual well completions have been made in increasing numbers during recent years. This increase appears to be the result of apparent initial economic advantage and improved equipment and producing techniques.

Some of the first duals and even triple completions were tried as early as 1939 using two or more concentric tubing strings of different sizes. This plan was not completely successful since the separate zones were difficult to produce when pumping was required. Two major oil companies on Aug. 20, 1954, proved that two parallel tubing strings could be run independently in 7 inch OD casing. This plan of dual completion has now been accepted by most operators and many hundreds of duals have been completed in West Texas alone.

By running two or more strings of tubing in one well, dual completions can be successfully accomplished on flowing zones or zones which require artificial lift. Either one of the two zones can be produced by rod pumps, hydraulic pumps or by gas lift, or two different artificial lift methods may be employed in a dual well. Parallel tubing strings also may be used to advantage in single zone wells where hydraulic rodless pumping requires the use of more than one tubing string. In some instances, two tubing strings are used with a dual rod pump.

Recently, considerable interest has been shown in the use of a small gas relief string to obtain more efficient pumping from the lower zone, either on rod or hydraulic rodless pumping. In some fields it is believed that venting will be required to economically deplete a lower zone. Some operators are attacking this gas problem by using a larger tubing string to the lower zone. This allows the use of larger pumps.

CLEARANCES ON PARALLEL TUBING STRINGS

Parallel tubing string clearances, when run independently, can be obtained from charts on most combinations. When two tubing strings are run, it is recommended that joint clearance should not be less than 0.100 inches. Minimum running clearances on the order of 0.200 inches are preferred by some operators. The running clearance is defined as the drift diameter of casing less the sum of the two joint or coupling outside diameters, as indicated in Fig. 1. With a minimum clearance of 0.100 inches, no troubles that can be attributed to clearance have been encountered.

When three tubing strings are run independently, minimum clearance should not be less than 0.750 inches, as shown in Fig. 2. This clearance is determined by laying out to scale the three joints involved and measuring the clearance.

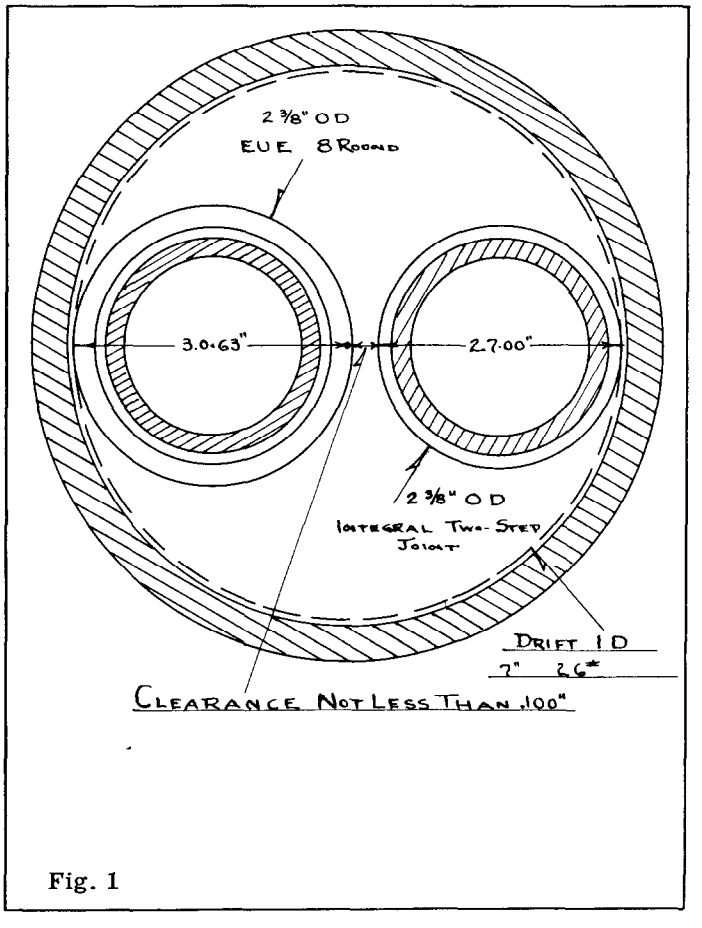

Fig. 1

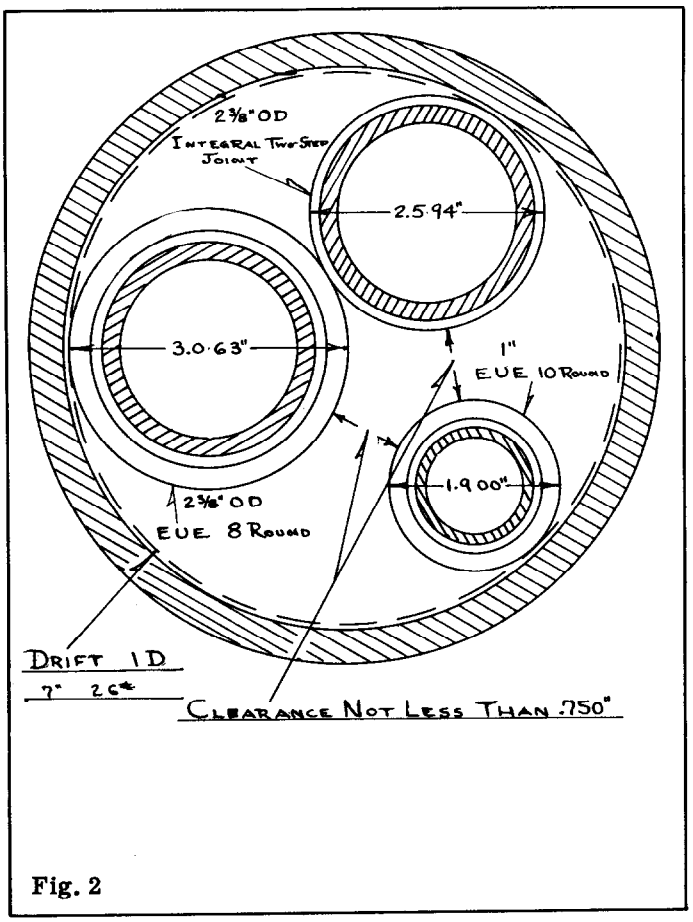

Fig. 2

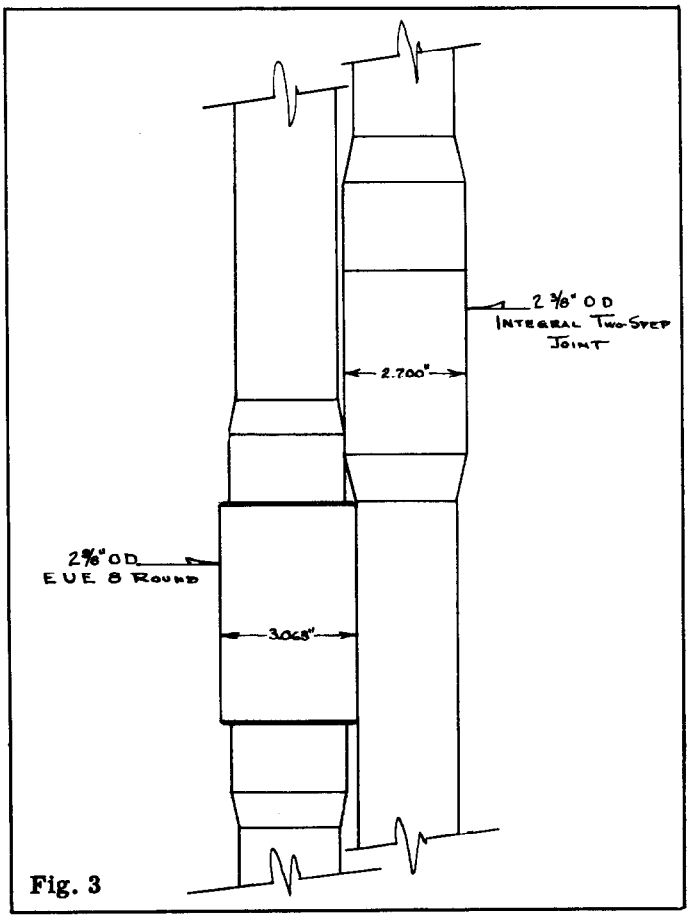

Fig. 3

These minimum clearances for two and three string combinations are based on operators' experiences. When clearances less than these have been used, too much friction has been indicated.

Typical combinations and clearances are shown in the following tabulations. All of these combinations have been used satisfactorily.

Casing Size	Casing ID Drift Diameter	2-3/8" OD EUE T&C-3.063" 2-3/8" OD CS - 2.700" 5.763"
		Clearance
7"-23#	6.241"	0.478"
7"-26#	6.151"	0.388"

2-3/8"-OD EUE T&C Turned & Beveled	2.910"
2-3/8"-OD EUE T&C Turned & Beveled	2.910"
	5.820"

		Clearance
7"-23#	6.241"	0.421"
7"-26#	6.151"	0.331"

Casing Size	Casing ID Drift Diameter	2-1/16" OD CS - 2.330" 2-1/16" OD CS - 2.330" 4.660"
		Clearance
5-1/2" - 15.5#	4.825"	0.165"
5-1/2" - 17#	4.767"	0.107"

2-3/8" OD CS - 2.700"	
2-3/8" OD CS - 2.700"	
1" EU E T&C - 1.900"	
	Clearance
7" - 23#	6.241" 1.290"
7" - 26#	6.151" 1.160"

INTERFERENCE

Interference, caused by some tubing joint combinations, is definitely an important factor in successfully running parallel tubing strings.

Possible interference when joints pass each other may add to tensile load of tubing strings, and may prevent strings from being free to rotate, in order to pull loose from latching connections. These problems sometimes may be caused by a combination of interference and clearance.

Fig. 3 illustrates one of the commonly used combinations of two strings of 2-3/8 inch OD tubing. One string has 2-3/8 inch OD EUE 8 Rd. couplings, and the other 2-3/8 inch OD integral two step joints. For this combination, the bottlenecked (above and below) integral joints eliminate interference and reduce friction to a practical minimum. Also, no interference occurs (Fig. 4) when running two strings of 2-3/8 inch OD tubing with EUE 8 Rd. couplings when both ends of the couplings on both strings are beveled. With this coupling combination, it is usually necessary to turn the coupling OD on each string to obtain proper clearance.

If only one of the two 2-3/8 inch OD EUE 8 Rd. strings have turned and beveled couplings, as shown in Fig. #5, or if the top of the couplings only are beveled on each string, possible interference occurs. This interference is caused by the area retained at the end of the coupling, due to the recess inside the coupling end and can vary, due to tolerances in forming the EUE upset OD.

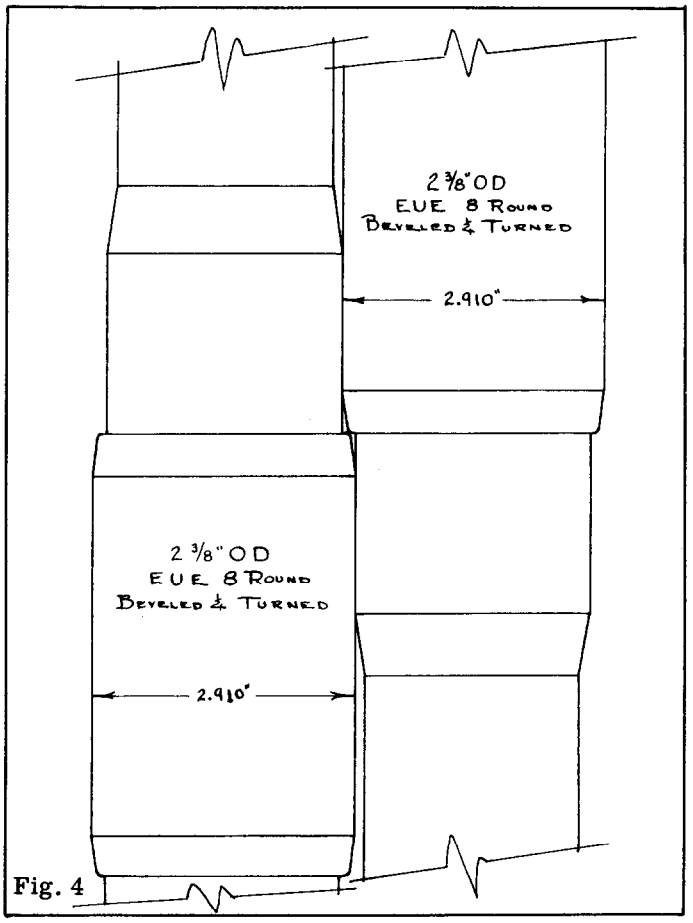

Fig. 4

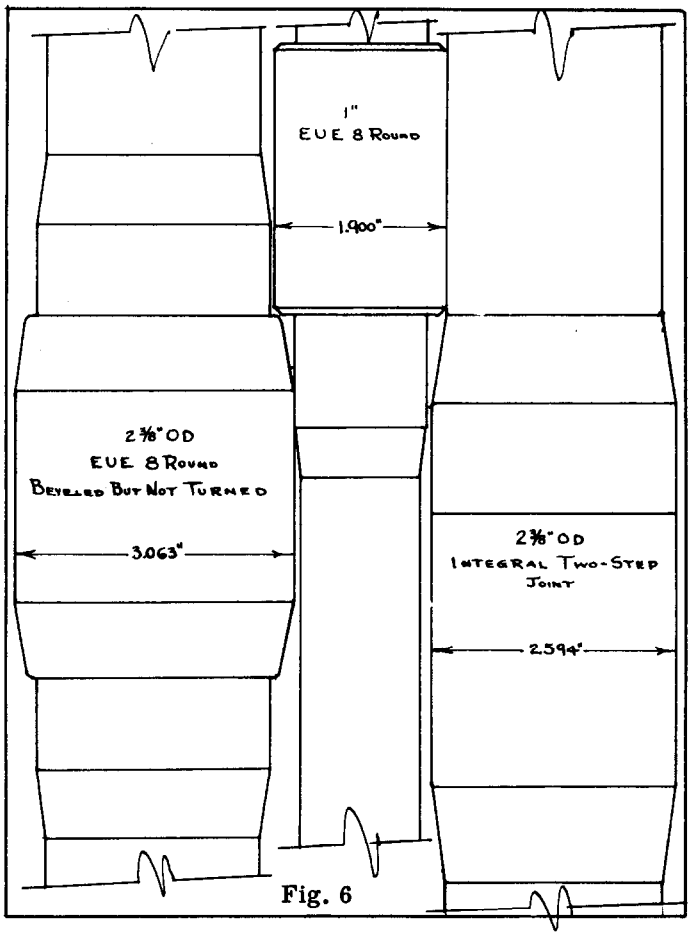

Fig. 6

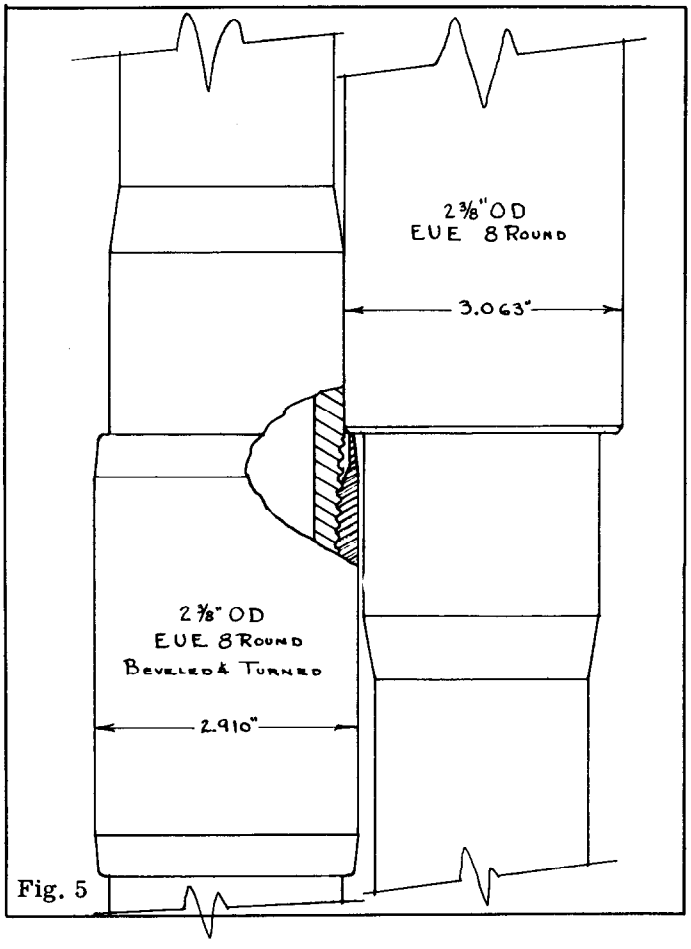

Fig. 5

Tubing Joint Combinations

When a third or gas relief tubing string is used, it is even more important to select proper tubing joint combinations to prevent interference. Many different combinations have been used in West Texas wells. One interference free combination consists of two strings of 2-3/8 inch tubing with integral two step joints and a string of 1 inch or 3/4 inch EUE 10 Rd. couplings. Another combination is two strings of 2-3/8 inch OD EUE 8 Rd. with turned and beveled couplings and one string of 1 inch or 3/4 inch EUE 10 Rd. with beveled couplings. Still another combination is shown in Fig. 6. This was suggested by one operator and may prove to be successful. It consists of one string of 2-3/8 inch OD with integral two step thread joints, one string of 2-3/8 inch OD EUE 8 Rd. couplings, beveled but not turned, and one string of 1 inch EUE 10 Rd. couplings.

As previously stated, some operators are using a larger tubing string for the lower zone of dual wells in 7 inch OD casing. It is planned that this will provide room for larger pumping equipment or will permit higher rates with gas lift. Fig. 7 shows an example of 2-3/8 inch OD and 2-7/8 inch OD parallel strings, both with integral two step joints. This also indicates one of close clearances when run in 7 inch OD 29# casing. The clearance of 0.139 inches has caused no running or pulling problems even when 4500 feet of this weight of casing was involved.

During the past six months, many successful dual completions have been accomplished by running two strings of 2-1/16 inch OD tubing with integral two

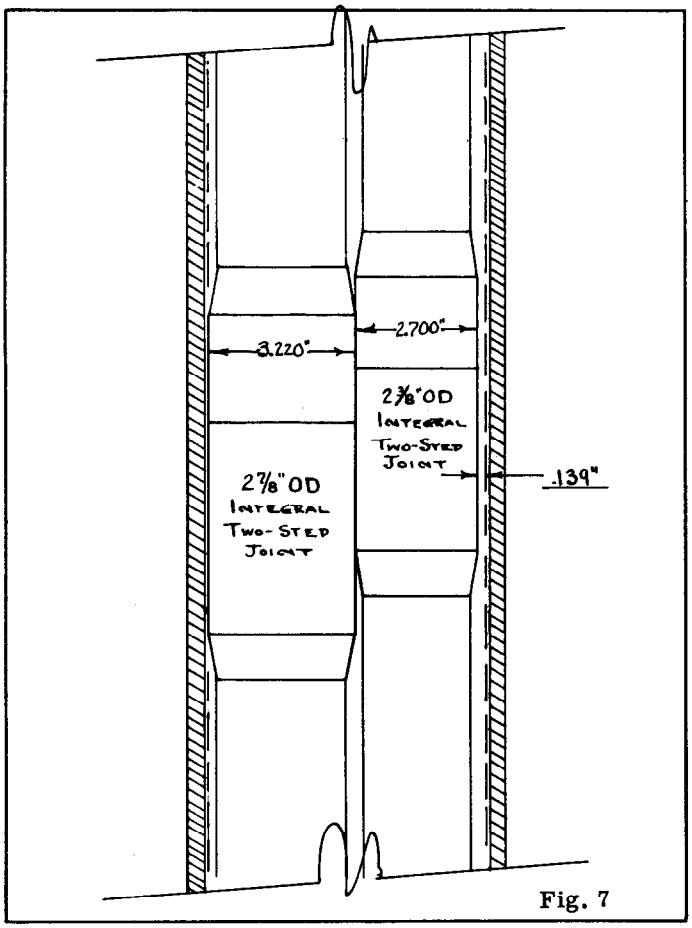

Fig. 7

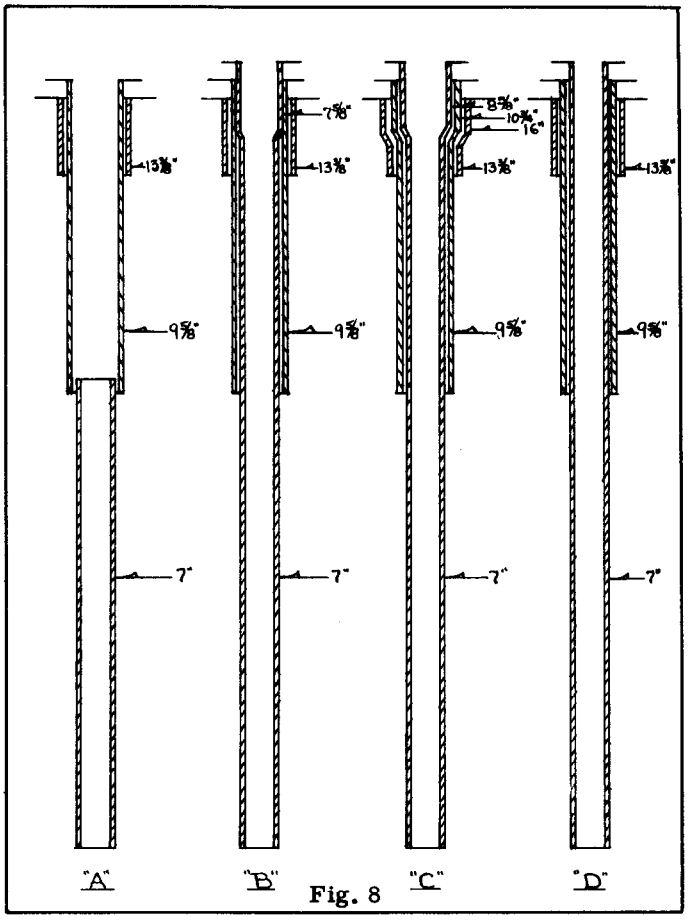

Fig. 8

step joints in 5-1/2 inch casing. When 2-1/16 inch OD tubing is used for rod pumping, the depth of lift is limited by the strength of 3/4 inch rod. However, high strength rods are being used successfully with pumps set to depths as deep as 8600 feet.

Two strings of 2-1/16 inch OD tubing in 5-1/2 inch OD casing and gas lift have been used in other wells. This method can be used to lower zones, but the clearance then becomes a limiting depth factor. It appears that this combination cannot be run in 5-1/2 inch OD casing with weight heavier than 17 pounds per foot.

Triple Completions

Many triple completions of wells have been accomplished in areas where pumping of all zones is not required. Those wells have been completed with three tubing strings run independently in 7 inch OD or larger casing. The three tubing strings are normally 2-1/16 inch OD or 2-3/8 inch OD, all with integral two step joints.

CASING PROGRAMS FOR DUAL WELLS

Fig. 8 indicates the four casing programs that have been used on dual wells. Program A shows the use of a 7 inch OD liner hung in 9-5/8 inch OD casing to allow greater spread of tubing strings at surface. This arrangement is still used by some operators. The spread is required for hydraulic rodless pumping when a hydraulic lift is used for paraffin removal. Casing programs B and C were also designed for additional spread of tubing strings at the surface. Some of the earlier dual hangers required this spread. Program B, with 3 joints of 7-5/8 inch OD casing at the surface swaged to 7 inch OD, is still being used by some operators when 2-3/8 inch OD and 2-7/8 inch OD parallel tubing strings are run in 7 inch OD casing. This combination permits the use of flanged dual valves and gives less interference when two single valves are staggered above the tubing hanger. Program C with 8-5/8 inch OD swaged to 7 inch OD is not being used at the present. Program D is employed by most operators. With the 7 inch OD production string at the surface, dual hanger manufacturers can furnish hangers to meet operators' requirements.

HANDLING AND CARE OF SPECIAL INTEGRAL TUBING JOINTS

Pre-Running:

A. EUE elevators may be used with elevator plugs. Elevators must be worn or bored on ID to fit some of joint upsets. Slip type elevators may be used. The slip setting mechanism should be checked carefully to be sure the slip setter does not ride up over upset and result in possible damage to tubing by slips supporting string at upset. When running tubing with pulling unit, it is usually more economical and convenient to use elevator plugs and EUE elevators. If tubing is to be round tripped and to be stood back in stands in derrick, it is recommended that slip type elevators be used. Otherwise it would be necessary to have one elevator plug for each stand.

B. Do not remove thread protectors from either end until tubing is pulled into derrick. Box end protectors may be removed on pulling units.

C. Clean threads with kerosene if any dirt or sand accumulates in threads.

Running Procedure:

A. Bump elevator plugs after shouldering plugs.
B. Use lubricant of zinc or lead base as normally used on drill collar threads, or API thread dope.
C. Do not use spinning chain. When possible use stabbing board. On pulling units suggest starting thread by hand.
D. Power tongs are normally used to attain manufacturers recommended make up torque.
E. Use backup tongs with sufficient die area to prevent damage to tubing.

Swabbing:

Special swab cups are available for all integral tubing joints.

CONCLUSION

It appears that tubing running operations in dual completions will continue to be successful if tubing joint combinations are selected that can be run without interference, and with no less than recommended minimum clearances.

When dual wells are completed with two or more tubing strings run independently, many advantages can be gained, including:

1. More flexible control of the two zones being pumped, by having entire separate pumping equipment for each zone.
2. Elimination of costly fishing jobs which have occurred when one tubing string is supported by another tubing string.
3. Partial elimination of possible communication between zones since one packer is usually sufficient, and no cross over tools are required.
4. Simplicity in swabbing either zone.
5. In gas distillate wells, it is possible to produce a larger amount of distillate with gas.