COMBINATION BEADING EXPANDERS

Available in 2.0", 2.1/2" and 3.0" OD.

Powermaster Industrial Ltd Tel:(613) 764-0572 sales@tubetools.ca

Tube O.D.	Tube Thickness		Expansion Range		Model No.	Mandrel Model No. (Square)	Spare Roller Set Model No.	Beading Roll Model No.	Guide Roll Assembly Model No.
inch	bwg	inch	mm	inch					
2	10	.134	43.2 - 48.41	1.700 - 1.906	41633 - 0010	41615 (3/4")	41670 set of 4	41631 -0010	41701 - 0010
	11	.120			41633 - 0011			41631 - 0011	41701 - 0011
	12	.109			41633 - 0012			41631 - 0012	41701 - 0012
	13	.095			41633 - 0013			41631 - 0013	41701 -0013
2.1/2	10	.134	55.9 - 62.48	2.200 - 2.460	41634 - 0010	41635 (1")	41673 set of 5	41651 - 0010	41702 -0010
	11	.120			41634 - 0011			41651 - 0011	41702 - 0011
	12	.109			41634 - 0012			41651 - 0012	41702 - 0012
	13	.095			41634 - 0013			41651 - 0013	41702 -0013
3	10	.134	68.6 - 75.69	2.700 - 2.980	41359 - 0010	41653 (1")	41676 set of 5	41666 - 0010	41703 - 0010
	11	.120			41359 - 0011			41666 -0011	41703 - 0011
	12	.109			41359 - 0012			41666 - 0012	41703 -0012

Note : Refer to operations manual for all other parts listed.

Each of the relevant sizes to the to tube being rolled can be converted to the correct tube guage by replacing the beading roller and the guide assembly.

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Combination Beading Expander

Why we Bead Tube Ends in Fire Tube Boilers

We bead tubes for one reason, to transfer the heat from the tube end into the tube sheet. If not burn back and cracking can occur therefore with a fully beaded tube end the heat from the gases transfer into the tube sheet.

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 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 enough 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 found in expanders of this type and using coolant, which has the quality of minimum lubricity. If the beading roller expander is set so 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 encountered 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 enough 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 progresses. When the stop nut on the mandrel engages the thrust bearing on the cage housing preventing any of the mandrel. This force then diminishes as continued rotation of the expander irons out the tube bead. Therefore, it is necessary that the beading

operation be completed before the final expansion of the tube since it will require the maximum tractive force available to perform the 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 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 to set the tool with the beading 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 requirements is even more of a critical nature when using the Combination Beading Expander.

Working out the Finished I.D.

Working out the finished ID., otherwise calculating the required expansion. The amount of expansion required may usually be determined from past experience records that will indicate that there is quite a variable between installations. This variable may be due to personal preference as well as service conditions. The type of material and hardness of the tube. The tube sheet will also have a bearing on the amount of expansion due to tube sheet thickness.
Depending on tube OD, tube sheet thickness, pressure and service, etc., a 10% wall reduction (thinning of the tube wall after expanding) may suffice. In other cases, a 15% wall 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 10-15%. Extensive experimentation has established that the most reliable method of determining what a joint should be and its effectiveness is to measure displacement of the tube metal, after metal to metal contact of the tube wall with the tube seat has been made.

Example of how to determine the desired expanded diameter for a 2.0” OD tube x 12 BWG (0.109”)

2.015” Tube Sheet Hole Size
0.015” Clearance (between Tube OD and Tube Sheet Hole Diameter)

12 BWG = 0.109” Wall thickness x 2 = 0.218” therefore OD 2.0”-0.218” = ID of 1.782”
Therefore: 1.782” + 0.015” to metal contact.

To obtain a 10% Wall thinning = 10% x 0.109x2 so becomes 0.10 x 0.218” = 0.0218”
So: Metal Contact ID. 1.797” + 0.0218” = Finished ID of 1.819” for 10% wall thinning.

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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 ID.)

Tube Projection

Tube projection from the tube sheet is one of the most important things to achieve the perfect bead. This projection is the material which forms the bead within the beading roll. Beware of different tube lengths required to achieve the individual tube projection. Especially on older boilers be aware of tube sheets that may have bowed or warped. Measure each distance on each tube from the outside of each tube sheet then add the projection twice if being beaded both ends. Tube projection is from 1/4" to 9/32" depending on tube OD and wall thickness.

		COMBINATION BEADING EXPANDER					TUBE PROJECTION Nominal Size			
TUBE OD	PART No	Contracted Diameter	Expanded Diameter	Body Diameter	Bead Roll Diameter	Drive Square	Tube Gauge			
							10	11	12	13
2.0"	41633	1.700"	1.875"	1.688"	5/8"	3/4"	1/4"	1/4"	1/4"	1/4
2.1/2"	41634	2.200"	2.375"	2.156"	7/8"	1.0"	9/32"	9/32"	9/32"	9/32"
3.0"	41653	2.700"	2.900"	2.562"	7/8"	1.0"	9/32"	9/32"	9/32"	9/32"

The tube projection above is nominal for the best formed bead. It may be necessary to adjust the tube projection to allow for tube sheet distortion, tube type and hardness of material. Adjusting of projection should be done in 1/32" increments.

If on completion of the bead you find the bead is not touching the tube sheet, then adjustments will be needed.
(Remember the reason why we bead tube ends is to transfer the heat from the tube end to the tube sheet.)
Take a measurement of the inside of the rolled tube and if the finished tube ID is correct then the correct amount of wall thinning has taken place, so the projection needs to be increased.
If the tube ID is under the required measurement, then adjustment of the mandrel stop needs to take place to make the finished ID.

Guide Roll

Guide rolls of different diameter are available for the correct tube gauge. This is based on the tube ID therefore correct matching must be obtained to form the perfect bead. Guide rolls are mounted eccentrically on the body of the expander. This means that a guide roll that is too large will prevent entry into the ID of the tube. Also, if the guide roll is too small the combination beading expander will roll uneven producing a poor bead as in seal and appearance. The ID of the tube, with a smaller guide roll, can be marked by the cage or mandrel not being centralized.
When ordering, the tube OD and tube wall thickness is critical for correct tool selection.

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Beading Roll

Beading rolls will operate on a range of wall thicknesses, but the best result is achieved by having the correct beading roll, for the tube gauge to be worked. Individual beading rolls are marked with the associated tube gauge.

Tube and Tool Cleanliness

Both the tube and the beading expander should be totally clean and free of any protective rust inhibitors from the tube manufacturer. The presence of any such material will prevent the expander rolls from having the traction needed to develop the force needed to feed the beading roll against the tube end to form the bead.

During the beading operation check between rolls for dirt and debris within the rolls and the beading mechanism. Any foreign material can be detrimental on the final quality of the roll and bead. Washing the tool out in oil during the operation will prolong the life of the rolls and mandrel.

After rolling many boiler tubes rolls may need to be replaced. If replacing, replace the rolls and mandrel at the same time. Early indication is the scoring of the mandrel.

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Tool Coolant

The pressures of bead formation, due to tube end deformation imparts extreme heat to the tool. This heat builds up within the tool and must be removed using a good water-soluble coolant. The use of a paste type coolant like Lube One or Lube A Tube placed within the tube is an ideal medium. This will not only prevent the tool from over heating but will assist in maintaining the cleanliness which in turn extends the service life of the tool. Tool over heating will cause tube material flaking, cage rotation stoppage due to beading roll gouging, seizure and poorly formed beads.

Operation Procedures

The expansion and beading of tube ends can only be accomplished successfully using 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 based on the gauge (BWG) /wall thickness to be expanded and beaded.
2. Thoroughly clean the Combination tool and tubes to remove all anti rust, oil or grease.
3. All tubes to be beaded must have the proper projection from the tube sheet as listed in the specifications. Swab out the inside of the tube with solvent.
4. Set the mandrel stop nut for the required tube ID expansions. (Refer to the 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 can then be pushed into the tube until expanding rolls contact the tube ID. At this point the mandrel stop nut can be adjusted 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 nut face allowing for each inch of mandrel movement a 0.031" inch increase in the tube ID. (1/32" of mandrel movement equals 0.001" inch increase on tube ID)

5. The Combination Beading Expander is now set approximately to the required expansion and is ready to complete its first roll.
6. Insert cooling paste into the tube and rollers. Insert the tool until the beading roll groove touches the tube end. Attach the drive unit to the mandrel square and begin expanding and beading. Continue the clockwise rotation of the drive motor for several turns after the mandrel stop nut engages the thrust bearing face, indicating that the expansion has been accomplished and the beading of the tube end is complete. **Do not stop drive rotation until this point.** Continued drive rotation will not over expand the tube, nor will it degrade the quality of the bead formation.
7. On completion of the first expansion/bead check the finished ID to make sure the correct values have been achieved. Adjust the mandrel stop nut accordingly.
8. If the bead is not fully formed against the tube sheet, make projection adjustments as necessary.
9. The tool has been designed such that the only adjustment necessary is the movement of the mandrel stop nut for the proper expansion to be achieved.
10. On some boilers where the tubes are close together, the roller support holder can foul against beads previously made. To counteract this problem, grinding a bevel into the edge fouling the tube allows the tool to rotate without hinderance. This modification does not alter the performance or strength pf the tool.

Tool Maintenance

The simultaneous expanding and beading being performed requires tremendous pressures within the tool which becomes extremely heated. This requires a proper schedule of maintenance to lubricate the bearing involved to prevent premature failure. It is recommended the tool be lubricated as frequently as possible using a good quality bearing grease.