COMBINATION BEADING EXPANDER

OPERATING INSTRUCTIONS, CARE & MAINTENANCE REPLACEMENT PARTS.

Combination Beading Expander – for 2” O.D., 2-1/2” O.D. and 3” O.D., Fire Tube Boiler tubes.

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SPECIFICATIONS (IN INCHES)

		COMBINATION BEADING EXPANDER					(2) TUBE PROJECTION			
Tube OD	(1) Cat. No.	Contracted Diameter	Expanded Diameter	Body Diameter	Bead Roll Diameter	Drive Square	(1) Tube Gauge			
							10	11	12	13
2”	41633-OWXY	1.700	1.875	1.688	5/8	3/4	1/4	1/4	1/4	1/4
2-1/2”	41634-OWXY	2.200	2.375	2.156	7/8	1	9/32	9/32	9/32	9/32
3”	41359-OWXY	2.700	2.900	2.562	7/8	1	9/32	9/32	9/32	-

SPECIFICATIONS (IN MILIMETERS)

		COMBINATION BEADING EXPANDER					(2) TUBE PROJECTION			
Tube OD	(1) Cat. No.	Contracted Diameter	Expanded Diameter	Body Diameter	Bead Roll Diameter	Drive Square	(1) Tube Wall (MM)			
							3.4	3.0	2.8	2.4
50.8	41633-OWXY	43.2	47.6	42.9	15.9	19.0	6.3	6.3	6.3	6.3
63.5	41634-OWXY	55.9	60.3	54.8	22.2	25.4	7.1	7.1	7.1	7.1
76.2	41359-OWXY	68.6	73.7	65.1	22.2	25.4	7.1	7.1	7.1	-

1) See Note no. 1 on page no.5 for EXPANDER ASSEMBLY CAT. NO. CODE.

2) **Tube projection** above is nominal for the best bead. It may be necessary to adjust this tube projection opening on (1) tube type and hardness or (2) tube sheet material. See paragraph no. 8 under **Operating Procedure.**

Introduction:

The Powermaster Combination Beading Expander will in one operation quickly and quietly expand and bead tubes. Successful operation is readily achieved by following three (3) simple rules.
The guide roll assembly and the beading roll (key #9 and 17. Page. 4 & 5.) must be the proper size for the tube wall being expanded and beaded.
Tube must have correct amount of projection from tube sheet before starting expansion (refer specification).
Both tube and tool must be totally free of any anti-rust oil lubricant.

Theory of Operation:

The combination beading and expanding tool simultaneously expands and beads the tube end in a single operation. Operating as it does, the tool assures the creations of a joint, which is both pressure-tight and has a bead in intimate contact with the tube sheet. The tool achieves this objective by utilizing the natural feed force built in to the expander to force beading against the end of the tube while expansion is taking place. The ability of the tool to satisfactorily accomplish this depends upon the amount of tractive force available being of sufficient magnitude to enable feeding forces to be developed which will enable the beading roll to deform the end of the tube and press the bead tightly against the sheet. The tractive force is made a maximum by utilizing five expansion rolls in place of the three or four normally used in expanders of this type and by the use of a coolant, which has the quality of minimum lubricity. If the beading roll or expander is set so that full expansion is accomplished before the bead has been formed, it will not be possible to complete a proper bead without further expansion of the tube.
The tool operates such that, once the beading roll has come in to contact with the end of the tube, the entire inward force of the tool is available to form the bead. However, this force is not always of sufficient magnitude to perform the required operation. The force is at a minimum initially while the expander is expanding the tube to a metal to metal condition. At this point the tractive force increases sharply and builds to a maximum as the expansion progress. When the stop nut on the mandrel engages the thrust bearing on the cage housing preventing any, further axial movement of

The mandrel, this force stabilizes then diminishes as continued rotation of the expander irons out the tube bead. This is why it is necessary that the beading operation be completed before final expansion of the tube since it will require the maximum tractive force available to perform this beading. Because of normal manufacturing practices, it would be possible to perform a proper beading and expanding operation with the tool without necessary setting it so that the Beading roll was in contact with the end of the tube. How far back would be determined by two factors, one would be by the amount of clearance between the tube sheet hole and the tube OD the greater this clearance, the further back the beading roll could be set since effective tractive force will not be developed until the tube has been expanded to the metal to metal condition. The second factor would be the effective thickness of the tube sheet however the safest course to follow in the use of this tool would be to set the tool with the beading roll close to or in contact with the tube end. It must be emphasized that no expanding tool can do a satisfactory job unless the following three items are complied with.

1. Tool of the correct size.
2. Tube ends and tube sheet holes have been properly prepared and are clean.
3. The tool is properly lubricated.

Compliance with these requirement is even of more critical nature when using the Combination Beading Expander tool.

Guide Roll

Guide roll of different diameter is made to bracket the range of the tube diameters that the expander can handle. Pick the correct guide roll for the gauge of tube to be expanded and beaded. The dash number of the guide roll part number indicates the gauge of tube. Guide rolls that are too large or small will prevent proper bead formation. Guide rolls are mounted eccentrically on the body of the expander. This means that a guide roll that is too large may prevent entry of the expander in to the tube even though the guide roll itself is smaller than the tube I.D. guide rolls that are too small will not centralize the expander in the tube and this excessive cocking of the expander will be reflected in the forming of a poor bead or marking of tube I.D. by the cage. Actual original tube I.D. is the only factor controlling guide roll selection.

Beading Roll

Beading rolls will operate on a range of wall thicknesses but the best result will be obtained by using the correct beading roll for the tube gauge to be worked on. The dash number of the beading roll part number indicates the gauge of tube.

Tube Projection

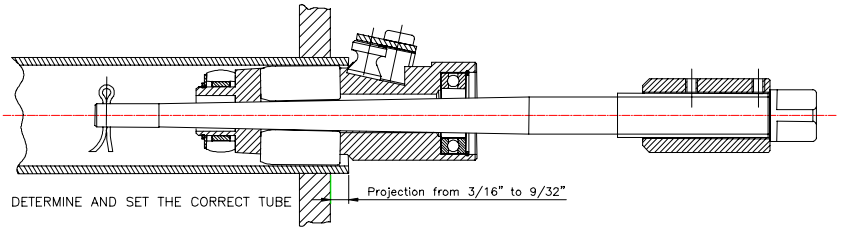
The best bead will be formed when the tube projects the proper amount from the tube sheet before it is expanded. The amount of projection can vary depending on tube diameter, wall thickness, tube sheet thickness and whether or not the tube is cut off square or has a flare due to use of an internal type tube cutter. Normal range of tube projection is 3/16” to 9/32”. When the tube sheet is bowed or warped so that it is not parallel to the end of the tube, the desired projection should be measured at the midpoint so that half of the tube will have greater and half will have less than the desired projection.

Tube and Tool Cleanliness

Both the tube and beading expander should be totally free of any lubricant of any nature. Any anti-rust present must be completely removed. The presence of any such material will prevent the expander rolls from having the traction required to develop the force needed to feed the beading roll against the end of the tube and form the proper bead. Swabbing out the ends of the tubes with a good solvent to remove any anti-rust or oil is recommended prior to tool use.

Tool Coolant:

The pressures of bead formation, due to tube end material deformation, imparts extreme heat to the tool. This heat must be removed by the use of a good water-soluble coolant. Dipping the roll end of the expander in a bucket of coolant between tube expansions is recommended. This will not only prevent the tool from overheating but will assist in maintaining the cleanliness, which extends the service life of the highly stressed rolls and mandrel. Tool overheating will cause tube material flaking, cage rotation stoppage due to beading roll gouging tube end (excessive feed), seizure and poorly formed beads.



Operating Procedure

The expansions and beading of the tube ends can only be accomplished successfully by use of a properly equipped Combination Beading Expander Assembly and the correct operating procedure. The minimum requirements of a proper operating procedure are as follows.

1. The Combination Beading Expander must have the proper gauge guide roll assembly and beading roll for the tube to expanded and beaded (see page no. 4 & 5)

2. Thoroughly clean the Combination Beading Expander Assembly to remove the all anti-rust, oil or grease.

3. All tubes to be expanded and beaded must be clean and have the proper tube projection from the tube sheet as listed in specifications. Swabbing the tube I.D. with a good solvent to remove oil and grease is recommended.

4. Set the mandrel stop nut for the calculated required tube I.D. expansions. (Refer to the section on calculating the required expansion.)
   A simple method of setting this tool would be to insert the Combination Beading Expander into the tube so that the beading roll groove rests against the tube end. Use caution to avoid throwing expander body off center but allow expanding rolls to centralize body when mandrel is thrust forward. The mandrel then can be pushed into the tube until expanding rolls contact the I.D. of the tube. At this point, the mandrel stop nut can be adjust approximately the position for the required expansion. To do this, it is only necessary to measure the distance from the thrust bearing face to the mandrel stop face allowing for each inch of mandrel movement a 0.031 inch increase in the tube I.D. (1/32 inch mandrel movement equals 0.001 inch increase in the tube I.D.)

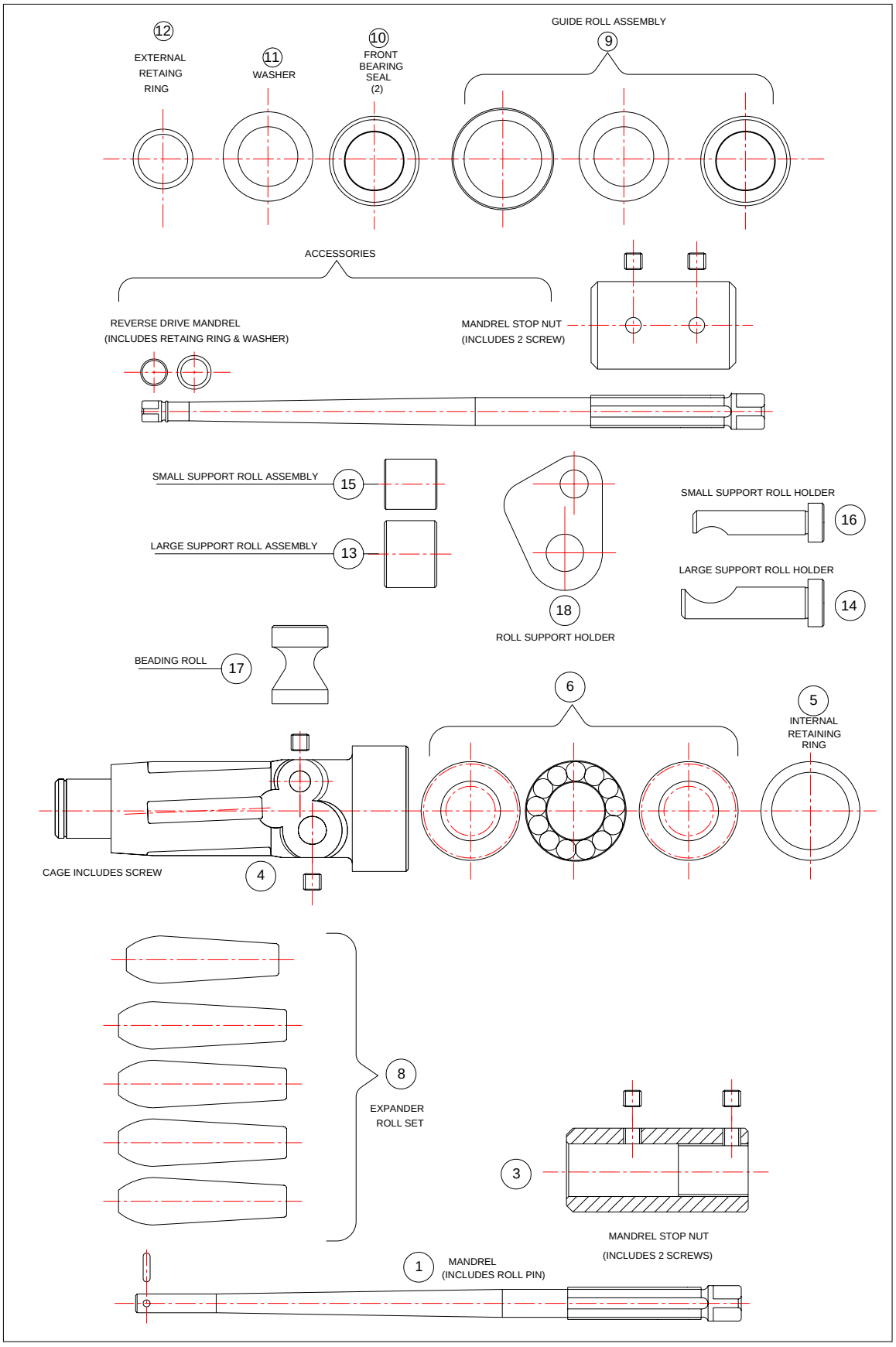
5. The Combination Beading Expander should now be set approximately to the required expansion and is ready to be tried.

6. After swabbing tube with coolant, insert cleaned expander assembly in to tube to be expanded until the beading roll groove touches the tube end. Attach the drive motor to the Mandrel Square and begin expanding and beading. Continue the clockwise rotation of the drive motor for several turns of the expander cage after the mandrel stop nut engages thrust bearing face, indicating that the expansion has been accomplished and the beading of the tube end is the complete. Do not stop drive rotation until this point. Continued rotation will not over expand tube I.D. or degrade bead formation.

7. If the expansion or bead is not sufficient, the mandrel stop can be readjusted and the tube re-expanded and beaded to this new setting.

8. If the bead is not completely against the tube sheet, it may be necessary to do one of two things to correct. They are:
   a. Decrease the tube projection by 1/32 of in inch increments.
   b. Adjust the mandrel stop cut to allow further expansion.

9. It is highly recommended that the use of Powermaster B-KOOL (see page no.7) be used as a coolant, mixed 20-24 parts water to one part Powermaster B-KOOL, for each tube as it is expanded. It is also recommended that the front end of the Combination Beading Expander be dipped in to a bucket of B-KOOL coolant mixture between each tube expansion to remove as much heat from the tool as possible and to keep it clean, a prime necessity for this operation. Do not immerse the entire tool to a depth, which permits the lubricant from being washed out of the thrust bearing. The use of two expander assemblies alternating between each tube beaded is recommended.


12
EXTERNAL RETAING RING
11
WASHER
10
FRONT BEARING SEAL (2)
GUIDE ROLL ASSEMBLY
9
ACCESSORIES
REVERSE DRIVE MANDREL (INCLUDES RETAING RING & WASHER)
MANDREL STOP NUT (INCLUDES 2 SCREW)
SMALL SUPPORT ROLL ASSEMBLY
15
LARGE SUPPORT ROLL ASSEMBLY
13
18
ROLL SUPPORT HOLDER
SMALL SUPPORT ROLL HOLDER
16
LARGE SUPPORT ROLL HOLDER
14
BEADING ROLL
17
6
5
INTERNAL RETAINING RING
CAGE INCLUDES SCREW
4
8
EXPANDER ROLL SET
3
MANDREL STOP NUT
(INCLUDES 2 SCREWS)
1
MANDREL
(INCLUDES ROLL PIN)

Item no.	Description		Catalog No. Tube OD		
			2”	2 1/2”	3”
			50.8mm	63.5mm	76.2mm
	*(1) Assembly		41633-OWXY	41634-OWXY	41359-OWXY
1	Mandrel		41615	41635	41653
3	Mandrel Stop Nut		41683	41637	41654
4	Cage		41619	41639	41657
5	Internal Retaining Ring		34266	34268	34268
6	Thrust Bearing		28123	28070	28070
8	*(2) Expander Roll Set		41670-OABC	41673-OABC	41676-OABC
9	*(3) Guide Roll Assembly		41701-OOXY	41702-OOXY	41703-OOXY
10	Front Bearing Seal		41681(2)	41697(2)	41699(2)
11	Washer		41682	41696	41698
12	External Retaining Ring		41624	41644	35135
13	Large Support Roll Assembly		41668	41671	41674
14	Large Support Roll Holder		41627	41647	41663
15	Small Support Roll Assembly		41669	41668	41668
16	Small Support Roll Holder		41630	41650	41665
17	*(3) Beading Roll		41631-OOXY	41651-OOXY	41666-OOXY
18	Roll Support And Holder		41632	41652	41667
Accessories		Reverse drive mandrel	42157	42158	42159
		Mandrel Stop Nut	41683	41637	41654

*(1) Expander assembly CAT No. Code W=0 for standard 1-1/2” effective roll lengths W=8 for 7/8” effective roll.
*(2) Expander Roll Set CAT No. code OABC=0000 for standard 1-1/2” effective roll length OABC=0087 Effective
*(3) Guide Roll assembly and Beading Roll CAT Nos. code XY=10,11,12 or 13 equal to tube gauge e.g.

Lengths; W = 9 For 1-3/16” Effective Roll Lengths Expander Are Not Offered For Roll Lengths;
OABC = 0118 FOR 1-3/16” Effective Roll Lengths.
Parts for 3” OD X 13 gauge

10. The tool has been designed such that the only adjustment necessary is the movement of the mandrel stop for the proper expansion required. All other adjustment have been designed into the tool.

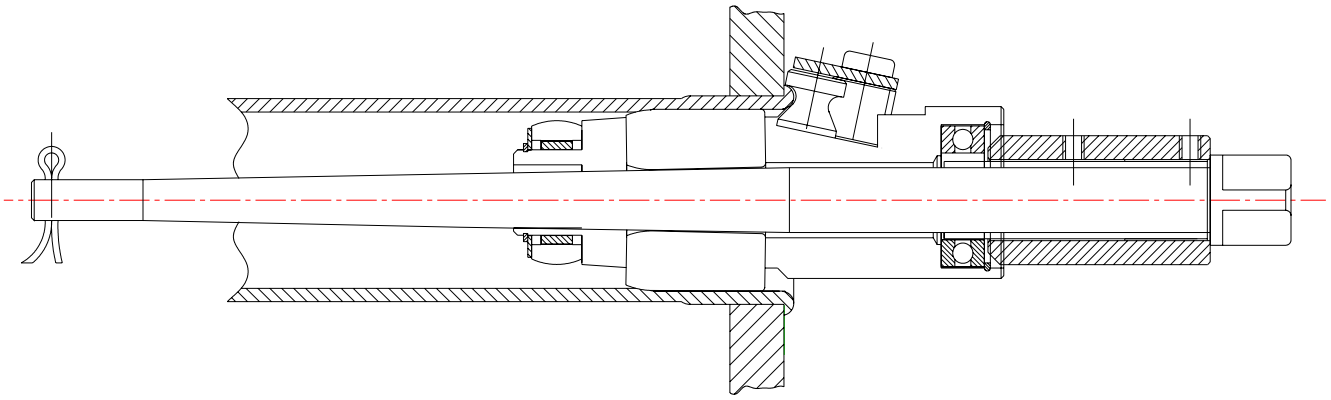
11. Replacement of any part of this tool can be accomplished easily. All parts are designed such that the proper assembly is evident. Two indicators which have been added to prevent any misinterpretation are:

    a) A dimple on one side of the beading roll to indicate that this is the bottom surface.
    b) A stamped “v” on the support roll holders to indicate the set screw dimple position so that the mandrel clearance grooves are located in their proper position.

Calculating the Required Expansion

The amount of expansion desired may usually be determined from past experience records will indicate that there is quite a variable between installation. This variable may be due to personal preference as well as service conditions. The type and hardness of tube metal and the tube sheet will also have a bearing on the amount of expansion. Depending on tube OD sheet thickness, pressure and service, etc., a 10% wall reduction (thinning of the tube wall after expanding) may suffice. In another case a 15% reduction or greater may be required.

The amount of the tube wall reduction generally considered most desirable for the average ferrous tube application is approximately 10 to 15%. Extensive experimentation has established that the most reliable method of determining what a joint should be and its effectiveness is to measure displacement of tube metal, after metal to metal contact of tube wall with tube seat has been made.



An example of how to determine the desired expanded diameter for a 2” x 12 gauge (.109) tube is shown.

	2.015	Tube sheet Hole
minus -	2.000	Tube O.D.
Equals	.015	Clearance (Diameter)
Plus +	1.782	Tube I.D.
Equals	1.797	Tube I.D. at metal to contact
plus +	.022	Increase in I.D. to obtain 10% tube wall reduction. (10% X 0.109 wall X2)
Equals	1.819	Desired expanded diameter of I.D.

If a 10% tube wall reduction is satisfactory, expanding may continue, otherwise the mandrel stop nut must be reset. (Each 1/32” inch mandrel movement equals 0.001 inch change in tube expansion I.D.)

Total Maintenance

The simultaneous expanding and beading being performed required tremendous forces to be generated by the tool, which becomes extremely heated. This requires a proper schedule of maintenance to lubricate the bearing involved to prevent their premature failure. It is highly recommended that the support roll assembly bearings be lubricated as frequently as possible. It is also advisable that the front guide roll assembly is lubricated. The use of good bearing grease is recommended.

Rework Techniques

Certain conditions will arise which are not acceptable and require that the bead or expansion be reworked. This rework can and should be accomplished with the combination beading expander. Under no circumstances should it become necessary to utilize hand methods to rework the expanded, beaded joint. Some of these conditions are :

a. Bead not right against tube sheet:

This condition requires an increase in the tube I.D. expansion to pull the bead against the sheet. It is only necessary to readjust the mandrel stop nut to provide an increased expansion from the setting used in the original expansion / beading operation. It is recommended that approximately five turns of the mandrel stop nut be the initial increase in expansion.

b. Leaking or bleeding tube joints:

The repair of leaking or bleeding tube can be accomplished by the use of the Combination Beading Expander if leaking is not over expansion. To seal the tube joint, it will be necessary to increase the tube I.D. expansion to seal. Therefore, readjusting the mandrel stop nut to increase the expansion from the initial setting used is required. Three to four turns of the mandrel stop nut is recommended as the initial starting point to seal leaking or bleeding tube joints.

Oversize Tube Sheet Holes

If the tube sheet hole diameter is 1/16” or larger than the tube outside diameter, ferrules or sleeves must be used to obtain proper tube expansion without excessive thinning of the tube wall thickness. The combination beading and expanding tool has been designed to provide sufficient expansion for tube sheet holes up to 1/16” over the tube outside diameter. Therefore, ferrules or sleeves are required to perform the expansion and beading of the tube end in oversize tube sheet holes.

Probable Cause Of Failures

1) Bead Not Completely Formed Or Tight Against Tube Sheet:

This condition is caused by one of three reasons:

a. The amount of the tube expansion may not be sufficient; therefore, check, and if necessary, reset the mandrel stop nut for further expansion.

b. Tube sheet projection not correct. The initial tube sheet projection was not sufficient to provide enough material to from the bead tightly against the tube sheet. It would be necessary to increase the tube projection in increments of 1/32”.

c. Lubricant or anti-rust in tube or on expander rolls. Clean tube or expander assembly thoroughly to remove or anti-rust.

2) Excessive Bead Formed:

This condition is evidenced by the outer diameter of the bead being flattened against the tube sheet. This has resulted from an excessive tube sheet projection. It will be necessary to decrease the tube projection in increments of 1/32” until the proper bead is formed.

3) Tube Galling or Flaking:

This condition of excessive galling and flaking evidenced on the tube bead is caused by excessive heat being retained in the tool from the prior tube expansions and beading. The elimination of this problem requires the use of coolant that tool be dunked in to a container of coolant to remove as much heat as possible. It is recommended that the alternate use of tube tools be considered to eliminate any heat buildup problems. If flaking inside tube, this usually indicates over expansion. Correct by resetting stop nut of mandrel.

4) Cage, Stops, Mandrel, Continues to Rotate Prior To Completion of Expansion and Beading:

This condition is caused by excessive heat being retained in the tool. Continued rotation of the mandrel will causes the appearance of a glaze on the rolls and mandrel. The beading roll will appear to have sunk in to the tube end. Therefore, it is of utmost importance that a coolant be used and the tool dunked in to a container of coolant. The alternate use of two Combination Beading Expander assemblies is highly recommended to prevent excessive heating.

5) Needle Bearing Failure:

Failure of the needle bearing that is the part of the beading roll support assemblies is an indication of insufficient lubrication. The tool should be lubricated at list twice per shift during its use.

Recommended Accessories:

Reversible electric Tube Roller Drives.
MP 3L 350 RPM
Mandrel coupling for 3/8"square
Mandrel coupling for 1/2" square
Mandrel coupling for 3/4" square
Mandrel coupling for 1” square