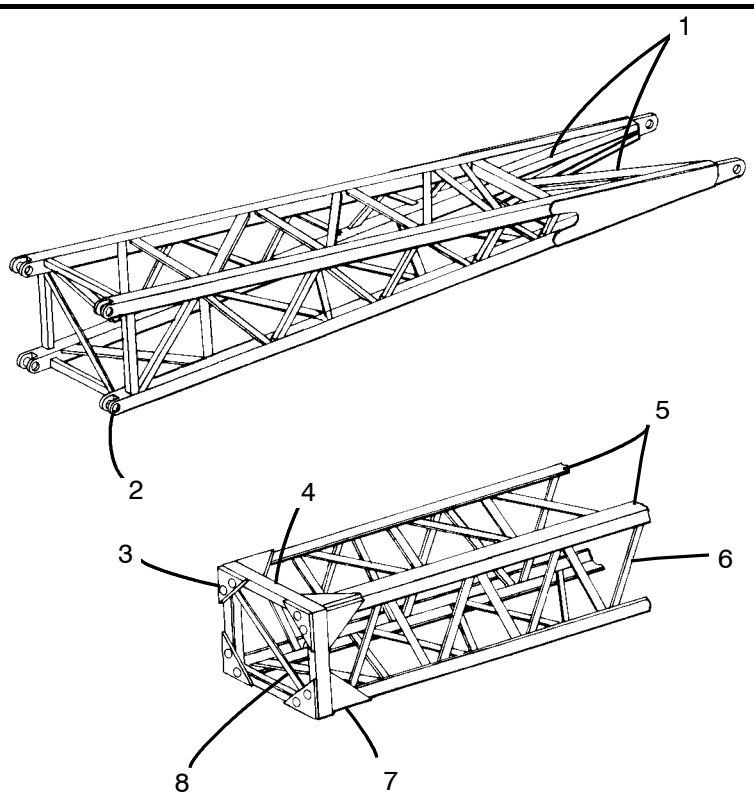
Link-Belt CRANES

Boom Inspection and Repair

Table of Contents:

This booklet contains four individual Service Manual Codes. SM08- 01- 001.00 concerns inspection and repair of lattice booms and jibs made of steel angle material. SM09- 001- 002.00 concerns inspection and repair of lattice booms, flys, and jibs made of tubular steel material. SM17- 001- 036.00 concerns inspection of diamond embossed, telescopic booms. And lastly, SM17- 001- 053.00 concerns inspection of two piece, formed, telescopic booms.

Notes:



1. Throat Braces
2. Pin Connection
3. Corner Bolt Plate
4. Picture Frame Angle
5. Chords
6. Lattice
7. Corner Gusset Plate
8. Diagonal

Acceptable Cosmetic Conditions Which Do Not Require Repair

1. See Appendix A.

Repairable Conditions Which Must Be Corrected

1. Broken, bent, kinked, or missing lattice, picture frame angles, diagonals, or braces.
2. Cracks in welds or braces other than chord members, or boom or jib lugs.

Non-Repairable Conditions Which Require The Section To Be Destroyed To Avoid All Possibility Of Future Use

1. Any cracks in main chord members or boom or jib lugs.
2. Unacceptable dents or pitting in or corrosion on the chord members. (See Appendix A.)*
3. Overall straightness of each of the chords is not within 3/16 inch (*4.8mm*) per free span (distance between lattice), or 1/4 inch (*6.4mm*) over length of section.
4. Any prior repairs on the chord members or boom or jib lugs (other than authorized lattice replacement).
5. Cracks which continue into the chord in welds joining parts to chord members.
6. Chord members which have had brackets, rigging parts, walkways, etc. welded on which are not original equipment.
7. Obvious deformation of the section.

* Consultation with LBCE is required in this area.

Figure 1
Typical Angle Boom Sections

Repairing Damaged Angle Booms And Jibs

Introduction

This procedure provides information for identification, inspection, and repair of angle boom and jib sections manufactured by Link-Belt Construction Equipment (LBCE), which have only specific types of damage. These instructions are not intended to repair live masts.

The scope of repairable damage to attachments is limited to only those components mentioned in Figure 1 under *Repairable Conditions Which Must Be Corrected*. It is important to note that LBCE will not assume responsibility for repairs made by anyone, other than a certified Link-Belt representative, using the procedures and restrictions outlined here.

The suggestions made or procedures given are for information only and are based on LBCE's knowledge of the product. The repair personnel must assume the responsibility as to the workmanship and the owner must bear the final responsibility as to its use. Prior to starting any repair work, all information contained in these procedures, must be read and thoroughly understood.

All inspection and repair work is to be performed by qualified personnel. All work prescribed in these procedures is to be done on a non-working boom or jib, and whenever possible, as single sections. Boom or jib sections must be positioned in such a manner that the work can be done in a safe and ready fashion.

Note: In an emergency situation, repairs can be done with the attachment installed. However, extreme care must be taken to fully support it, relieve any stress and remove all load from the damaged attachment. In this situation, only one lattice can be replaced at a time.

The area of the boom or jib section being repaired must be free of moisture prior to any repair work which requires welding, gouging, or cutting. The use of low-hydrogen electrodes is required in many portions of these procedures. See Appendix B for care of low hydrogen electrodes.

Materials used to manufacture booms and jibs, and the performance of these structures, requires special repair procedures as outlined in these instructions.

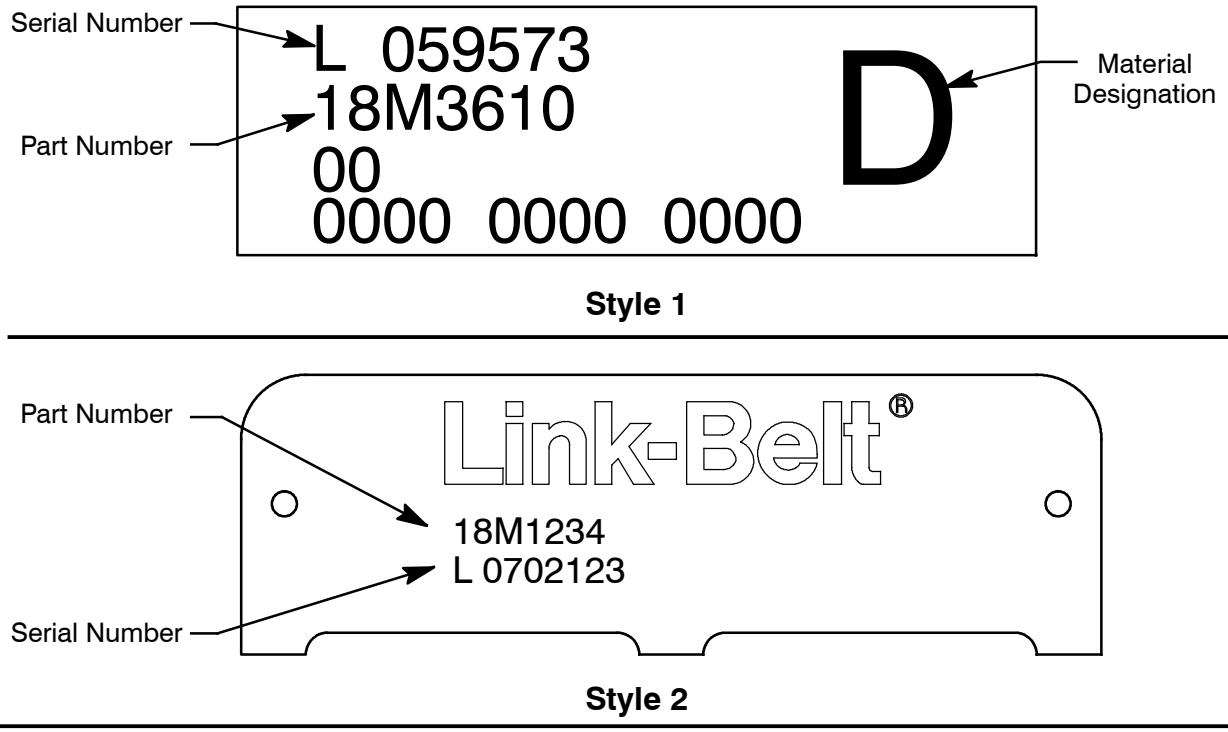


Figure 2
Typical I.D. Plates

Chord Material Identification

Before repairs are started, it may be necessary to identify the boom chord material if certain types of cutting and gouging equipment are used. See Table B. If coated - electrode (gouging w/o air) equipment is used to cut and gouge on the main chord then it will be necessary to establish what type of material was used in the main chords of the boom or jib. There are two styles of identification (I.D.) plates. The Style 1 plate which contains the material designation and Style 2 plate which does not indicate the material designation. See Figure 2.

The Style 1 I.D. plate has a large alphabetical designation stamped on it. Using these letters, refer to Table A for material identification.

If a Style 2 identification plate is used, and the repair technique requires that the material be known, seek assistance from the LBCE Service Department for material identification.

⚠ DANGER

Use only Link-Belt approved materials. Any deviation from these materials could result in serious personal injury, death, or major equipment damage. In the event the boom or jib section I.D. plate is missing or unreadable, repair of that section is not recommended until it can be positively identified. Seek assistance from the LBCE Service Department for proper methods of identification.

If the factory I.D. tag and other informational or cautionary tags are on the lattice being replaced, it will be necessary to replace them. The I.D. plate can be removed by carefully cutting through the tack welds and relocating it on the replacement lattice. Any Warning or Caution labels will have to be ordered from a Link-Belt Distributor.

The repair procedures for both types of material are similar, except, different types of cutting and grooving equipment are needed. The welding procedure is the same for all booms and jibs.

For any additional information regarding chords or welding of various additions to the chords, please contact a Link-Belt Distributor. Be ready to provide identification plate information, amount and location of damage, location and object to be welded, etc.

Stamping	Type Of Angle Chord Material	Strength (Minimum Yield)	
		lb_f/in^2	N/mm^2
(1) "D"	Quenched And Tempered High Strength Alloy or Carbon Steel	100,000	*690*
(2) "TT"	Low Alloy High Strength Steel	50,000	*345*

Table A
Material Identification

Recommended Processes	Usage	Material Type	Notes
Oxygen Acetylene Cutting Torch (Cutting)	For Cutting Lattice At Chord Angles As Stated In Case III	TT and D	See Case III
Arc-Air (Gouging)	Gouging Of All Welds	TT and D	See Table C
Plasma Torch (Cutting & Gouging)	For Cutting Lattice At Chord Angles And Gouging Off Weld Material	TT and D	See Case I And Case III
Coated-Electrode (Gouging W/O Air)	Gouging Of All Welds	TT Only	See Table C
Grinders, Chisels, Saws	Removal, Cutting and Veeing of Lattices, Lattice Welds and Welds in General	TT and D	

Table B
Recommended Processes With Skilled Operator's Using Good Techniques To Keep Excessive Heat Out Of The Chord Material

Ordering Replacement Materials

Proper identification of replacement materials is crucial to ensure the structural integrity of the attachment, as well as ease the assembly and welding process. No variation of material type or nominal cross section dimensions is allowed.

DANGER

Use only Link-Belt approved materials. Any deviation from nominal cross section dimensions or material types could result in serious personal injury, death, and/or major equipment damage. In the event the boom or jib section I.D. plate is missing or unreadable, repair of that section is not recommended until it can be positively identified. Seek assistance from the LBCE Service Department for proper methods of identification.

Use the following Steps to collect the necessary information needed to order attachment repair material from Link-Belt or a Link-Belt Distributor.

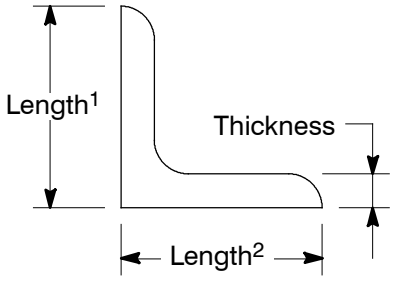


Figure 3
Nominal Cross-Sectional Dimensions

1. Locate the I.D. plate and record the serial number, part number, and chord material type, if shown. Refer to Figure 2.
   a. If I.D. plate Style 1 is used, refer to Table A for material specification requirements.
   b. If I.D. plate Style 2 is used, seek assistance from the LBCE Service Department for material specifications.
2. Accurately measure and record the nominal cross section dimensions of the lattice, diagonal, picture frame, or brace to be replaced or repaired. Refer to Figure 3.

Lattice, Diagonals, And Picture Frame Angle Repair

Lattice, diagonals, and picture frame angles must be kept in good condition to hold the chords in proper alignment. Bent lattice cause deflection of the main chord angles so they are no longer "in line", thus reducing and partially destroying the load carrying capacity of the boom.

A good percentage of damaged lattice can be straightened by conventional methods. If the damage to the lattice is beyond repair by straightening, such as a severe twist or kink, it must be replaced.

The maximum allowable uniform curvature, where no repair is necessary on lattice, diagonals, and picture frame angles, is 1/32 inch per foot (*1mm per 40cm*), or less.

A lattice, diagonal, or picture frame angle with a uniform curvature, greater than the maximum allowable mentioned, but less than the ratio of 1 inch across 36 inches (*1cm across 36cm*), may be straightened. Curvature in excess of this ratio requires complete replacement of the lattice, diagonal, or picture frame angle.

DANGER

Use only Link-Belt approved materials. Any deviation from these materials could result in serious personal injury, death, or major equipment damage.

The straightening, removal, and replacement of damaged components and repair of welds can be separated into three cases. A thorough examination of the boom or jib must be made to determine which case is to be used for repair of the boom or jib.

Classification Of The Cases

Case I Repair of cracks in welds throughout the boom or jib.

Case II Straightening damaged lattice, picture frame angles, diagonals, and braces.

Case III Replacement of lattice, picture frame angles, diagonals, and braces.

Case I

Repair of cracks in welds throughout the boom or jib.

The most common cracks in a weld joint are at the end of welds. Less common are cracks along the edge of the weld. Refer to Figure 4.

The following are some helpful weld inspection hints. The most common weld inspection process is visual examination with the aid of a portable light.

The equipment listed below, can be used to clear any doubt.

3. Magnetic Particle
   a. Wet
   b. Dry
4. Penetrant Dye
   a. Visible
   b. Florescent

The indication of cracks when using the visual method would be:

1. Chipped, flaked, or blistered paint.
2. Rust lines staining the paint.
3. Bent, twisted, or broken parts in the area.

A procedure should be established for boom inspection. The section should be placed so that a good inspection can be made of each side of the boom. There should be equipment available to turn or roll the section from side to side so that a good inspection can be made. Each lattice weld should be examined, along with all other areas of the boom section. The cracked welds should be marked, and only after marking all places, should the repair be started. An orderly procedure should also be followed in the repair of cracked welds.

Procedure For Removing, Veeing, Or Grooving Cracked Welds

1. Cracks in lattice welds only:
   a. Remove entire weld.
   b. Replace entire weld.
2. Cracks other than lattice welds:
   a. Cracks in welds where the weld length is less than 2 inches (*50.8mm*) long.
      1. Remove entire weld.
      2. Replace entire weld.
   b. Cracks in welds where the weld length is greater than 2 inches (*50.8mm*) long and the crack is less than one half the length of the weld.
      1. Vee or groove out the weld deposit the length of the crack plus 1/4 inch (*6.4mm*) beyond the crack length.
      2. Replace removed section of weld.
   c. Cracks in welds where the weld length is greater than 2 inches (*50.8mm*) long and the crack is greater than one half the length of the weld.
      1. Remove the entire weld.
      2. Replace the entire weld.

Diameter Of Electrode		Air Pressure		Speed Of Travel		Amperage Range
inches	*mm*	psi	*kPa*	ft/min	*m/min*	
0.156	*4*	80- 100	*552- 690*	10- 20	*3- 6*	90- 150
0.188	*4.8*	80- 100	*552- 690*	10- 20	*3- 6*	150- 200

Table C
Data For Arc-Air And Coated-Electrode Gouging

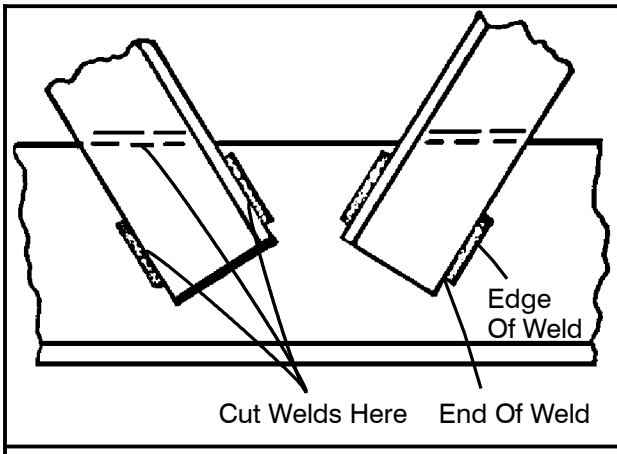


Figure 4
Weld Removal Example

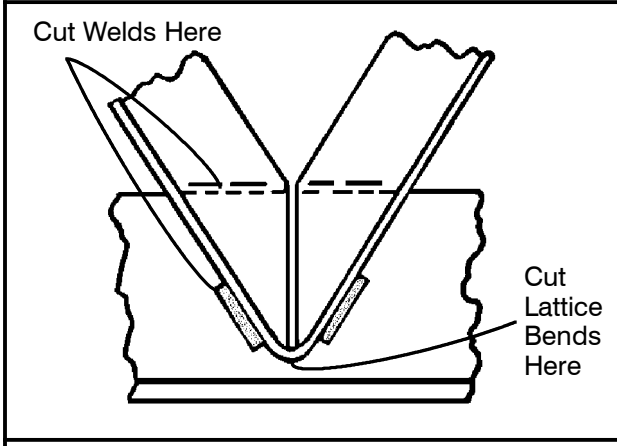


Figure 5
Cutting Lattice And Weld Removal Example

3. Cracks in a plug or deep groove weld.
   a. The length of the crack is to be vee'd or grooved out plus 1/4 inch (*6.4mm*) beyond its length and as deep as the crack penetrates into the weld. The vee or groove is to have a minimum face opening of 1/4 inch (*6.4mm*) wide, or one half times its depth.
   b. Replace removed section of weld.

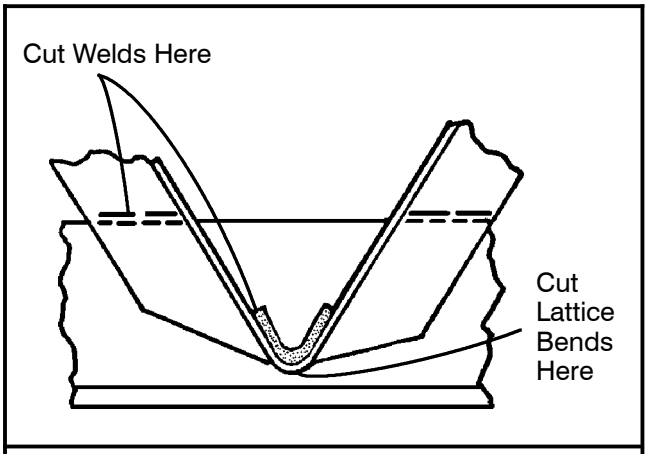


Figure 6
Cutting Lattice And Weld Removal Example

Table B shows the recommended processes for cutting, veeing, and gouging of lattice, and all welds on a boom or jib.

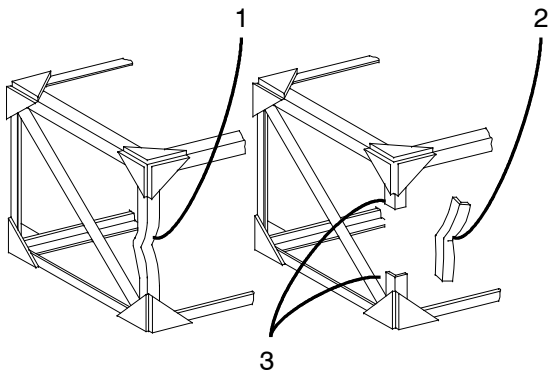
When using the arc-air process:
1. Use only those parameters listed.
2. Use qualified personnel.

The maximum allowable gouging depth into the base metal is 1/32 inch (*0.8mm*). The gouges must be filled with weld during the repair procedure.

Use of electrodes for gouging **without air** (i.e. Eutectics Astrode) is allowable only on type "TT" material.
In Table C, the parameters for gouging out welds **with the arc-air** process are listed. This data is given so that the process may be used on both type "D" and "TT" materials. This process is to be used by qualified personnel, skilled in the arc-air process.

Note: It is important that the speed of travel shown in Table C is adhered to.

In Summary Of Case I
1. Position the section properly.
2. Inspect and mark areas for repair in an orderly fashion.
3. Repair the welds using a recommended process which is proper for that material.



1. Damaged Picture Frame Angle
2. Removed Portion
3. Stubs

Figure 7
Removing Damaged Picture Frame Angle

Case II

Straightening damaged lattice, picture frame angles, diagonals, and braces.

Straightening may be performed on bent lattice, picture frame angles, diagonals, and braces using conventional methods such as hammering and bumping dollies, anvils, prying with bars, twisting with adjustable wrenches, etc. If heating is used in the straightening process the maximum allowable temperature is 1,100° F (*593° C*). Temperature should be controlled with the use of temperature crayons, thermometers, etc.

Case III

Replacement of lattice, picture frame angles, diagonals, and braces.

Replacement of lattice, diagonals, and braces

If the chord angle is bowed in the area of the damaged lattice, diagonal, or brace, it may be due to the bend in the lattice, diagonal, or brace. The chord may return to its original position when the lattice, diagonal, or brace is removed. If the chord does not straighten up when the lattice, diagonal, or brace is removed, repair is not recommended.

The lattice, diagonals, or braces must be removed from the chord by cutting out the welds at the chords or cross braces. In single piece replacement, the ends joining the chords must be cut as shown in either Figure 5, Figure 6, or Figure 7., using an oxygen-acetylene torch with cutting parameters listed in Table B. If more than a single piece replacement of adjacent pieces is required, then each bent section of the piece which is welded to the chord must be removed by cutting through these welds.

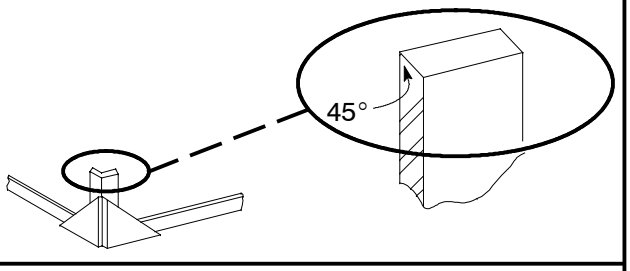


Figure 8
Preparing Angle Stub

Note: A replacement lattice may either be a single piece, or bent adjacent pieces.

Caution should be used in maintaining alignment of chord angles. This can be done by clamping a brace to the chords to keep them in line prior to welding. If the diagonal bracing of the angle of the picture frame is being replaced, the section should be pinned up with another section in good condition, to hold the picture frame (boom box) square while making repairs.

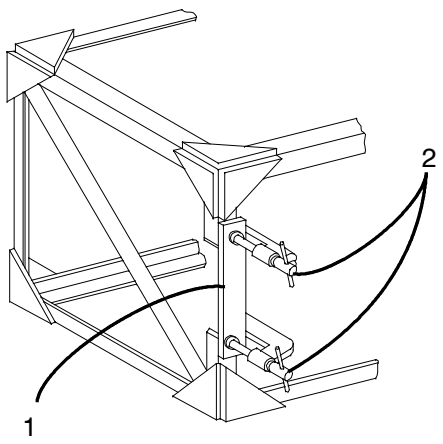
The replacement angle components for lattice, diagonals, or braces must have the same nominal cross section dimensions as the original parts. Refer to Figure 12. The replacement components must also have the same material and strength specifications as the original part.

Replacement Of Picture Frame Angles

Cut out the damaged picture frame angle 1- 2 inches (*25.4- 50.8mm*) above the corner gusset plate, and/or the corner bolt plate (See Figure 7).

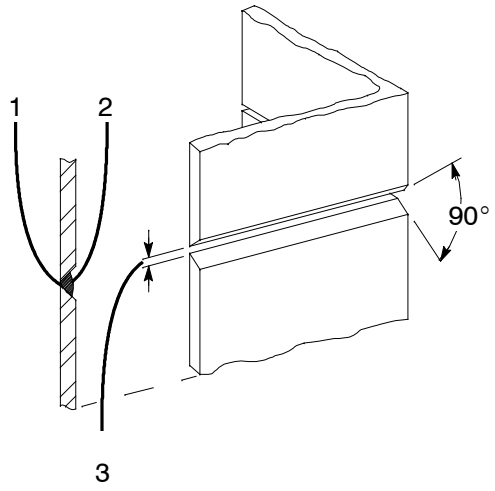
Note: On some booms, there may be plates or angles welded to the picture frame angle that will have to be cut loose to allow replacement of the damaged angle. If the plate or angle welded to the picture frame is also damaged, straighten or replace it.

Chamfer the remaining stubs at a 45° angle (See Figure 8). Pin or bolt the section to another section in good condition to check for squareness. It may be necessary to jack the damaged section around to achieve alignment. Clamp angles or flat bars across the boom to hold alignment, then disconnect the other section. Recheck the squareness of the boom section to make sure it remained square after removal from the other section.



1. Guide
2. Clamps

Figure 9
Clamping On Guide Angle



1. Check back side for complete penetration. If not, grind.
2. Root Pass Weld
3. 0- 1/16 inch (*0- 1.6mm*) Maximum Gap

Figure 10
Weld Procedure

Clamp an angle or flat bar across the stubs where the picture frame angle is being replaced. This angle or flat bar will be used as a fixture to hold in the replacement lattice (See Figure 9). Cut the replacement angle 0 to 1/8 inch (*0- 3.2mm*) shorter than the distance measured between the stubs to provide a weld root opening at each end. Chamfer the ends of the replacement angle to a 45° angle to match the chamfer on the stubs so that an included "V" angle of 90° for a butt joint is formed. Clamp the replacement angle in place, allowing for a 0- 1/16 inch (*0- 1.6mm*) root opening on each end. Tack the replacement angle in place, and remove the flat bar or angle used for a fixture.

Recheck the squareness of the section by pinning or bolting to another section in good condition. If the squareness is acceptable, remove the section and prepare for welding.

Weld the root pass, one side only, on both ends. Check the back side of the root pass for complete weld penetration (See Figure 10). If there is a lack of penetration, grind or air-arc the root side to sound metal. Weld the back side, then fill in the groove.

In Brief Summary Of Case III:

1. Remove entire length or lengths of damaged lattice, diagonals, or braces by:
   a. Cutting through the welds on the chords or support braces.
   b. Cutting through the center of the bent portion of the lattice at the chord as shown in Figure 5, Figure 6, and Figure 7.
2. Maintain chord alignment.
3. Replace lattice, diagonals, and braces in same locations as they were removed.
4. Use only those lattice, diagonal, and brace angle sizes and materials as were originally used.

Any given job may require adjustment of current setting for welding. Therefore, refer to the welding rod manufacturer's recommended current ranges.

Prior to welding, the area should be properly cleaned. This may include grinding free the paint, cutting slag, etc. While grinding, avoid under-cutting or gouging into the base metal.

Appendix A

Angle Boom Or Jib Chord And Lattice Corrosion, Pitting, Or Dents

The information contained in this appendix is to be used when considering chord and lattice corrosion, pitting, or dents. These guidelines state what is acceptable based on structural strength.

Corrosion Or Pitting:

LBCE will allow corrosion or pitting up to a depth of 7.5% of the nominal angle leg thickness without replacing the lattice or condemning the chord and therefore the boom section. This will be allowed provided that the amount, size, and location of the damage is not deemed excessive by a qualified LBCE representative. For example: An angle leg with a thickness of 3/8 inch (*9.5mm*), would have an allowable pit depth of 0.028 inch (*0.7mm*).

As an alternative to measuring the depth of the damage, the actual angle leg thickness may be measured. The angle leg thickness must be at least 92.5% of the nominal thickness.

Dents:

LBCE will allow up to 1/8 inch (*3.2mm*) of dent depth for angle booms or jibs in chords or lattice provided all criteria listed in Figure 1 is maintained. A dent by definition does not reduce angle leg thickness. The dent depth given will only be allowed if the angle leg thickness has not been reduced by gouging or other means. Follow the thickness requirements listed for corrosion or pitting if the angle leg thickness has been affected. The dent depth listed will be allowed provided that the number, size, and location of the dent(s) is/are not deemed excessive by a qualified LBCE representative.

Cause For Rejection:

Any main chord or lattice damage which exceeds the cosmetic guidelines stated above requires the section be taken out of service immediately.

Repair:

All damaged areas that fall into the acceptable category as outlined above are to be treated as cosmetic damage only. It is not recommended that they be repaired. All lattice damage which exceeds the limitations stated above requires the lattice be replaced.

DANGER

Angle boom or jib chord members are not to be repaired unless approved by LBCE. Any authorized repairs must be performed by a LBCE weld specialist. Improper repair procedures could result in serious personal injury, death, and/or major equipment damage.

Appendix B

Care Of Electrodes

The low-hydrogen characteristics of the electrode should not be taken for granted. Hydrogen is an unwanted chemical element in welding many types of steels, including all the heat-treated steels. Normally, the higher-strength alloy-steel low-hydrogen electrodes are packaged in hermetically sealed containers and have less the 0.2% moisture in the coating. Such electrodes are suitable for immediate use provided the container has not been damaged and the electrodes have not been exposed to the air.

Some electrodes, however, are packaged in cardboard containers with "moisture-proof wrapping" which may or may not provide adequate protection.

To minimize weld cracking, the following steps are recommended for the conditioning and handling of low-hydrogen electrodes:

1. As soon as the electrode container is opened, the electrodes should be removed and placed into a baking oven.
2. Electrodes should be baked according to the manufacturer's instructions (usually 800° F (*427° C)* for one hour). The electrodes should be put into the oven at 500° F (*260° C*) maximum and heated up to 800° F (*427° C*) with the electrodes placed no more than three layers deep on a tray.

   Note: This baking may be omitted only if the user is certain that the electrode coating, as ready for use, contains less than 0.2 percent moisture.

3. Whether baked or not, the electrodes should be immediately transferred to a storage or holding oven at 250° ±25° F (*121° ±4° C*).
4. Both the baking oven and the storage oven should be equipped with air-circulating systems and temperature indicators with controls.
5. Electrodes should not be placed in the storage oven unless sufficiently dry as received or properly baked.
6. The welding electrodes should be used within one hour after removal from the storage oven.
7. Electrodes removed from the storage oven and exposed in a clean, dry location for times longer than those specified should be re-baked as described under item (2). Electrodes exposed to water, grease, or dirt should be destroyed.
8. When welding is done in areas of high humidity, it is advisable to store a suitable quantity of electrodes in a small portable oven from which electrodes may be drawn one at a time by the welder.

For any additional information concerning repair of chords, picture frame sections, or welding of various additions to the chords, contact a Link-Belt Distributor giving the identification tag information, amount and location of damage, location and object to be added on, etc.

The use of covered stick electrode (SMAW) or solid wire electrode (GMAW- S) or flux cored wire electrode (FCAW) is permitted.

For covered stick electrode, use 3/32 inch (*2.4mm*) or 1/8 inch (*3.2mm*) diameter electrodes of A.W.S. E7018 class. Use the procedures given below, which will produce a 1/8- 3/16 inch (*3.2- 4.8mm*) one pass fillet weld:

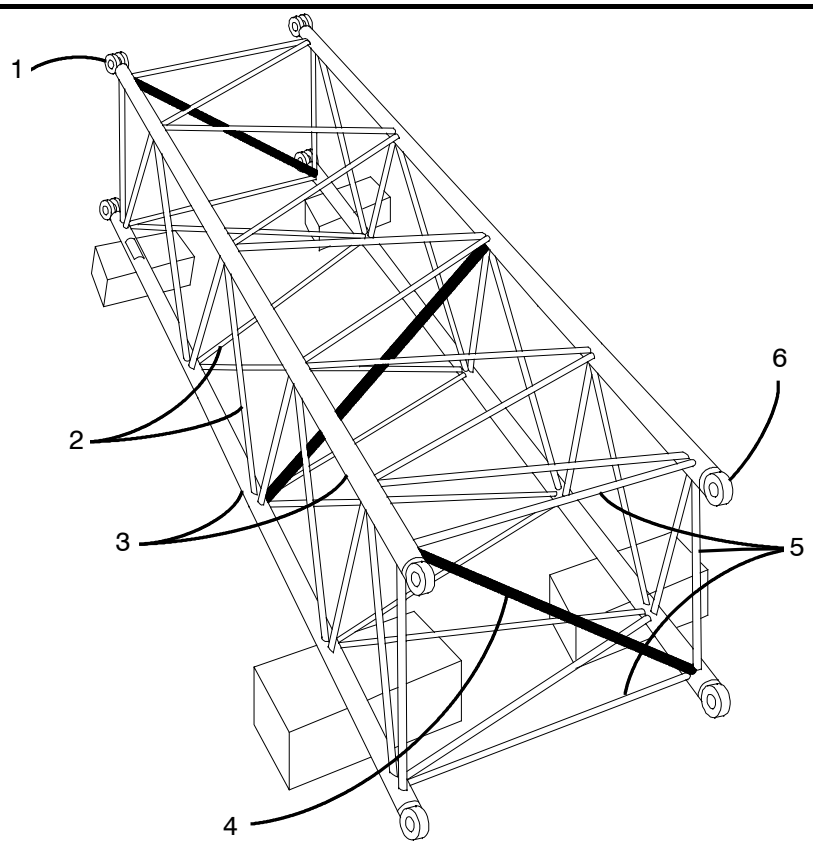
Electrode Size	3/32 inch (*2.4mm*)
Amperage, A	60- 100
Voltage, V	21- 23
Travel Speed,	7 inches (*177.8mm*)/min
Electrode Size	1/8 inch (*3.2mm*)
Amperage, A	90- 135
Voltage, V	22- 23
Travel Speed,	8 inches (*203.2mm*)/min

For wire welding please note desired weld size. If weld fillet size is 3/16 inch (*4.8mm*) or smaller use the GMAW- S process. All welding to be done in the flat position only. Use the GMAW- S process with A.W.S. ER70S- 3 or ER70S- 6 wire and 100% CO^2 gas shielding. For 0.045 inch (*1.1mm*) diameter wire use CO^2 at 25 to 35 scfh*, voltage set at 20 volts and wire speed set to 182- 198 inches (*4.6- 5.0mm*) per minute.

If weld fillet size is 1/4 inch or larger use the FCAW process. Welding can be done in the flat, horizontal, vertical up and overhead positions. Use the FCAW process with A.W.S. E71T- 1 wire and 100% CO^2 or 75% Argon and 25% CO^2 gas shielding as recommended by the weld wire manufacturer. For 0.045 inch (*1.1mm*) diameter wire use the shielding gas flow set at 30 to 40 scfh, voltage set at 24 volts and wire speed set to 220- 240 inches (*5.6- 6.1mm*) per minute.

* SCFH (Standard Cubic Feet Per Hour).

Notes:



1. Pin Connecting Lug (Female)
2. Lattice
3. Chords
4. Diagonal
5. Picture Frame Lattice
6. Pin Connecting Lug (Male)

Acceptable Cosmetic Conditions Which Do Not Require Repair

1. See Appendix A.

Repairable Conditions Which Must Be Corrected

1. Broken, bent, kinked, or missing lattice, diagonal, or picture frame lattice.
2. Cracks in welds or braces other than chord members, or boom, fly, or jib lugs.

Non-Repairable Conditions Which Require The Section To Be Destroyed To Avoid All Possibility Of Future Use

1. Any cracks in main chord members or boom, fly, or jib lugs.
2. Unacceptable dents or pitting in or corrosion on the chord members. (See Appendix A.)*
3. Overall straightness of each of the chords is not within 3/16 inch (*4.8mm*) per free span (distance between lattice), or 1/4 inch (*6.4mm*) over length of section.
4. Any prior repairs on the chord members or boom, fly, or jib lugs (other than authorized lattice replacement).
5. Cracks which continue into the chord in welds joining parts to chord members.
6. Chord members which have had brackets, rigging parts, walkways, etc. welded on which are not original equipment.
7. Obvious deformation of the section.

* Consultation with LBCE is required in this area.

Figure 1
Nomenclature/List Of Terms

Repairing Damaged Tubular Booms, Flys, And Jibs

Introduction

This procedure provides information for identification, inspection, and repair of tubular booms, flys, and jib sections manufactured by Link-Belt Construction Equipment (LBCE), which have certain specific types of damage. These instructions are not intended to repair live masts. The scope of repairable damage to attachments is limited to only those components listed in the “Lattice Repair Parts Book”. It is important to note that LBCE will not assume responsibility for repairs made to attachments, unless those repairs are made by a certified Link-Belt representative, using these procedures.

The suggestions made or procedures given are for information only and are based on LBCE’s knowledge of the product. The repair personnel must assume the responsibility as to the workmanship and the owner must bear the final responsibility as to its use. Prior to starting any repair work, all information contained in these procedures, must be read and thoroughly understood.

The alloy steel used in the manufacture of tubular boom, fly, and jib sections necessitates the use of special procedures for the removal and replacement of damaged lattice, diagonals, or picture frame lattice. Strict adherence to the following procedures is absolutely necessary.

It is very important that the lattice elements on a boom, fly, or jib section be maintained and kept in good condition. Damaged lattice allow deflection of the main chord tubes when under load so that they are no longer in line; which destroys the true column effect of the boom, fly, or jib. The result is reduced boom, fly, or jib strength and capacity.

All inspection and repair work should be done by qualified personnel. The welding of lattice, diagonals, and picture frame lattice requires a unique skill and conscientious workmanship. It is therefore of the utmost importance that the workman studies these instructions, learns them, follows them, and takes time to develop the skill through practice.

The area of the boom, fly, or jib section being repaired must be free of moisture prior to any repair work which requires welding, gouging, or cutting.

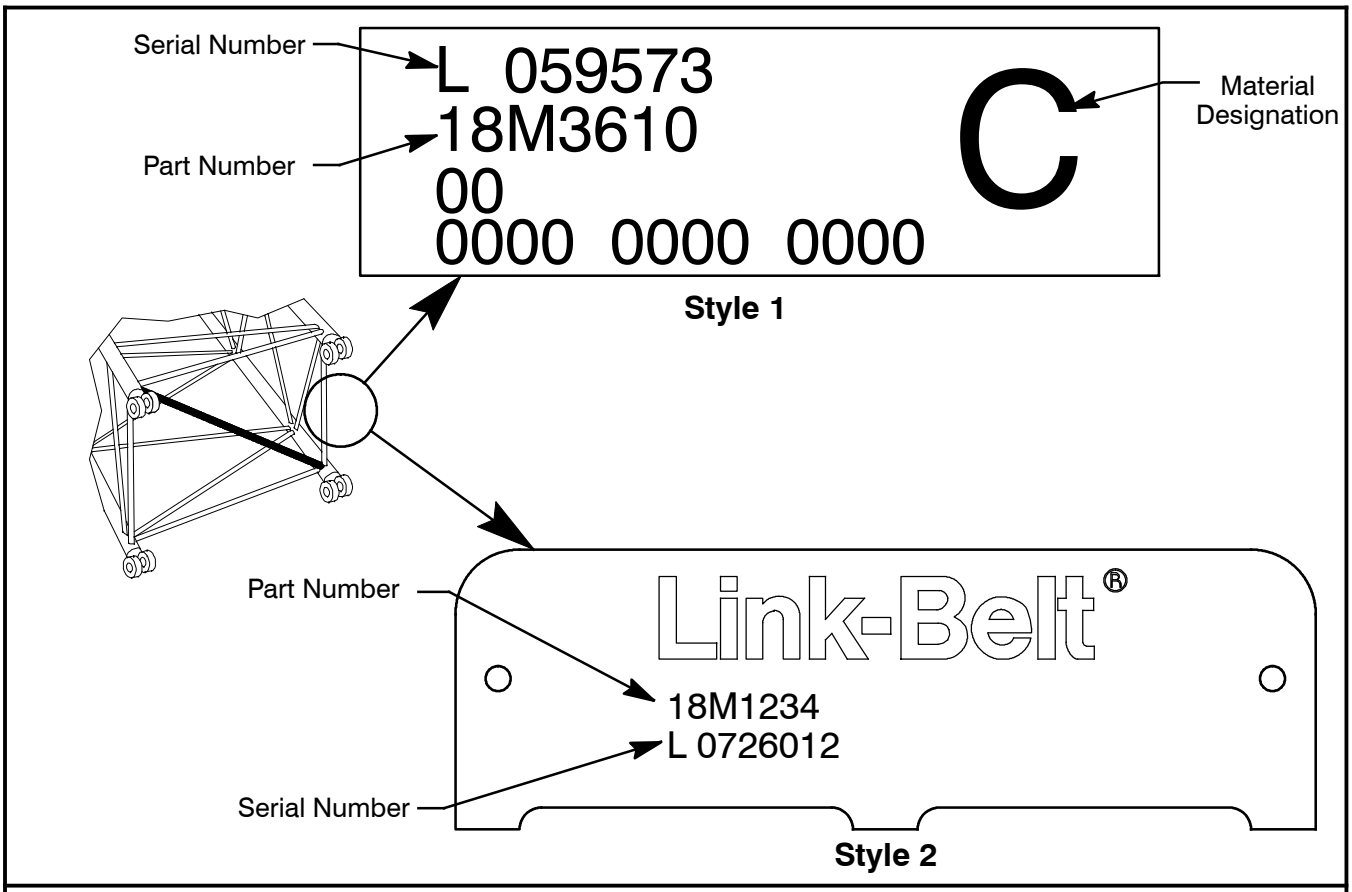


Figure 2
Typical Identification Plates

Preparation For Repair

The nomenclature, or list of terms, used throughout these instructions are given in Figure 1.

DANGER

Use only Link-Belt approved materials. Any deviation from these materials could result in serious personal injury, death, or major equipment damage. In the event the boom, fly, or jib section I.D. plate is missing or unreadable, repair of that section is not recommended until it can be positively identified. Seek assistance from the LBCE Service Department for proper methods of identification.

Identification

Different types of materials are used in the chord members of tubular boom, fly, and jib sections. It is important to determine the correct material type, of the attachment being repaired, since welding procedures vary based on the material used. There are two styles of I.D. or identification plates.

The Style 1 I.D. plate has a large alphabetical letter designation stamped on it. Using these letters, refer to Table B thru Table D for specific welding techniques required to repair the boom, fly, or jib section.

If a Style 2 identification plate is used, and the repair technique requires that the material type be known, seek assistance from the LBCE Service Department for material identification before proceeding with repairs. Locate the identification plate and record the part number and serial number to have available before contacting the factory.

If the factory I.D. tag and other informational or cautionary tags are on the lattice being replaced, it will be necessary to replace them. The I.D. plate can be removed by carefully cutting through the tack welds and relocating it on the replacement lattice. Any Warning or Caution labels must be ordered from a Link-Belt Distributor.

Inspection

All inspection and repair work suggested in these procedures should be done on a non-working boom, fly, or jib which has been separated into individual sections. These sections are then to be positioned in such a manner that the work can be performed in a safe, proper fashion.

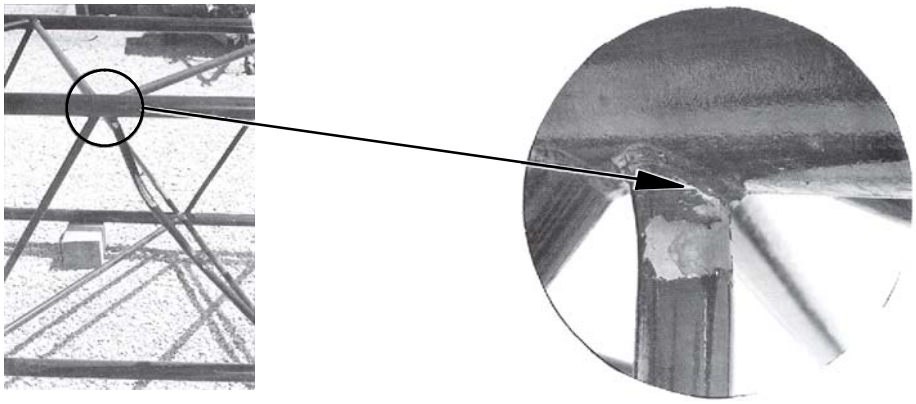


Figure 3
Inspect For Cracks At Weld

Note: In an emergency situation, repairs can be done with the attachment installed. However, extreme care must be taken to fully support it. Relieve any stress and remove all load from the damaged attachment. In this situation, only one lattice, diagonal, etc., can be replaced at a time.

Prior to repair, the entire section should be thoroughly inspected so all areas in need of repair can be found. The inspection should proceed as follows:

Inspection Equipment

1. The inspection equipment should be such standard equipment as a portable light, wire brush, probe, 10X magnifying glass, marker (chalk, crayon, etc.), magnetic particle, dye penetrant, and other non-destructive testing equipment.

Inspection Procedure

1. Thoroughly clean the entire boom, fly, or jib section of all mud, dirt, grease, oil, etc. so adequate inspection may be performed.
2. Establish a pattern of working from one connection to the next to ensure each connection is examined.
3. Closely observe any areas where the paint has been chipped, wrinkled, or is missing, or contains faint rust lines or marks (see Figure 3).
4. Inspect section and note points listed in Figure 1.

General Instructions And Procedure Selection

1. The section serial number, the nature of the work performed, date of the repair, and the names and clock numbers of those people involved should be recorded and made part of the machine records.
2. Environmental conditions should be such that they do not hinder the performance of the maintenance or create an un-weldable surface condition such as moisture, extreme cold, etc.
3. Proper tooling and safety equipment, in good working order, should be used. See ANSI Z49 “Safety in Welding and Cutting”.
4. Use of low-hydrogen electrodes is required in many portions of these procedures. See “Appendix B” for the care of low-hydrogen electrodes.
5. Unless otherwise noted, all welding should be performed with DC reverse polarity.
6. All repairs, other than on chord members, may be repaired by good conventional methods. Vee out the entire weld on lattice, diagonals, and picture frame lattice. Repair welds must be done with low-hydrogen type welding electrode such as E7018.
7. Vee out the entire cracked weld of structural plate components, a minimum of 3 inches (*7.6cm*) beyond the end of the crack.
8. For any additional information concerning repair of chords or welding of various additions to the chords, please contact LBCE giving identification plate information, amount and location of damage, location and object to be welded, etc.
9. Select proper repair procedure using Table A. Refer to “Appendix C” to locate and order repair parts.
10. Picture frame lattice repair requires extra steps to maintain alignment in addition to the standard procedures given here. Refer to “Appendix F,” Repair Of Picture Frame Lattice.

Guidelines For Straightening Of Lattice, Diagonals, And Picture Frame

Maximum allowable uniform curvature, where no repair is necessary on lattice, diagonals, and picture frame lattice, is 1/32 inch per foot (*0.8mm per 30.5cm*), or less.

Type Of Section	Type Of Damage - Refer To Procedure Noted		
Refer to figure given below for illustration.	Bent less than 1 inch across 36 inches (*2.54cm across 91.44cm*) and without damage to lattice, diagonal, or picture frame lattice to chord weld.	Bent, kinked, broken, or otherwise damaged	
		Without damage to the weld that joins the lattice, diagonal, or picture frame lattice to the chord.	With damage to the weld that joins the lattice, diagonal, or picture frame lattice to the chord.
Square Chord Towers Figure 4	Procedure A	Procedure C	Non-repairable
Booms & Luffing Booms Coped, Figure 5 Pinched, Figure 6 Flattened, Figure 7	 Procedure A Procedure A Procedure A	 Procedure C Procedure C Procedure B,C	 Procedure C Procedure C Procedure C
Jibs Pinched, Figure 6 Flattened, Figure 7	 Procedure A Procedure A	 Procedure C Procedure B,C	 Procedure C Procedure C
Flys Coped, Figure 5	 Procedure A	 Procedure C	 Procedure C

"Procedure "A" - "Straightening"
"Procedure "B" - "Replacement Of Lattice By Lap Replacement" (Flattened Lattice Only)
"Procedure "C" - "Replacement Of Lattice, Diagonals, Or Picture Frame By Complete Replacement"

Table A
General Procedure Selection Index

A lattice, diagonal, or picture frame lattice with a uniform curvature, greater than the maximum allowable mentioned, but less than the ratio of 1 inch across 36 inches (*2.54cm across 91.44cm*), may be straightened. Curvature in excess of this ratio requires complete replacement of the lattice, diagonal, or picture frame lattice.

Curvature in excess of 1 inch across 36 inches (*2.54cm across 91.44cm*) requires replacement of the lattice, diagonals, or picture frame lattice (see Figure 8).

Procedure "A" - Straightening

1. Bends should be drawn out by clamping a 4 x 4 inch (*101.6mm* x *101.6mm*) timber against the bent lattice, diagonal, or picture frame lattice with large clamps. Care should be taken to prevent localized crushing or denting of the tube with the clamps. It may be necessary to block away from the tube to allow for over-bend and spring back.
2. Section must be warmer than 50° F (*10° C*) when straighting bent lattice, diagonals, or picture frame lattice.
3. Do not use a hammer or otherwise strike the tube. This may result in localized structural damage to the tube.
4. Do not use heat. Heat may destroy the physical strength of the steel in area where heat is applied.
5. After straightening, re-inspect the lattice, diagonal, or picture frame lattice to chord welds per section on "Inspection" earlier in this procedure.

Procedure "B" - Replacement Of Lattice By Lap Replacement

(Flattened Lattice Only)

Flattened lattice that are damaged may be replaced by the lap "Replacement Procedure" which follows. If cracking occurs in any welds of the lattice/chord tube joint, the procedure for complete replacement given in "Replacement Of Lattice, Diagonals, Or Picture Frame Lattice By Complete Replacement - Booms, Flys, And Jibs" must be used.

Note: This section does not apply to diagonal replacement.

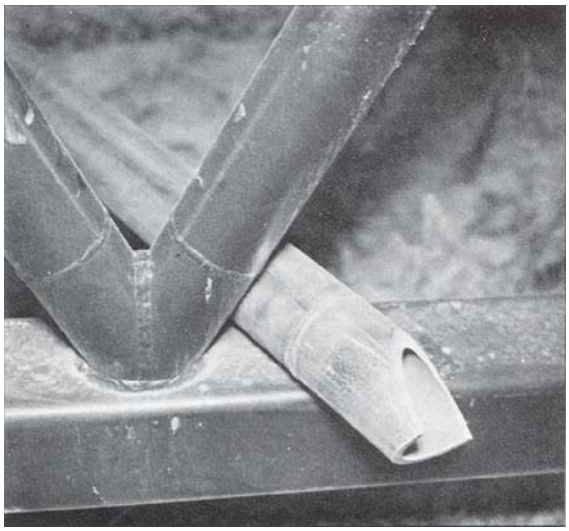


Figure 4
Tower/Luffing Boom Lattice

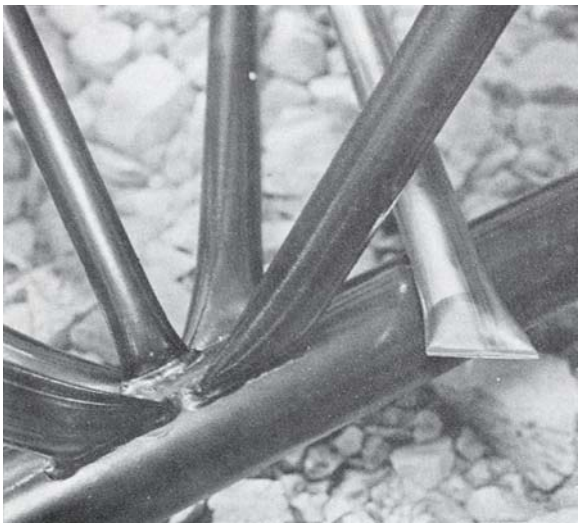


Figure 6
Pinched Lattice

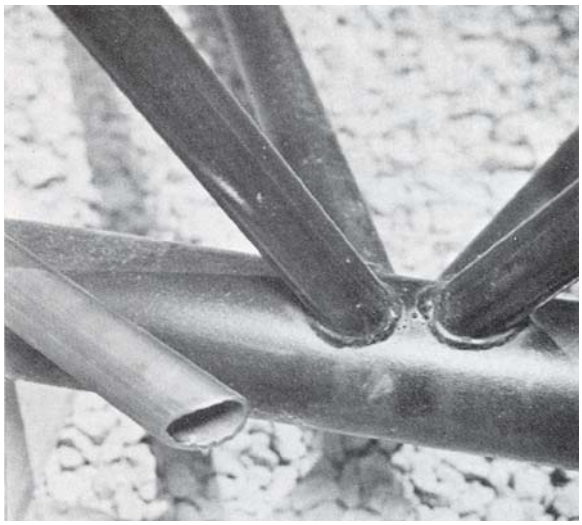


Figure 5
Coped Lattice

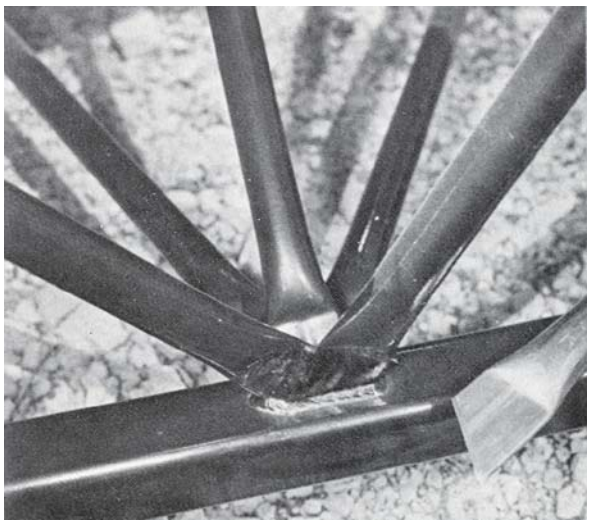


Figure 7
Flattened Lattice

Replacement Procedure:

1. Remove the damaged lattice by cutting at each end. See Figure 9.
2. Angle the cut to miss the diagonal.

   Note: This is a difficult cut to make. Use caution not to cut out beyond the weld and into the chord.

3. Grind cut surface square, i.e. grind the angular hacksaw cut square with the lattice for a good welding fit-up. Take care not to damage adjacent parts.

CAUTION

Any cut or gouge in the main chord will make the section non-repairable. When grinding or polishing the chord, do not use any form of hard grinding disc. Use only resin backed sanding disc of 80 to 100 grit. Excessive metal may be removed and the section may be rendered non-repairable and must be destroyed.

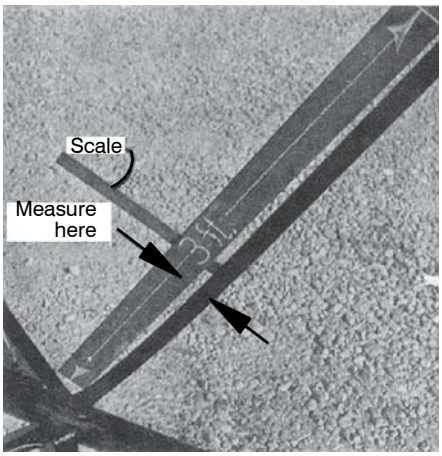


Figure 8
Measuring For Straightness

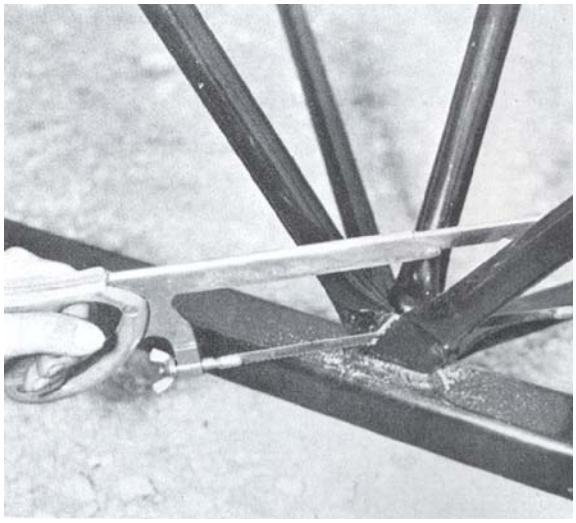


Figure 9
Removing The Lattice

4. Check to see if replacement tube will fit snugly onto stub and in the proper position and alignment. If necessary, carefully shape or contour the replacement lattice for proper fit-up.
5. Clean area to be welded to bright clean metal (see Figure 10).
6. Align and clamp lattice into position for welding (see Figure 11).
7. Weld all around each end. All weld sizes should be 3/16 inch (*4.8mm*). Use an A.W.S. 1/8 inch (*3.2mm*) E7018 electrode. (The amperes and voltage should be set within the ranges recommended by the electrode manufacturer. See "Appendix D").
8. Inspect welds; correct if required.
9. Touch up the paint on all affected areas of the section.

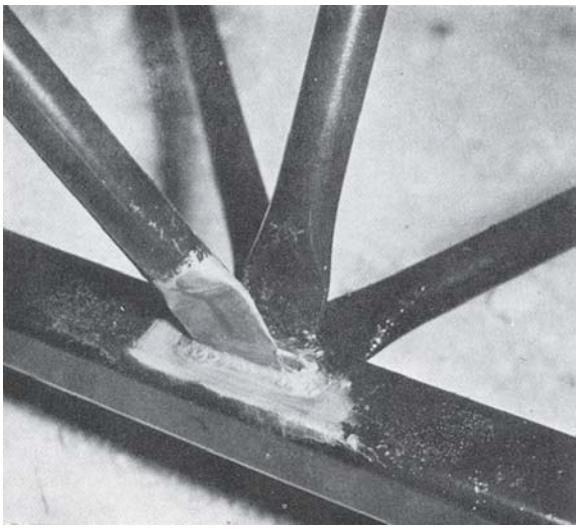


Figure 10
Area Cleaned For Welding

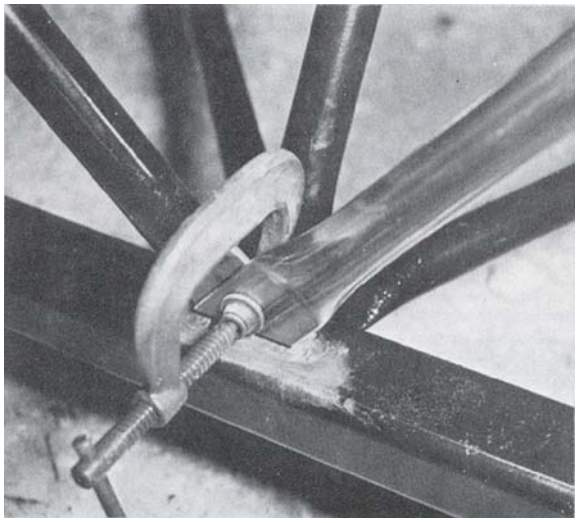


Figure 11
Lattice Clamped In Place

Procedure "C" - Replacement Of Lattice, Diagonals, Or Picture Frame By Complete Replacement

Lattice, diagonals, or picture frame lattice which are damaged may be repaired by complete replacement. This procedure covers both lattice and diagonals of the flattened, pinched or coped type end connection.

Replacement Procedure:

1. Remove the lattice, diagonal, or picture frame lattice above the chord along section C- C in Figure 12.

   Note: Be careful not to damage main chord member.

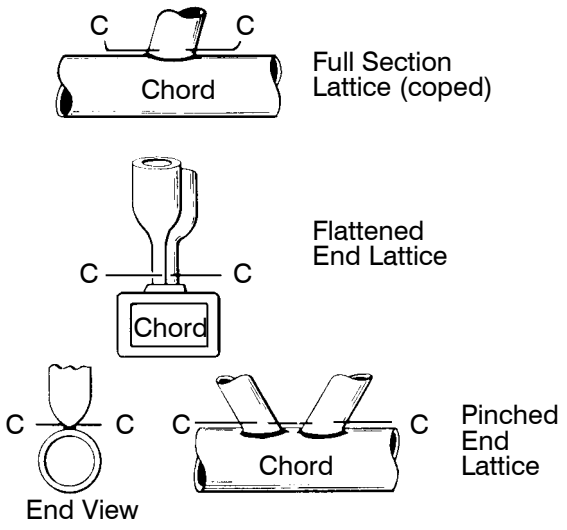


Figure 12
Removal Of Lattice

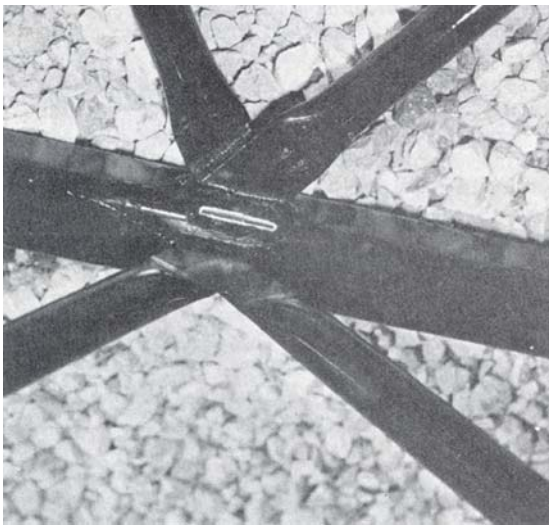


Figure 13
Removed Single Flattened Lattice

2. Removal of the lattice, diagonal, or picture frame lattice is most easily accomplished on flattened diagonals, single flattened lattice, pinched lattice and pinched diagonals by cutting well above the weld and manually flexing the tube until it separates just above the weld. See Figure 13. For double lattice connections of the flattened type, a hacksaw or similar cutting tool must be used. For coped lattice and diagonals, a hacksaw, torch, or similar cutting tool is recommended. See Figure 14 and Figure 15.

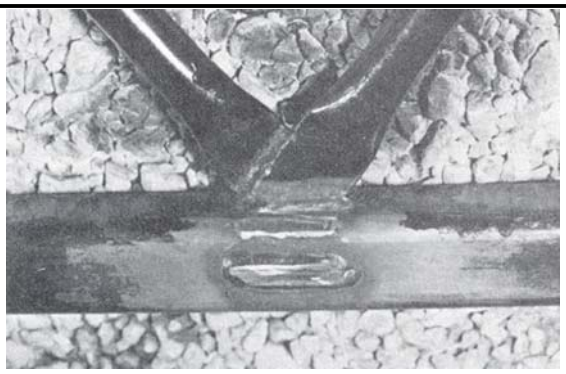


Figure 14
Removed Double Flattened Lattice Using An Abrasive Cut-Off Tool

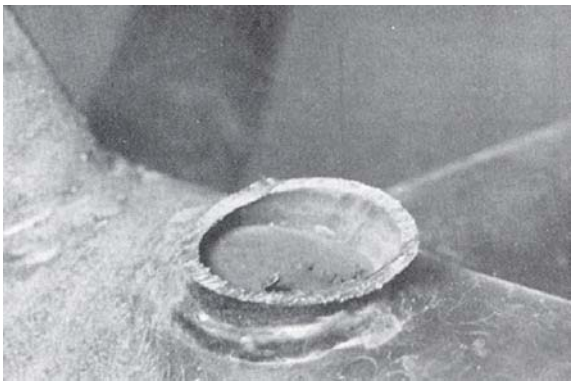


Figure 15
Removed Coped Lattice Using A Hacksaw

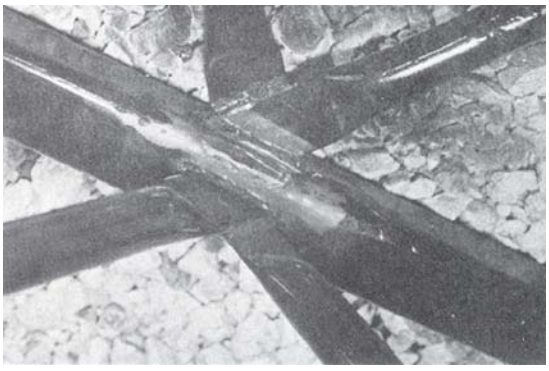


Figure 16
Ground Down Diagonal Weld

3. Carefully grind weld down to within 0.010 - 0.020 inch (*0.3mm - 0.6mm*) of the chord surface as shown in Figure 16, Figure 17, and Figure 18. No metal should be removed from the chord member.

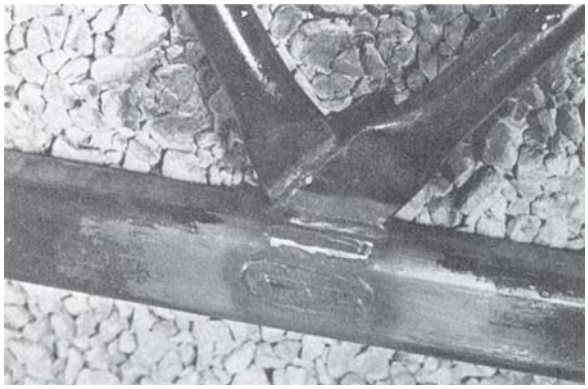


Figure 17
Ground Down Lattice Weld

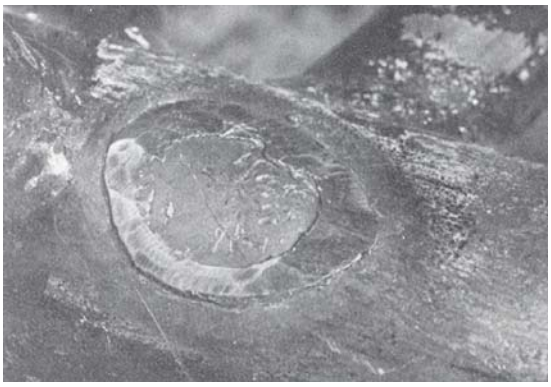


Figure 18
Ground Down Coped Weld

CAUTION

The marks made during the following polishing procedures must run parallel to the chord length. Care must be taken so that no gouging or deep grinding is done. Excessive damage to the chord can result in a non-repairable condition, and the section must be destroyed.

4. Using a fine (80- 100 grit) resin backed disc, polish the weld area to a bright clean metal. See Figure 19.

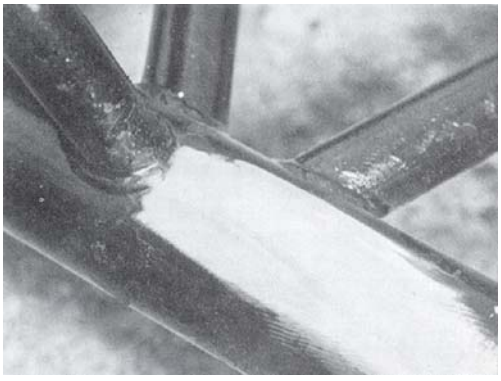


Figure 19
Chord Polished Clean

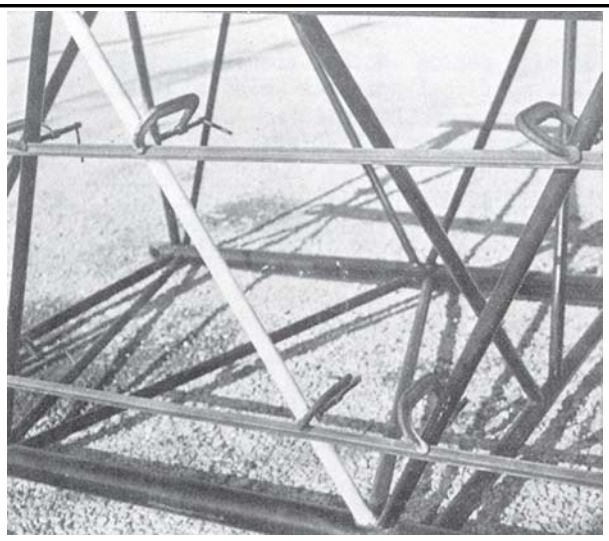


Figure 20
Lattice Alignment

5. Check to ensure that the replacement tube will fit snugly onto the chord and in proper position and alignment. If necessary, carefully contour or shape the replacement for a proper fit-up. A good fit-up will aid in proper heat and weld size control resulting in a better repair job.
6. Position the replacement tube to be welded into the proper location and clamp into place. See Figure 20. Check to ensure that all grease, oil, and paint are removed from the area to be welded.

Welding Instructions

Refer to the headings in Table B thru Table D to obtain the proper welding instructions for sections with and without "Material Stamping" codes. Welding instructions for type "A" and "B" material are the same. Procedures for type "C" material are different. In addition, the type "C" material flys and jibs require particularly close control. Therefore, three different sets of welding procedures have been listed to be used.

Before proceeding, check the material type recorded in "Preparation For Repair" found on Page 2 to ensure that the proper instructions are used.

Some lattice repairs to hammerhead top sections, and to the tapered extensions they attach to, require an A.W.S. E9018 covered stick electrode, flux core, or solid wire electrode equivalent. Please contact LBCE Service Department for additional information.

All Booms and Luffing Booms or Stamped "C" Material Boom Sections

1. Preheating is not always required, but control of heat input must be exercised. Preheat is required if the base metal is below 50° F (*10° C*) or if the base metal is wet or oily.

2. The use of stick or wire electrode is permitted. For stick electrode, use 3/32 inch (*2.4 mm*) or 1/8 inch (*3.2mm*) diameter electrodes of A.W.S. E7018 class. Use the procedures given below, which will produce a 1/8 inch (*3.2 mm*) to 3/16 inch (*4.8mm*) one pass fillet weld:

Electrode Size	3/32 inch (*2.4mm*)	1/8 inch (*3.2mm*)
Amperage, A	60- 100	90- 135
Voltage, V	21- 23	22- 23
Travel Speed,	7 inches (*177.8mm*)	8 inches (*203.2mm*)

   For solid wire electrode (GMAW- S) or flux core wire electrode (FCAW) welding, please note desired weld size:

   If weld fillet size is 3/16 inch or smaller, use the GMAW- S process. All welding to be done in the flat position only. Use the GMAW- S process with A.W.S. ER70S- 3 or ER70S- 6 wire and 100% CO^2 gas shielding. For 0.045 inch (*1.1mm*) diameter wire, use CO^2 at 25 to 35 scfh, voltage set at 20 volts, and wire speed set to 182- 198 inches (*4.6- 5.0m*) per minute.

   If weld fillet size is 1/4 inch or larger, use the FCAW process. Welding can be done in the flat, horizontal, vertical up, and overhead positions. Use the FCAW process with A.W.S. E71T- 1 wire and 100% CO^2 or 75% Argon and 25% CO^2 gas shielding, as recommended by the weld wire manufacturer. For 0.045 inch (*1.1mm*) diameter wire, use the shielding gas flow set at 30 to 40 scfh, voltage set at 24 volts, and wire speed set to 220 - 240 inches (*5.6- 6.1m*) per minute.

3. Weld in the replacement tube as shown in Figures:

   Coped end connections - Figure 22, Figure 23, Figure 24 "A", Figure 26
   Pinched end connections - Figure 24 "B", Figure 27, Figure 28, and Figure 29

   Note the starting and finishing positions and rod angle.

4. Allow the weld area to cool to 150° F (*66° C*) or less before welding the opposite side.

5. After welding, clean and inspect the repair area and touch up the paint as necessary.

Table B

All Fly and Jib Sections or Stamped "C" Material Fly and Jib Sections Only

1. Because of the smaller size of the fly and jib, repair must be performed with close control and special care. The welding procedures given below must be followed. If the welding machine used does not have reliable current and voltage indicating devices, "Appendix E" gives guidance for properly setting the machine.

2. Also due to the smaller size of the fly or jib, welding requires a person who has acquired a high degree of skill and is a conscientious workman. It is a must that practice welds be made duplicating as nearly as possible the welds to be made before starting the work. Preheat is required if the base metal is below 50° F (*10° C*) or if the base metal is wet or oily.

3. The use of covered stick electrodes (SMAW) or solid wire electrode (GMAW- S) is permitted. All welding machines don't perform equally when running E7018 3/32 inch (*2.4mm*) diameter electrodes or 0.035 inch (*0.89mm*) wire electrodes. If practice welds show inability to hold an arc, this may indicate instability of the welding equipment and a different machine should be used.

4. For covered stick electrodes (SMAW), use 3/32 inch (*2.4mm*) diameter electrodes of A.W.S. E7018 class. All values reported here have been obtained using a Hobart T- 225 machine. Use the procedures given below, depending on fly or jib chord size:

	Amp.	Volt.	Speed Of Travel - Inches (*mm*) Per Minute
Outside Dia. Of Chord 1- 1/4 inches	85A	23V	9.5 (*241.3*)
All Larger Fly Or Jib Chords	85A	23V	8.5 (*215.9*)

5. Weld in the replacement tube as shown in Figures:
   Flattened end connections - Figure 25, Figure 30, Figure 31, and Figure 32.
   Pinched end connections - Figure 24 "B", Figure 27, Figure 28, and Figure 29.
   Coped end connections - Figure 22, Figure 23, Figure 24 "A", and Figure 26.

6. For solid wire electrode welding (GMAW- S), all welding to be done in the flat position only. Use the GMAW- S process with A.W.S. ER70S- 3 or ER70S- 6 wire and 100% CO^2 gas shielding. For 0.035 inch (*0.89mm*) diameter wire, use CO^2 at 25 to 35 scfh, voltage set at 19 volts, and wire speed set to 240 - 260 inches (*6.1- 6.6m*) per minute.

7. Allow the weld area to cool to 150° F (*66° C*) or less before welding the opposite side.

8. After welding, clean and inspect the repair area and touch up the paint as necessary.

Table C

All 2.25" x 2.25" Square Chords and 3.5" x 3.5" Square Chords or Stamped "A" and "B" Material Boom and Jib Sections

1. Preheat the chord and replacement tube in the area to be welded to 350° F (*177° C*) (minimum) to 550° F (*288° C*) (maximum). Tempilsticks[1] should be used to determine the temperature. **Do not over or under heat.**

2. The use of covered stick electrode (SMAW) or solid wire electrode (GMAW- S) is permitted. For covered stick electrode (SMAW), use 3/32 inch (*2.4mm*) or 1/8 inch (*3.2mm*) diameter electrodes of A.W.S. E7018 class. Use the amperage, voltage, and travel speed recommended by the electrode manufacturer to obtain a 1/8 inch (*3.2mm*) to 3/16 inch (*4.8mm*) one pass fillet weld. Some examples are given in "Appendix D" for the flat, vertical, and overhead positions.

   For solid wire electrode (GMAW- S) welding, all welding is to be done in the flat position only. Use the GMAW- S process with A.W.S. ER70S- 3 or ER70S- 6 wire.

Solid Wire Electrode Size	0.035 inch (*0.89mm*)	0.045 inch (*1.1mm*)
Gas Type	100% CO^2	100% CO^2
Gas Flow Rate (scfh)	25 - 35	30 - 40
Voltage, V	19	20
Wire Speed	240 - 260 ipm (*6.1- 6.6mpm)*	182 - 198 ipm (*4.6- 5.0mpm*)
Amperage, A	130 - 150	165 - 185

3. Weld in replacement tube as shown in Figures:

   Coped end connections - Figure 22, Figure 23, Figure 24 "A", and Figure 26
   Pinched end connections - Figure 24 "B", Figure 27, Figure 28, and Figure 29
   Flattened end connections - Figure 25, Figure 30, Figure 31, and Figure 32

   Note the starting and finishing positions and rod angle.

4. The weld should be completed without delay. If the weld area cools below 350° F (*177° C*), preheat the area again.

5. After welding, clean and inspect the repair area and touch up the paint as necessary.

1 Tempilsticks are temperature indicating crayons and are available from local welding suppliers or Tempil Corp., 132 West 22nd St., New York, NY 10011

Table D

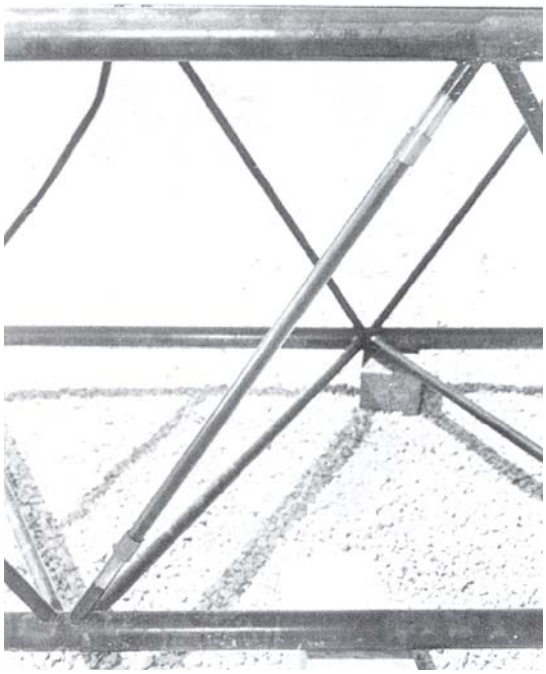


Figure 21
Splice Kit

Note: As of January 1, 1996 splice kits and procedures that were previously available have been discontinued.

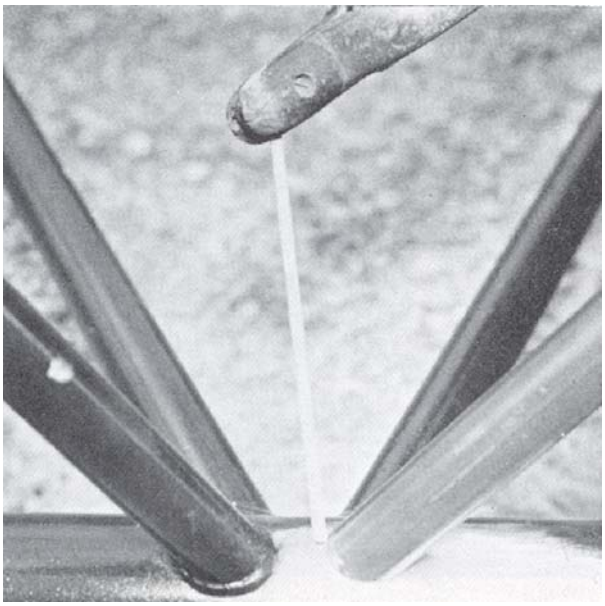


Figure 22
Rod Position And Angle For Start Of Lattice Weld Inside Boom (Use Opposite Position And Angle If Weld Is Started Outside First)

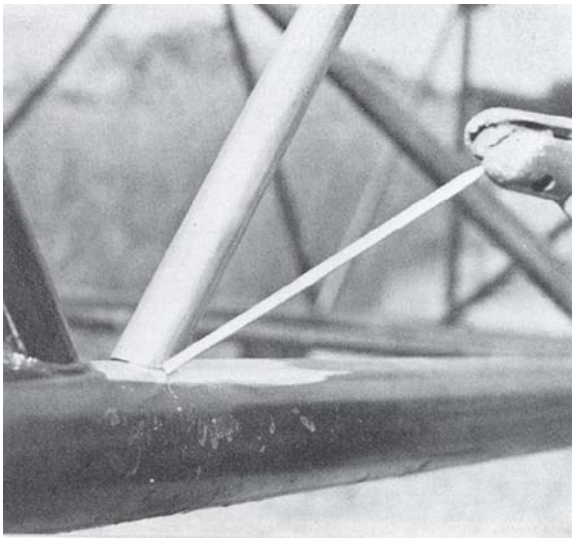


Figure 23
Rod Position And Angle For Lattice Weld Outside Boom

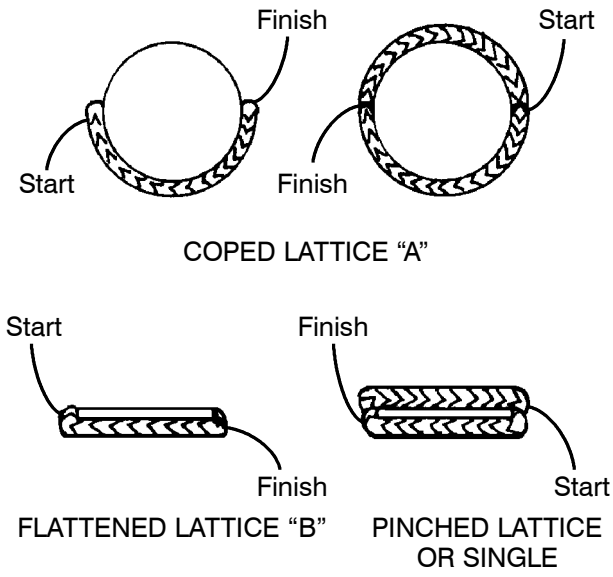


Figure 24
Welding Sequences

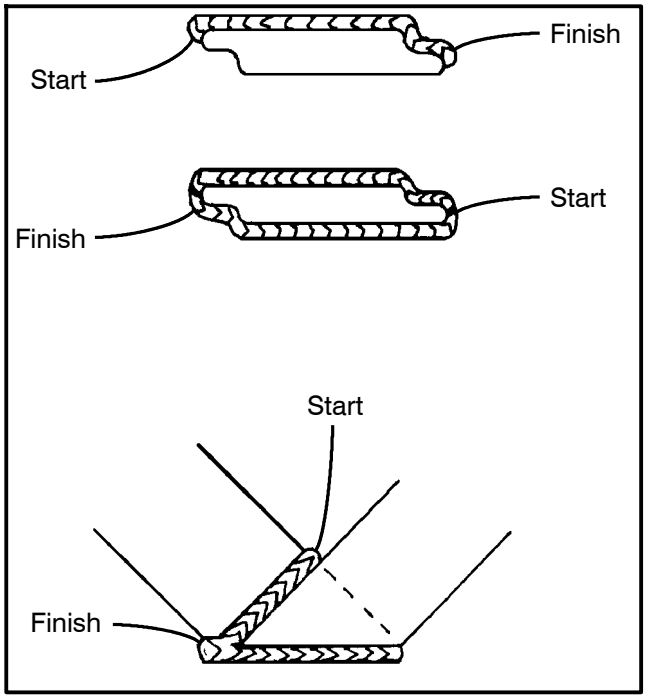


Figure 25
Welding Sequence For Flattened Lattice

Figure 26
Rod Position And Angle For End Of Lattice Weld Outside Boom - Start Position For Inside Weld

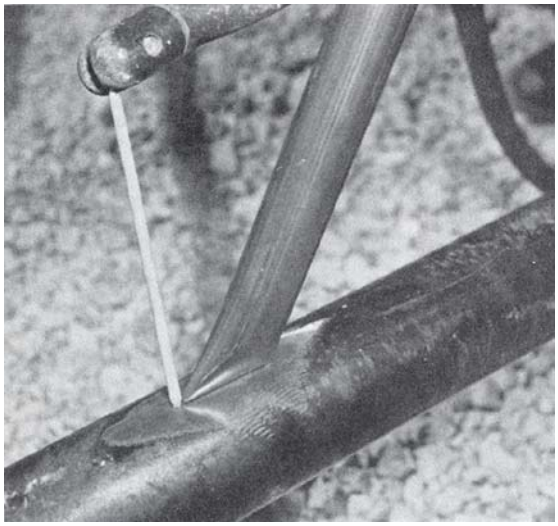


Figure 27
Rod Position And Angle For Start Of Lattice Weld Inside Boom (Use Opposite Position And Angle If Weld Is Started Outside First)

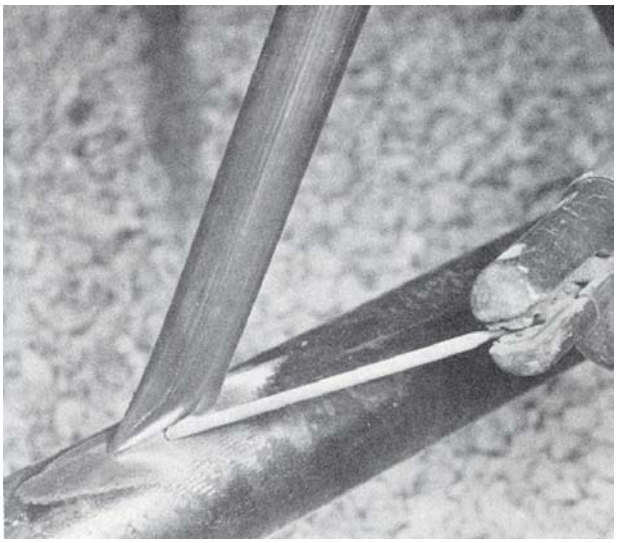


Figure 28
Rod Position And Angle For Lattice Weld Outside Boom

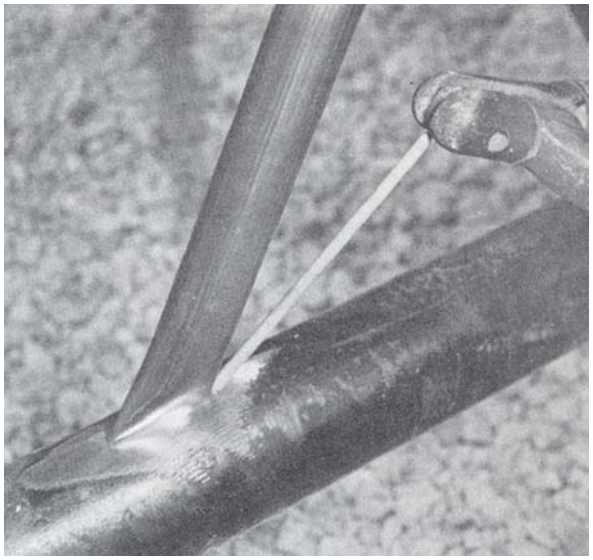


Figure 29
Rod Position And Angle For End Of Lattice Weld Outside Boom

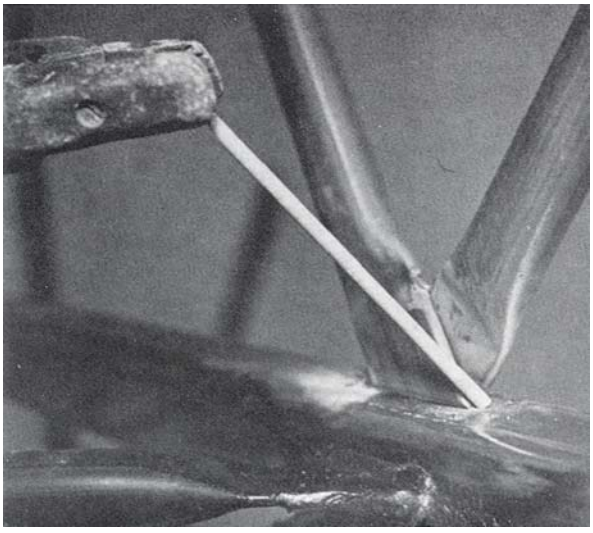


Figure 30
Rod Position And Angle For Start Of Lattice Weld Inside Boom

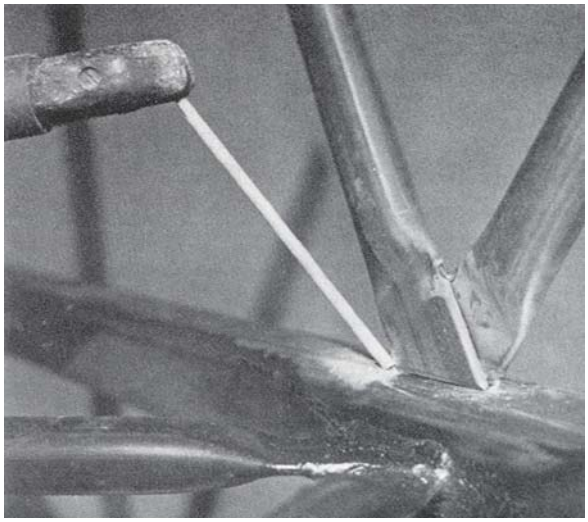


Figure 31
Rod Position And Angle For End Of Lattice Weld

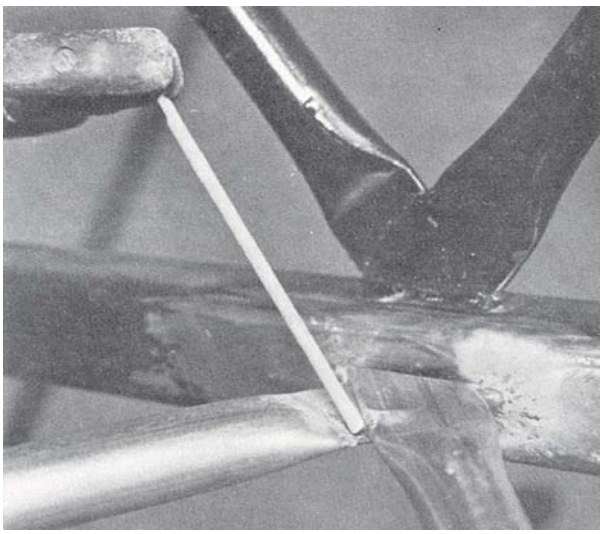


Figure 32
Rod Position And Angle For Start Of Weld For Lattice

Appendix A

Tubular Boom, Fly, And Jib Chord And Lattice Corrosion, Pitting, Or Dents

The information contained in this appendix is to be used when considering tubular chord and lattice corrosion, pitting, or dents. These guidelines state what is acceptable based on structural strength.

Corrosion Or Pitting:

LBCE will allow corrosion or pitting up to a depth of 7.5% of the nominal wall thickness without replacing the lattice or condemning the chord and therefore the boom, fly, or jib section. This will be allowed provided that the amount, size, and location of the damage is not deemed excessive by a qualified LBCE representative. For example: A tube boom, fly, or jib section with a wall thickness of 0.095 inch (*2.4mm*), would have an allowable pit depth of 0.007 inch (*0.2mm*).

As an alternative to measuring the depth of the damage, the actual tube wall thickness may be measured with an ultrasonic wall thickness measuring device or other suitable means. The tube wall thickness must be at least 92.5% of the nominal thickness.

Dents:

LBCE will allow up to 20% of the nominal wall thickness or 1/8 inch (*3.2mm*) of dent depth whichever is smaller for tube boom, fly, and jib section chords.

LBCE will allow up to 100% of the nominal wall thickness or 1/8 inch (*3.2mm*) of dent depth whichever is smaller for tube boom, fly, and jib section lattice.

A dent by definition does not reduce wall thickness. The dent depth given will only be allowed if the tube wall thickness has not been reduced by gouging or other means. Follow the thickness requirements listed for corrosion or pitting if the wall thickness has been affected. The dent depth listed will be allowed provided that the number, size, and location of the dent(s) is/are not deemed excessive by a qualified LBCE representative.

Cause For Rejection:

Any main chord or lattice damage which exceeds the cosmetic guidelines stated above requires the section be taken out of service immediately.

Repair:

All damaged areas that fall into the acceptable category as outlined above are to be treated as cosmetic damage only. It is not recommended that they be repaired. All lattice damage which exceeds the limitations stated above requires the lattice be replaced.

⚠ DANGER

Boom, fly, or jib chord members are not to be repaired unless approved by LBCE. Any authorized repairs must be performed by a LBCE weld specialist. Improper repair procedures could result in serious personal injury, death, or major equipment damage.

Appendix B

Care Of Electrodes

The low-hydrogen characteristics of electrodes should not be taken for granted. Hydrogen is an unwanted chemical element in welding most types of steels including all the alloy steels.

Normally, the higher strength alloy steel low-hydrogen electrodes are packaged in hermetically sealed containers and have less than 0.2% moisture in the coating. Such electrodes are suitable for immediate use provided the container has not been damaged and the electrodes have not been exposed to the air. Some electrodes, however, are packaged in cardboard containers with “moisture proof wrapping” which may or may not provide adequate protection.

To prevent under bead cracking in welds, the following steps are recommended for the conditioning and handling of low-hydrogen electrodes:

1. As soon as electrode container is opened, the electrodes should be removed and placed into a baking oven.
2. Electrodes should be baked according to the manufacturer’s instructions (usually 800° F (*427° C*) for one hour). The electrodes should be put into the oven at 500° F (*260° C*) maximum and heated up to 80° F (*427° C*) with the electrodes placed no more than three layers deep on a tray.

   Note: This baking may be omitted only if the user is satisfied that the electrode coating, as ready for use, contains less than 0.2 percent moisture.

3. Whether baked or not, the electrodes should be immediately transferred to a storage or holding oven at 250° ±25° F (*121° ±4° C*).
4. Both the baking oven and the storage oven should be equipped with air circulating systems and temperature indicators with controls.
5. Electrodes should not be placed in the storage oven unless sufficiently dry as received or properly baked.
6. The welding electrodes should be used within one hour after removal from the storage oven.
7. Electrodes removed from the storage oven and exposed in a clean, dry location for times longer than those specified should be re-baked as described under item (2). Electrodes exposed to water, grease, or dirt should be destroyed.
8. When welding is done in areas of high humidity, it is advisable to store a suitable quantity of electrodes in a small portable oven from which electrodes may be drawn one at a time by the welder.

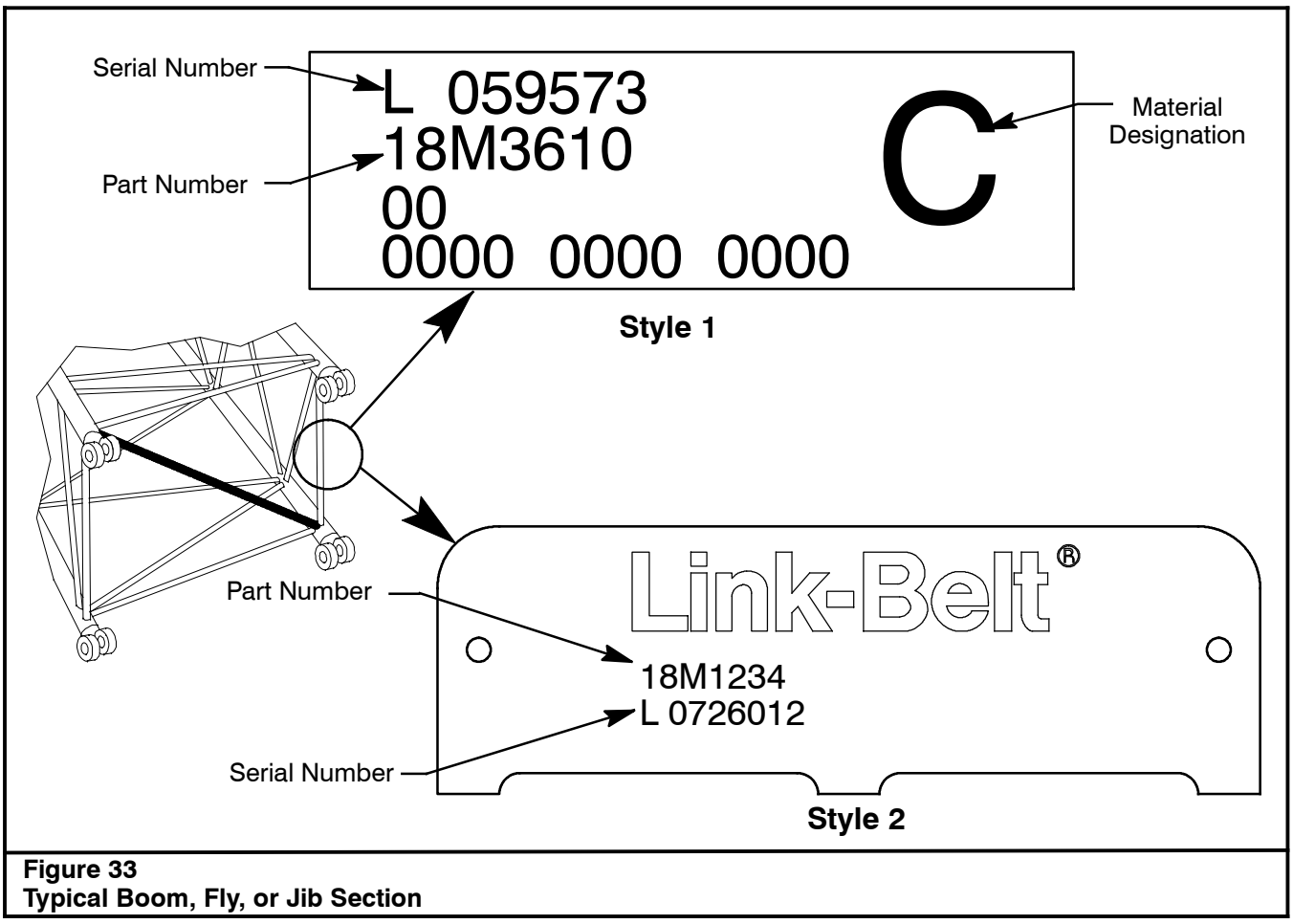


Figure 33
Typical Boom, Fly, or Jib Section

Appendix C

Ordering Replacement Parts

Proper identification of replacement parts is crucial to ensure the structural integrity of the attachment, as well as ease the assembly and welding process. Order replacement parts as follows:

1. Locate the identification plate and record the serial number, part number, and chord material type. See Figure 33.

DANGER

Use only Link-Belt approved materials. Any deviation from these materials could result in serious personal injury, death, or major equipment damage. In the event the boom, fly, or jib section I.D. plate is missing or unreadable, repair of that section is not recommended until it can be positively identified. Seek assistance from the LBCE Service Department for proper methods of identification.

2. There are two styles of I.D. plates. The Style 1 plate includes a material designation. Style 2 plates do not. If a Style 2 identification plate is used, and the repair technique requires that the material be known, seek assistance from the LBCE Service Department for material identification. Locate the identification plate and record the part number and serial number to have available before contacting the factory.
3. Refer to the “Lattice Repair Parts Page Code Cross Reference Index” located the “Lattice Repair Parts Book”. Use the cross reference to determine which Parts Page Code lists the replaceable parts for the damaged attachment.
4. Review the Parts Page Code and identify the part numbers for any damaged lattice to be replaced.

   Note: Some components, for any given attachment, may not be listed on the Parts Page. Only those components which are serviceable will be listed.
5. Forward the replacement part numbers required to LBCE when ordering replacement lattice.

Appendix D

Welding Current Table* (Use DC Reverse)

		Amps Flat		Amps	Amps
Size	Volts	Range	Optimum	Vertical	Overhead
3/32 in (*2.4mm*)	21- 24	70- 110	100	70- 100	70- 100
1/8 in (*3.2mm*)	21- 24	90- 160	140	90- 135	90- 160

*Handbook for Welding Low Alloy, High Tensile Steels, Alloy Rods Company, Division of Chemetron Corporation, Copyright 1964 by Alloy Rods Company, AR- 30 (Formerly HB- 3) 5- 769 Edition 3.

Appendix E

Training Instructions Required Before Welding Tubular Jib Structures.

Materials:

3/4 inch (*19.1mm*) wide x 3- 3/8 inches (*85.7mm*) long x 12 gauge (*2.8mm*) thick steel, with bright finish on one side.

The purpose of this test sample is to set the welding machine current (amps), voltage (volts), and arc travel speed to obtain the required heat input without the use of any meters. In effect, this sample serves as a known heat test. Heat input is controlled by voltage, current, and arc travel speed.

In order to maintain the toughness of "C" type materials, it is mandatory that heat input be controlled.

Previous instructions have shown the actual conditions used to weld each type lattice to chord connection. The same voltage and current was used in all cases and only the arc travel speed was adjusted to obtain the correct heat input for the different types.

The test sample has been sized for the 23V, 85A, and 6.75 inches (*171.5mm*) per minute arc travel speed.

Use Of "Heat Input Test Samples" ("HITS")

1. Run several passes on scrap material to adjust the welding machine for good electrode running performance. This may be considered "Initial Coarse Adjustment".
2. Tack both ends of the "HITS" to a scrap plate. Securely fasten the ground cable to the plate. Allow the tack welds to cool to room temperature. This assembly should be located in a draft-free area. If wind or draft is blowing over the "HITS", shield it so that the draft condition is eliminated.
3. Strike an arc at the extreme end of the "HITS" and weld a bead to the other end. Measure the time required to make this 3- 3/8 inches (*85.7mm*) long weld. The correct time is 30 seconds. The correct result is as follows:
   a. A continuous, even weld must be made.
   b. The weld must not melt through the strip at any point.
   c. The time must be 30 seconds ± 2 seconds.

   If all these conditions are met, the heat input is correct. If the arc is lost during the travel time, the test is not good. If the weld melts through, current, voltage, or speed is wrong. Since the time is easily checked on a heavier plate, the welder may want to practice speed control on heavier material before making test welds. If speed is correct and melt through still occurs then the current setting must be reduced.
4. Once a successful "HITS" is produced, the welder is ready to weld jib "Type C" materials.
5. This establishes the correct current and voltage settings and 6.75 inches (*171.5mm*) per minute travel speed. However, some lighter members require a faster travel speed and further practice must be done to obtain the new correct speed. This speed can be established on any scrap material because the voltage and current have been set by producing a good "HITS".

Heat Input Test Sample

To weld at 9.5 inches (*241.3mm*) per minute requires 3- 3/8 inches (*85.7mm*) of weld be made in 21 seconds.

To weld at 8.5 inches (*215.9mm*) per minute requires 3- 3/8 inches (*85.7mm*) of weld be made in 24 seconds.

Appendix F

Repair Of Picture Frame Lattice

When lattice members at the end of a boom, fly, or jib section picture frame lattice (see Figure 1) are damaged, several problems develop that hinder the use of “regular” lattice repair methods in these instructions. Therefore, it is necessary to understand what is different about replacing picture frame members and list those extra steps to be used for repair.

First: The most important part of this procedure is maintaining the alignment of the pin connections during repair so that the section will properly pin-up when the repair work is completed. When a picture frame lattice is damaged it is likely that alignment, (squareness) and proper location of the pin connection is thrown off. Therefore, when replacing the lattice members at the ends of the boom sections it is necessary to re-align the pin connections by pinning that section to a section in excellent condition; (which of course, would normally pin with it). If another section is not available, extra care should be taken to maintain the original dimension (Vertical, Horizontal and Diagonal).

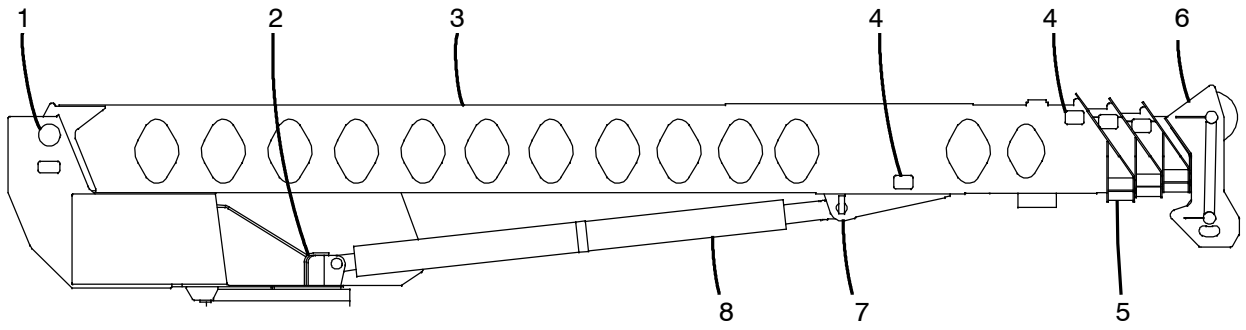
DANGER

Under no circumstances should picture frames be driven in place. Locate picture frame lattice by hand only. If necessary, grind picture frame length to fit. Prestressed or damaged picture frame lattice could result in serious personal injury, death, or major equipment damage.

Second: It will be necessary to select a working site which is flat, level, and of a suitable surface for working. A size at least equal to the width of the section and the length of the two sections, the one being repaired and the other being used to hold alignment.

Third: Set the sections (unpinned) on blocks (saw horses, or other suitable surface) at a good working height. The supports should be approximately 24 - 36 inches (*50.8 - 76.2 mm*) from each end of both sections (4 places).

Fourth: If the factory I.D. tag and other informational or cautionary tags are on the lattice being replaced, it will be necessary to replace them. The Stainless Steel I.D. plate can be removed by carefully cutting through the tack welds and relocating it on the replacement lattice. Any warning or caution labels will have to be ordered from a Link-Belt Distributor.



1. Boom Foot Pin
2. Upper Frame
3. Hydraulic Boom
4. Side Window Shoe
5. Front Shoe Support
6. Head Machinery
7. Cylinder Support
8. Boom Hoist Cylinder

Figure 1
Boom Nomenclature

Hydraulic Boom Inspection

Introduction

The following information is provided for the identification and inspection of diamond embossed hydraulic boom sections manufactured by Link- Belt Construction Equipment (LBCE). LBCE cannot assume responsibility for repairs of any kind made to hydraulic boom sections because it will neither control nor inspect the repairs. This document is for reference purposes only.

For information concerning tubular fly and jib attachments for hydraulic cranes, refer to SM Keysheet Area 9- 1.

It is very important to maintain the hydraulic boom section in good working condition. Damaged hydraulic boom sections can allow major deflection of the boom's corner members, known as chord angles, which may result in boom failure. The alloy steels used in the manufacture of hydraulic boom sections necessitates the use of special procedures.

Inspection procedures should be performed by qualified individuals with knowledge and experience in steel fabrication. It is of the utmost importance to study these instructions and follow them closely. Identification of terms used throughout this SM are given in Figure 1.

Identification

The part number and serial number, of each boom section, is located on an identification tag. On the tip section, it is located on the side plate of the head machinery. On all other sections it is located on the bottom of the front shoe support. Figure 2 shows an example of an identification tag.

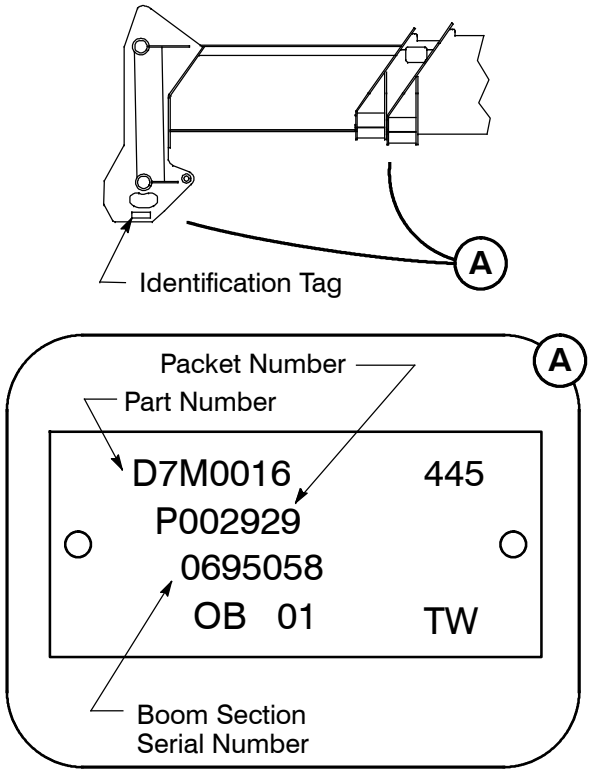


Figure 2
Typical Identification Tags

Documentation & Analysis

1. The specific inspection criteria on the "Hydraulic Boom Field Inspection Form" must be followed in order to evaluate the boom section properly. A sample of the form is shown on pages 6- 11.
2. The information gathered should be given to a LBCE Representative or Product Specialist at the factory for evaluation.

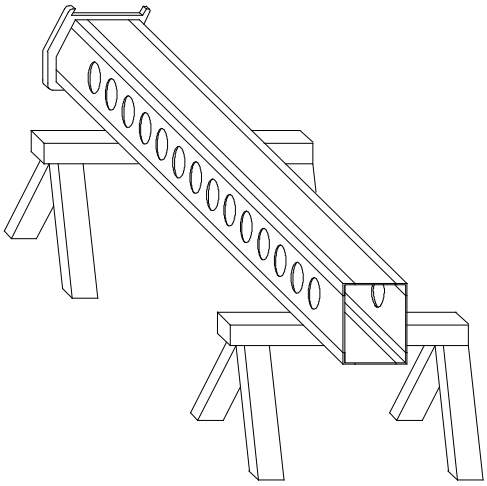


Figure 3
Set Boom Section On Blocking

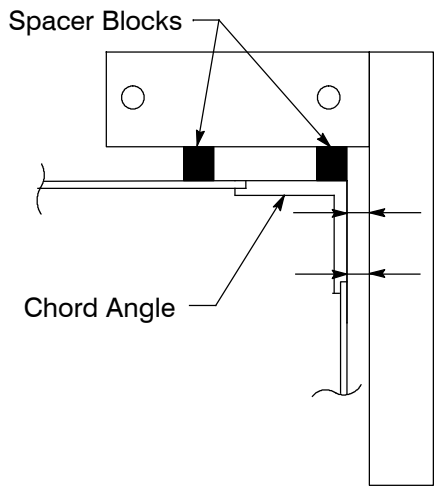


Figure 4
Chord Angle Squareness

General Inspection

All inspection procedures suggested in this document must be performed on a non- working boom which has been disassembled and separated into individual sections. For boom disassembly procedure, see SM Keysheet Area 17- 1. These sections are then to be positioned and secured in such a manner that the work can be performed in a safe, proper fashion.

The inspection equipment needed is such standard items as: portable light
wire brush
probe
10X magnifying glass
marker (chalk, crayon, etc.)
string line
two magnetic blocks of equal size
magnetic particle compound
dye penetrant
other nondestructive testing equipment

1. Thoroughly clean entire boom section of all mud, dirt, grease, oil, etc., so adequate inspection may be performed.
2. Throughout the inspection, you will be asked to collect data from different locations on the boom section. Positions of “TOP”, “BOTTOM”, “LEFT”, and “RIGHT” are to be interpreted as if the boom were installed on the crane, viewing the boom from the operator’s seat.
3. Set boom section up on blocking or sawhorses of equal height approximately 4 ft (*1.2 m*) from each end of the subject boom section. Make sure the width of the blocking or sawhorses is greater than the width of the boom section. See Figure 3.
4. Observe closely those areas where the paint has been chipped, wrinkled, or missing, or contains faint rust lines or marks.
5. Other types of damage, such as dents in the top, bottom, or side plates, brackets with dents or cracked welds, interference between boom sections, etc. requires review by a LBCE representative to determine if boom section can be repaired.
6. The nature and dimensional location of any deformity should be recorded on the “Hydraulic Boom Field Inspection Form”.

Chord Angle Squareness

After the initial general inspection, the chord angle squareness should be taken into consideration. It can be checked by using a small square or large square with spacer blocks, of equal size, as shown in Figure 4. The nature and dimensional location of any deformity should be recorded on the “Hydraulic Boom Field Inspection Form”.

Subsequent damage discovered and documented to this point, will assist in the analysis of further deformities which may be found during the remaining inspections. The true magnitude of damage and the repairability of boom sections may be determined by the inspection data taken here. Statements taken from the operator and/or oiler, as to the situation which caused the damage, are also essential.

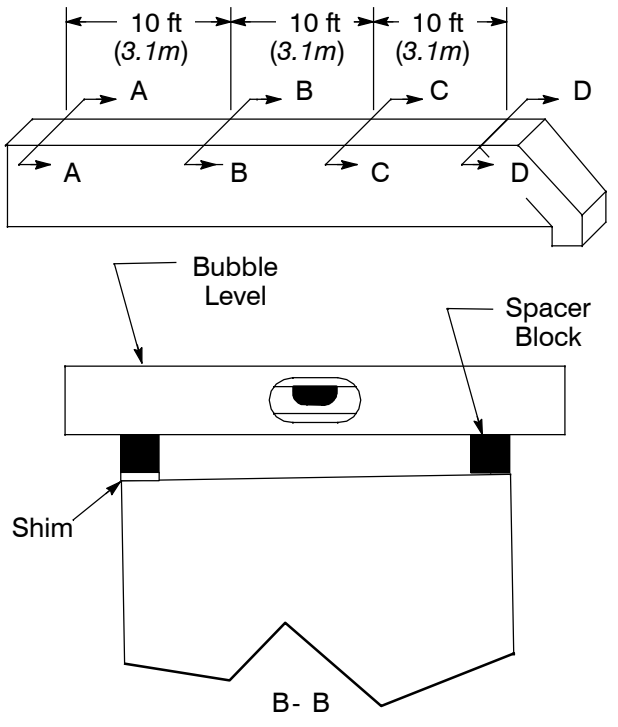


Figure 5
Boom Section Twist

Boom Section Twist Inspection

Boom section twist is the axial relationship from the rear of the section to the front of the section. This inspection also helps to determine if the boom section is straight. To inspect for twist, the boom section should be right side up on blocking or sawhorses. Inspect in four places per "Hydraulic Boom Field Inspection Form" and record values. Refer to Figure 5 for example.

1. Position level on two equal size spacer blocks at Location A- A.
2. Adjust the position of the boom section to achieve level reading at Location A- A.
3. Maintain boom section position during the remainder of inspection.
4. Move level and spacer blocks to next location.
5. Add shim(s), as required, between spacer block and level (one side only), to achieve level reading.
6. Record the position and thickness of the shim(s) used to the appropriate diagram above.
7. Repeat Steps 4 through 6 every 10 ft (*3.1m*) down the length of the boom section.

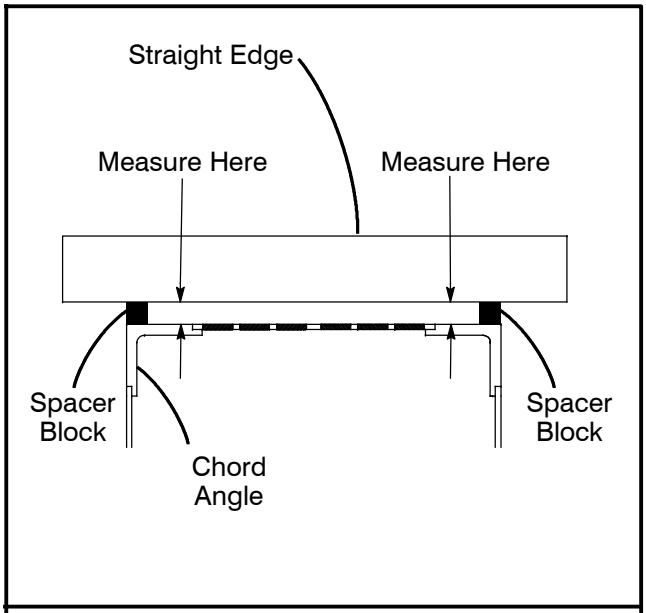


Figure 6
Angle Roll

Chord Angle Roll Inspection

Angle roll defines the parallel relationship between section angle chords. This should be done on the top and bottom of the boom section, as shown in Figure 6. Repeat this procedure every 1 ft (*0.3m*) over the entire length of the boom section, recording the results on the "Hydraulic Boom Field Inspection Form".

1. Starting at the base of the section, divide and label the boom section in 12 inch (*30cm*) segments.
2. Be sure to mark all four corners of the boom section along the entire length of each chord angle.
3. Each location consists of the four corresponding marks at each linear position down the section.
4. Number each location down the length of the boom section.
5. Measurements will be taken across the top and the bottom of the section at each location marked.
6. Starting at the base of section, position spacer blocks and straight edge on the first marks (top).
7. Record the two measurement as illustrated above.
8. Move straight edge and spacer blocks to corresponding location on the bottom of the section.
9. Measure and record the dimensions.
10. Move straight edge and spacer blocks to next location down the length of boom section (top).
11. Repeat Steps 7 through 10 every 12 inches (*30cm*) down the length of the boom section.

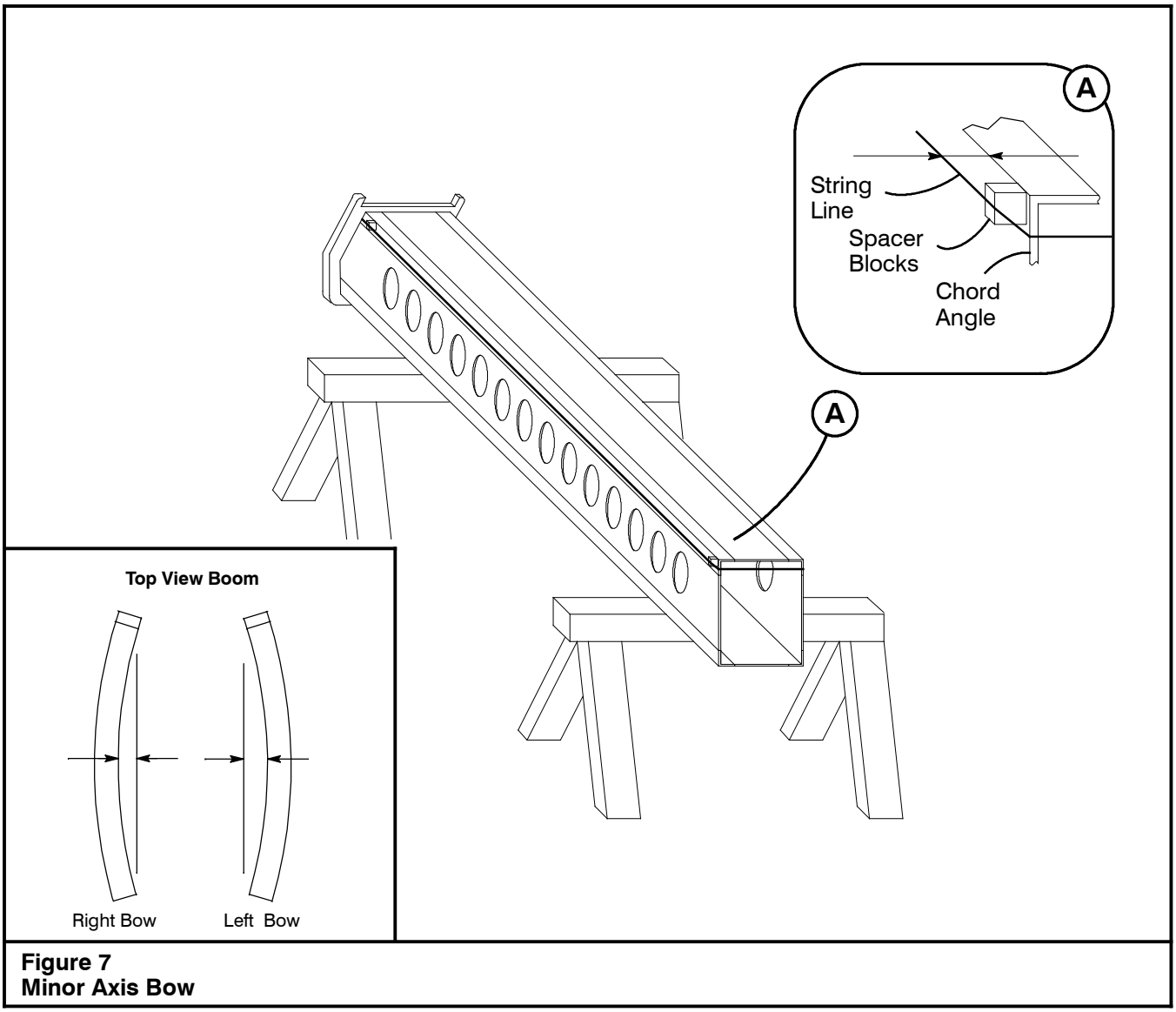


Figure 7
Minor Axis Bow

Minor Axis Bow

Minor axis bow is when the boom section is bowed to the left or right. To inspect the boom section for this condition, the boom section must be in the upright position. Take measurements every 3 ft (*1m*) and record measurements on the "Hydraulic Boom Field Inspection Form". Note the example in Figure 7.

1. Position boom section on its bottom surface so the head machinery or collar clears the ground. Secure the boom section to sturdy saw horses or blocking
2. Starting at the base of the section, divide and mark the boom section in 3 ft (*1m*) segments.
3. Be sure to mark all four corners of the boom section along the entire length of each chord angle.
4. Measurements will be taken at the top and the bottom of the section down the entire length of the boom section.
5. Position spacer blocks, of equal size, at each end of chord angle.
6. Pull a string over each spacer block and tie it to the very end of the boom section.
7. The string must be taught and span clearly between the spacer block at each end of the chord angle.
8. Measure and record the distance between the chord angle and the string at each of the marked locations.
9. Relocate the spacer blocks and string to the next chord angle.
10. Repeat Steps 5 through 9 for each of the four chord angles.

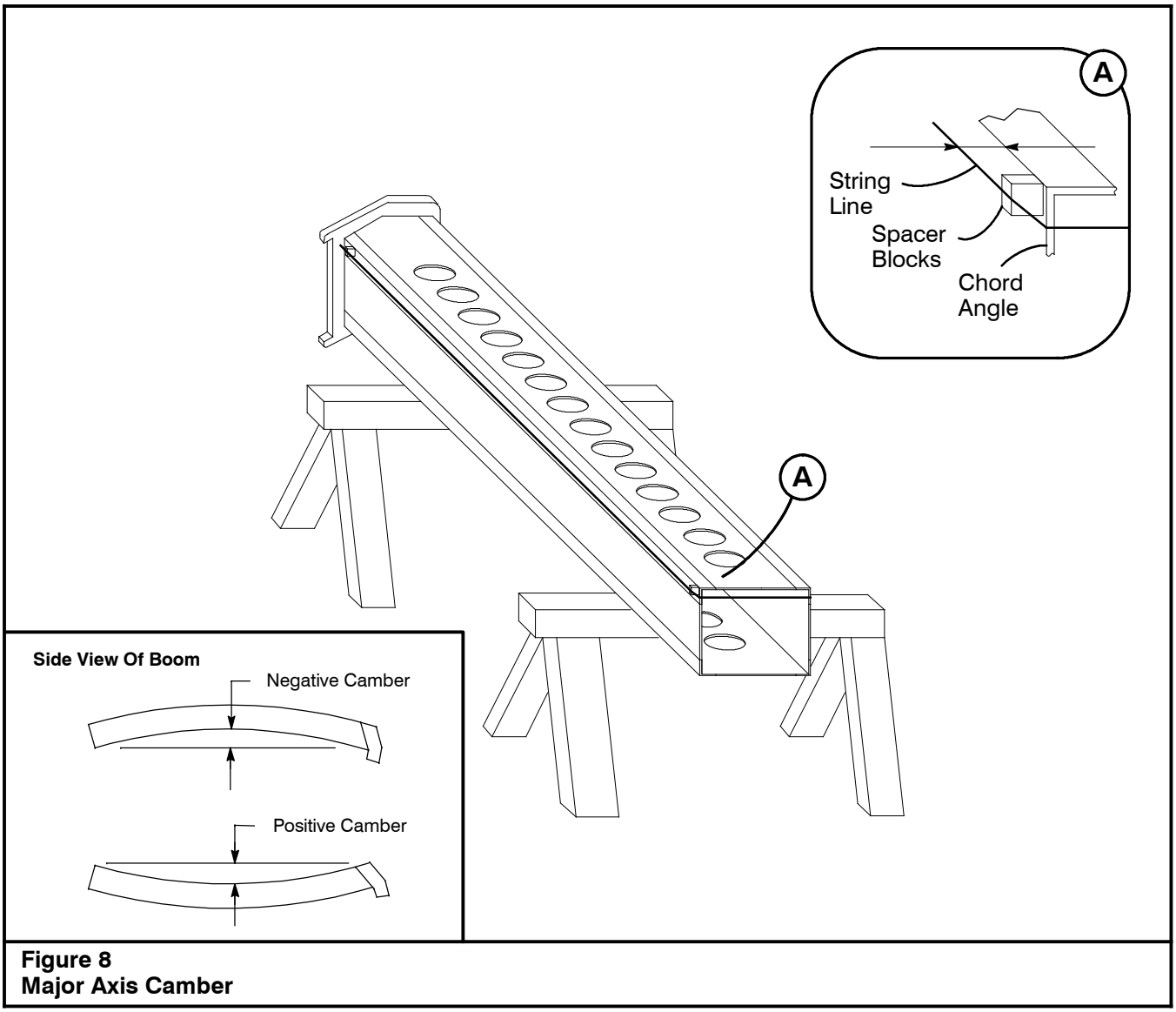


Figure 8
Major Axis Camber

Major Axis Camber

Major axis camber is when the boom section is bowed up or down. To inspect the boom section for this condition the boom section must be positioned on its side. Take measurements every 3 ft (*1m*) and record measurements on the "Hydraulic Boom Field Inspection Form". Note the example in Figure 8.

1. Position boom section on its LEFT side so the head machinery or collar clears the ground. Secure the boom section to sturdy saw horses or blocking.
2. Starting at the base of the section, divide and mark the boom section in 3 ft (*1m*) segments.
3. Be sure to mark all four corners of the boom section along the entire length of each chord angle.
4. Measurements will be taken on both sides of the section down the entire length of the boom section.
5. Position spacer blocks, of equal size, at each end of chord angle.
6. Pull a string over each spacer block and tie it to the very end of the boom section.
7. The string must be taught and span clearly between the spacer block at each end of the chord angle.
8. Measure and record the distance between the chord angle and the string at each of the marked locations.
9. Relocate the spacer blocks and string to the next chord angle.
10. Repeat Steps 6 through 9 for each of the four chord angles.

Hydraulic Boom Field Inspection Form

This form is used to collect and document inspection data for Link–Belt® diamond embossed, telescopic boom sections used on hydraulic cranes. Detailed inspection procedures are outlined in Service Manual document SM17–1–36.0 and should be performed by qualified individuals with knowledge and experience in steel fabrication. The information collected should be given to a LBCE Representative and forwarded to a Product Specialist at the factory for proper evaluation.

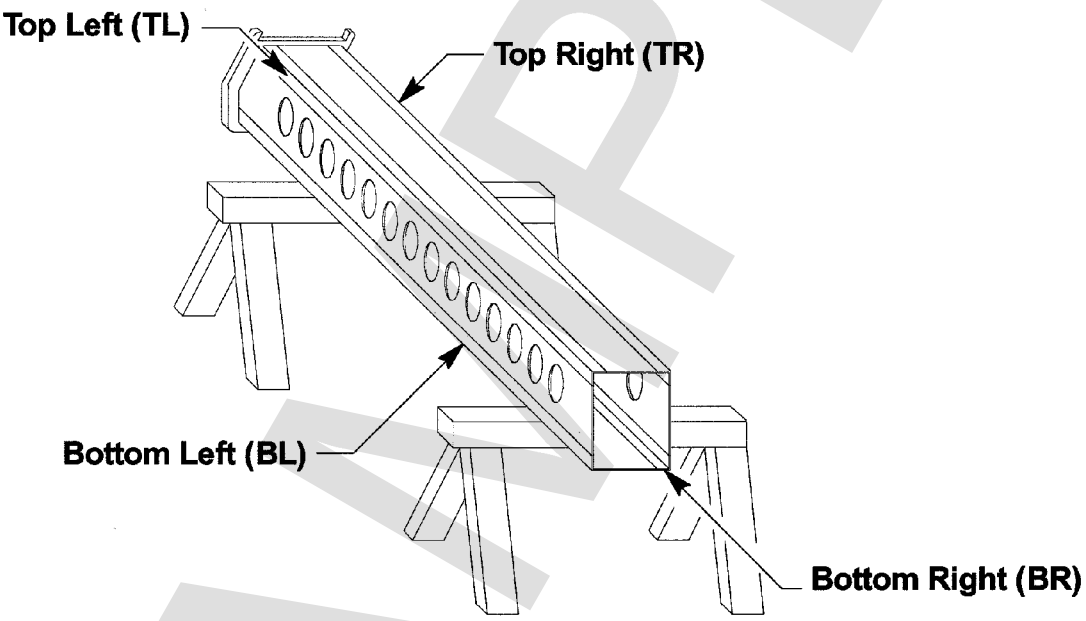
Crane Model Number: HTC-8670 Crane Serial Number: F2H6-5656

Date: JAN 17, 2001 Hourmeter Reading: 2027.5

Section: INNER MID Section Part Number: D7M0016

Section Serial Number: 0695058 Inspected By:

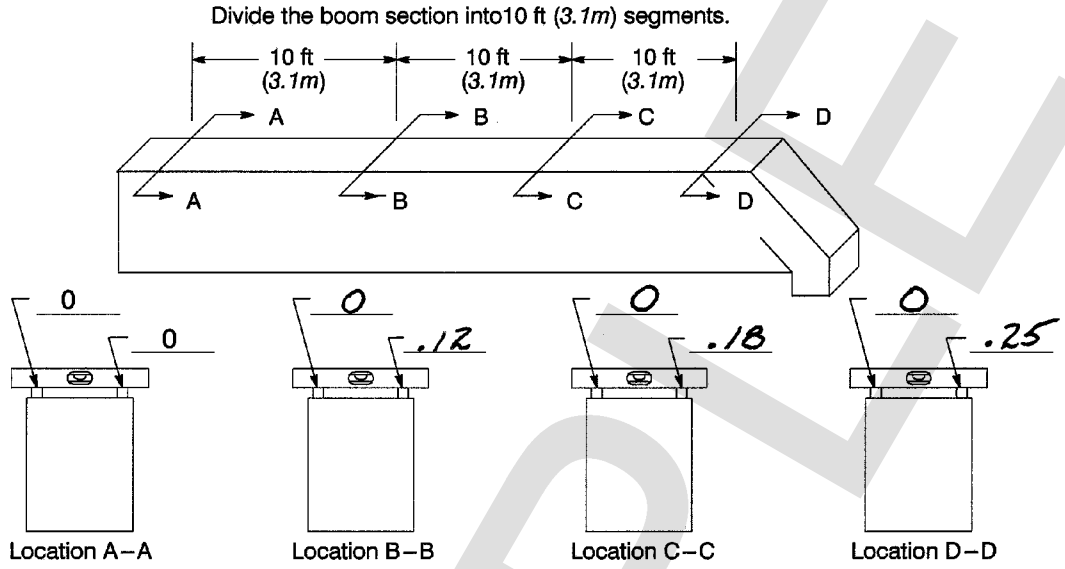
Position Nomenclature



Correct documentation is critical to arrive at an accurate analysis of the condition of a boom section. Throughout this inspection form, you will be asked to collect data from different locations on the boom section. Positions of "TOP", "BOTTOM", "LEFT", and "RIGHT" are to be interpreted as if the boom were installed on the crane, viewing the boom from the operator's seat. The illustration above clearly defines the location of each of the boom sections four main chord angles. The abbreviation for each of these four locations is also given in parenthesis.

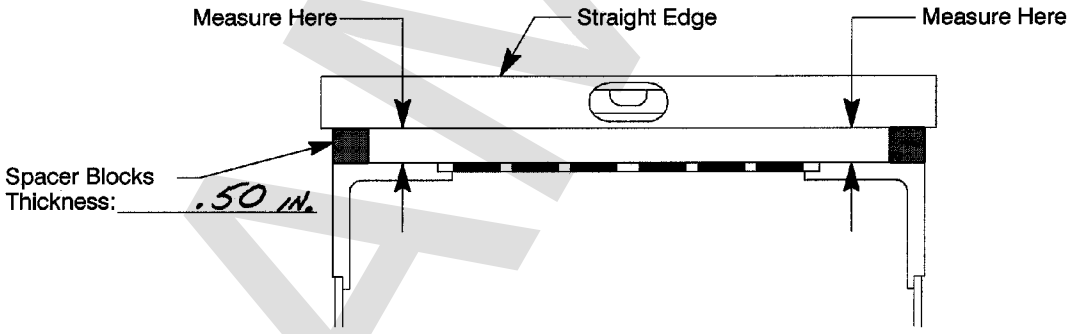
Hydraulic Boom Field Inspection Form

Twist Inspection



1. Position level on two equal size spacer blocks at Location A–A.
2. Adjust the position of the boom section to achieve level reading at Location A–A.
3. Maintain boom section position during the remainder of inspection.
4. Move level and spacer blocks to next location.
5. Add shim(s), as required, between spacer block and level (one side only), to achieve level reading.
6. Record the position and thickness of the shim(s) used to the appropriate diagram above.
7. Repeat Steps 4 through 6 every 10 ft (*3.1m*) down the length of the boom section.

Chord Angle Roll Inspection



1. Starting at the base of the section, divide and label the boom section in 12 inch (*30cm*) segments.
2. Be sure to mark all four corners of the boom section along the entire length of each chord angle.
3. Each location consists of the four corresponding marks at each linear position down the section.
4. Number each location down the length of the boom section.
5. Measurements will be taken across the top and the bottom of the section at each location marked.
6. Starting at the base of section, position spacer blocks and straight edge on the first marks (top).
7. Record on Page 3 the two measurement as shown above. Also, record spacer block thickness.
8. Move straight edge and spacer blocks to corresponding location on the bottom of the section.
9. Measure and record the dimensions.
10. Move straight edge and spacer blocks to next location down the length of boom section (top).
11. Repeat Steps 5 through 10 every 12 inches (*30cm*) down the length of the boom section.

Hydraulic Boom Field Inspection Form

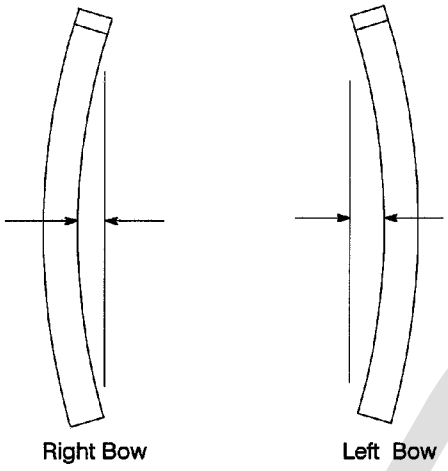
Chord Angle Roll Inspection Data

1.	TL .50 TR .50 BL .50 BR .50	16.	TL .52 TR .51 BL .51 BR .52	31.	TL .50 TR .51 BL .51 BR .50
2.	TL .50 TR .53 BL .50 BR .50	17.	TL .51 TR .53 BL .50 BR .50	32.	TL ____ TR ____ BL ____ BR ____
3.	TL .50 TR .51 BL .50 BR .50	18.	TL .50 TR .50 BL .51 BR .50	33.	TL ____ TR ____ BL ____ BR ____
4.	TL .51 TR .56 BL .51 BR .53	19.	TL .51 TR .54 BL .51 BR .54	34.	TL ____ TR ____ BL ____ BR ____
5.	TL .51 TR .54 BL .50 BR .54	20.	TL .51 TR .53 BL .51 BR .56	35.	TL ____ TR ____ BL ____ BR ____
6.	TL .50 TR .51 BL .51 BR .51	21.	TL .53 TR .51 BL .50 BR .50	36.	TL ____ TR ____ BL ____ BR ____
7.	TL .50 TR .50 BL .50 BR .50	22.	TL .50 TR .50 BL .50 BR .50	37.	TL ____ TR ____ BL ____ BR ____
8.	TL .51 TR .50 BL .50 BR .50	23.	TL .50 TR .50 BL .51 BR .50	38.	TL ____ TR ____ BL ____ BR ____
9.	TL .50 TR .50 BL .50 BR .50	24.	TL .50 TR .50 BL .50 BR .50	39.	TL ____ TR ____ BL ____ BR ____
10.	TL .50 TR .50 BL .53 BR .51	25.	TL .51 TR .51 BL .50 BR .51	40.	TL ____ TR ____ BL ____ BR ____
11.	TL .51 TR .56 BL .51 BR .53	26.	TL .51 TR .54 BL .53 BR .52	41.	TL ____ TR ____ BL ____ BR ____
12.	TL .51 TR .54 BL .51 BR .54	27.	TL .52 TR .54 BL .52 BR .54	42.	TL ____ TR ____ BL ____ BR ____
13.	TL .51 TR .50 BL .50 BR .50	28.	TL .51 TR .51 BL .53 BR .52	43.	TL ____ TR ____ BL ____ BR ____
14.	TL .50 TR .50 BL .51 BR .53	29.	TL .50 TR .50 BL .50 BR .50	44.	TL ____ TR ____ BL ____ BR ____
15.	TL .51 TR .52 BL .52 BR .51	30.	TL .51 TR .50 BL .50 BR .50	45.	TL ____ TR ____ BL ____ BR ____

TL = Top Left TR = Top Right BL = Bottom Left BR = Bottom Right

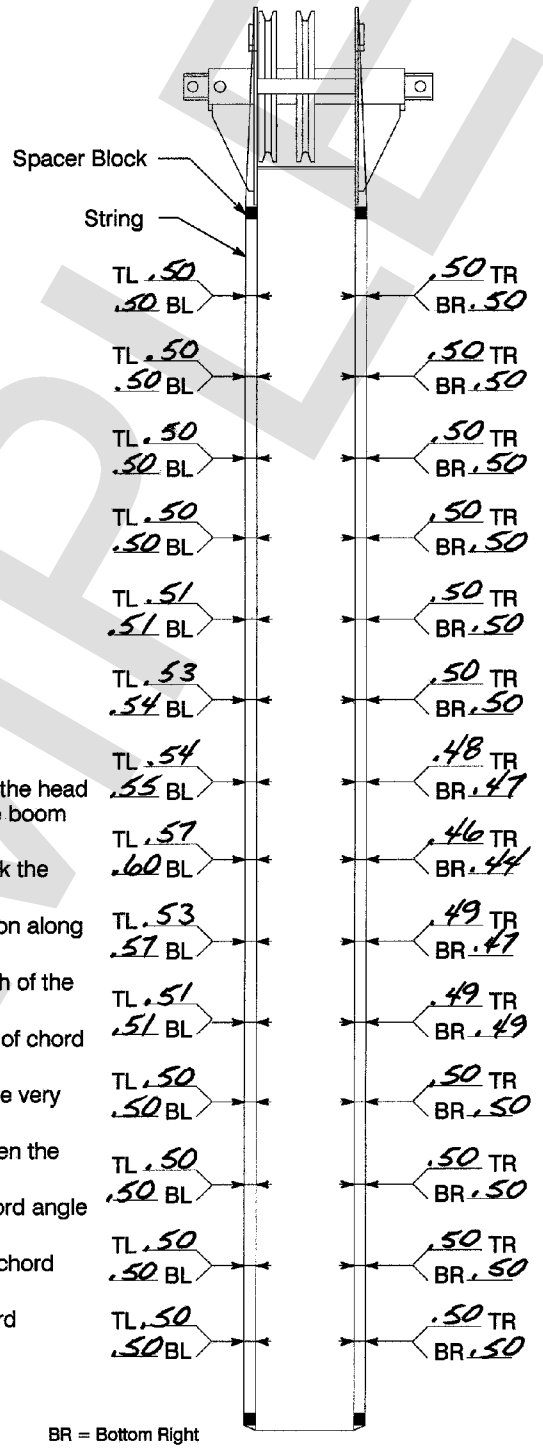
Hydraulic Boom Field Inspection Form

Minor Axis Bow Inspection



Top View Of Boom Section (Exaggerated Bow)

Top View of Boom Section on Sawhorses



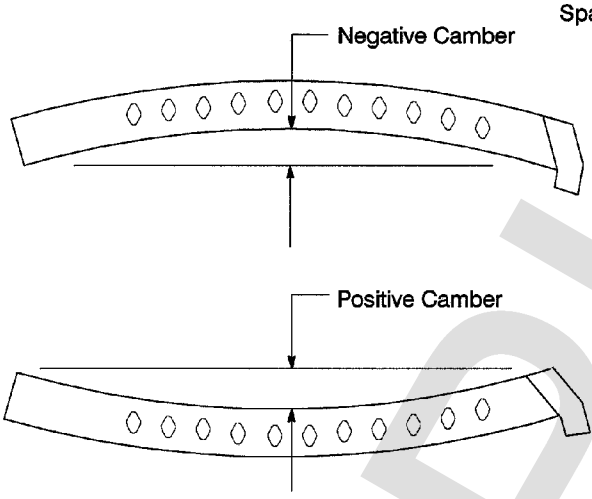
Spacer Block Thickness: .50 INCH

1. Position boom section on its BOTTOM surface so the head machinery or collar clears the ground. Secure the boom section to sturdy sawhorses or blocking.
2. Starting at the base of the section, divide and mark the boom section in 3 ft (*1m*) segments.
3. Be sure to mark all four corners of the boom section along the entire length of each chord angle.
4. Measurements will be taken along the entire length of the boom section.
5. Position spacer blocks, of equal size, at each end of chord angle. Record spacer block thickness.
6. Pull a string over each spacer block and tie it to the very end of the boom section.
7. The string must be taught and span clearly between the spacer block at each end of the chord angle.
8. Measure and record the distance between the chord angle and the string at each of the marked locations.
9. Relocate the spacer blocks and string to the next chord angle.
10. Repeat Steps 6 through 9 for each of the four chord angles.

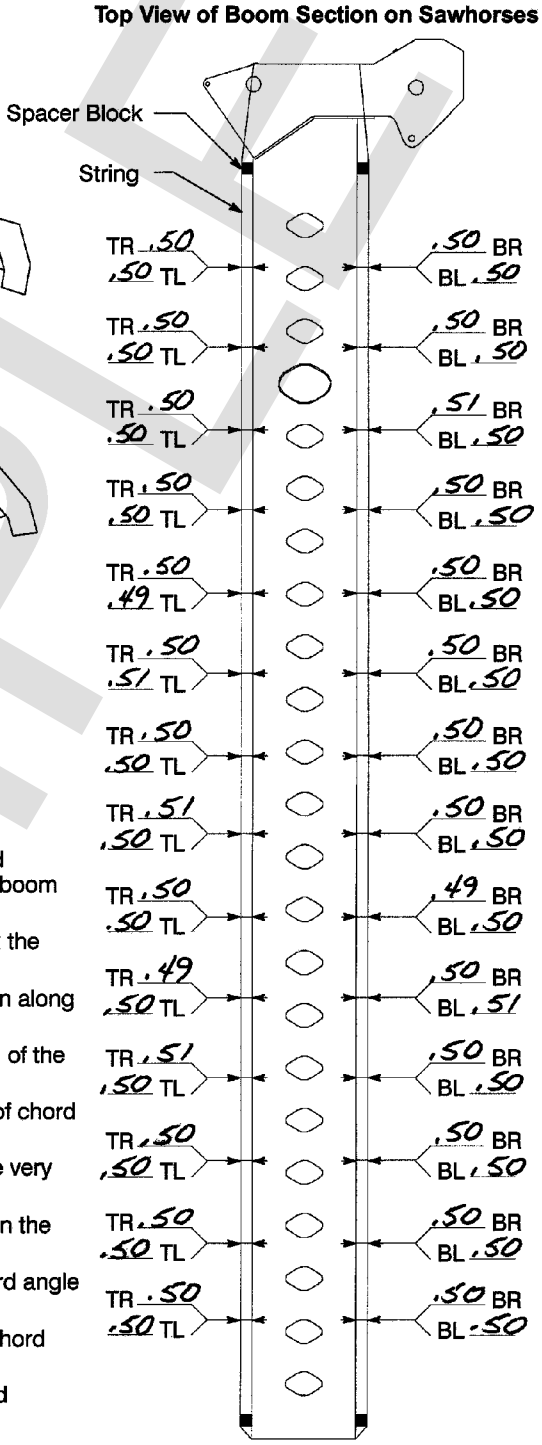
TL = Top Left BL = Bottom Left TR = Top Right BR = Bottom Right

Hydraulic Boom Field Inspection Form

Major Axis Camber Inspection



Right Side View Of Boom Sections (Exaggerated Camber)



Spacer Block Thickness: .50 INCH

1. Position boom section on its LEFT side so the head machinery or collar clears the ground. Secure the boom section to sturdy sawhorses or blocking.
2. Starting at the base of the section, divide and mark the boom section in 3 ft (*1m*) segments.
3. Be sure to mark all four corners of the boom section along the entire length of each chord angle.
4. Measurements will be taken along the entire length of the boom section.
5. Position spacer blocks, of equal size, at each end of chord angle. Record spacer block thickness.
6. Pull a string over each spacer block and tie it to the very end of the boom section.
7. The string must be taught and span clearly between the spacer block at each end of the chord angle.
8. Measure and record the distance between the chord angle and the string at each of the marked locations.
9. Relocate the spacer blocks and string to the next chord angle.
10. Repeat Steps 6 through 9 for each of the four chord angles.

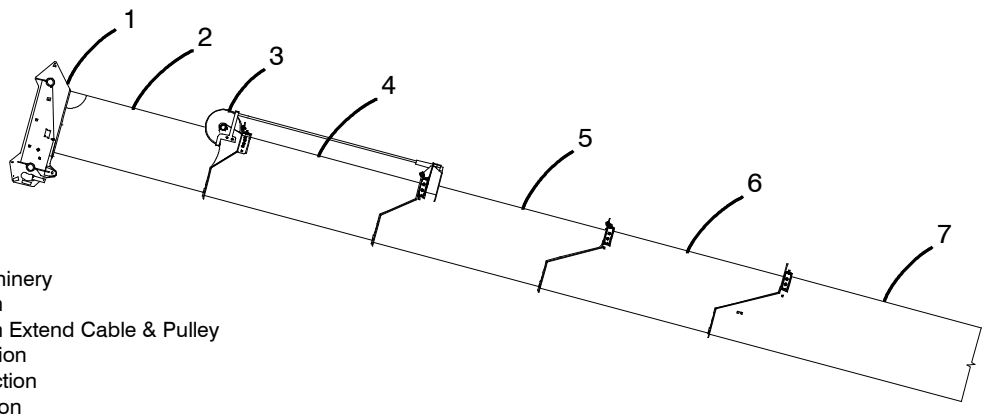
TL = Top Left BL = Bottom Left TR = Top Right BR = Bottom Right

Hydraulic Boom Field Inspection Form

Notes: A SMALL AREA, ABOUT 2 INCHES IN DIAMETER, OF BLISTERED PAINT WAS OBSERVED ON THE BASE SECTION. THE OPERATOR SAID HE NOTICED IT AT THE END OF HIS SHIFT. HE KNOWS IT WAS NOT THERE ON THE PREVIOUS DAY. THE OPERATOR REMARKED THAT ALL LIFTS MADE THAT DAY WERE WELL WITHIN CAPACITY.

THE SPOT IS LOCATED ON THE RIGHT HAND SIDE OF THE BASE SECTION, 12 INCHES OR SO BEHIND THE SIDE WEAR SHOE ACCESS HOLE.

Notes:



1. Head Machinery
2. Tip Section
3. Tip Section Extend Cable & Pulley
4. Outer Section
5. Center Section
6. Inner Section
7. Base Section

Figure 9
Typical Five Section Boom Nomenclature

Hydraulic Boom Inspection

Introduction

The following information is provided for the identification and inspection of two piece formed hydraulic boom sections manufactured by Link- Belt Construction Equipment (LBCE). LBCE cannot assume responsibility for repairs of any kind made to hydraulic boom sections because it will neither control nor inspect the repairs. This document is for reference purposes only.

For information concerning tubular fly and jib attachments for hydraulic cranes, refer to SM Keysheet Area 9- 1.

It is very important to maintain the hydraulic boom section in good working condition. Damaged hydraulic boom sections may result in boom failure. The steels used in the manufacture of hydraulic boom sections necessitate the use of special procedures.

Inspection procedures should be performed by qualified individuals with knowledge and experience in steel fabrication. It is of the utmost importance to study these instructions and follow them closely. Identification of terms used throughout this SM are given in Figure 9.

Identification

The part number and serial number, of each boom section, is located on an identification tag. On the tip section, it is located on the side plate of the head machinery. On all other sections it is located on the front of the bottom shoe support. Figure 10 shows an example of an identification tag.

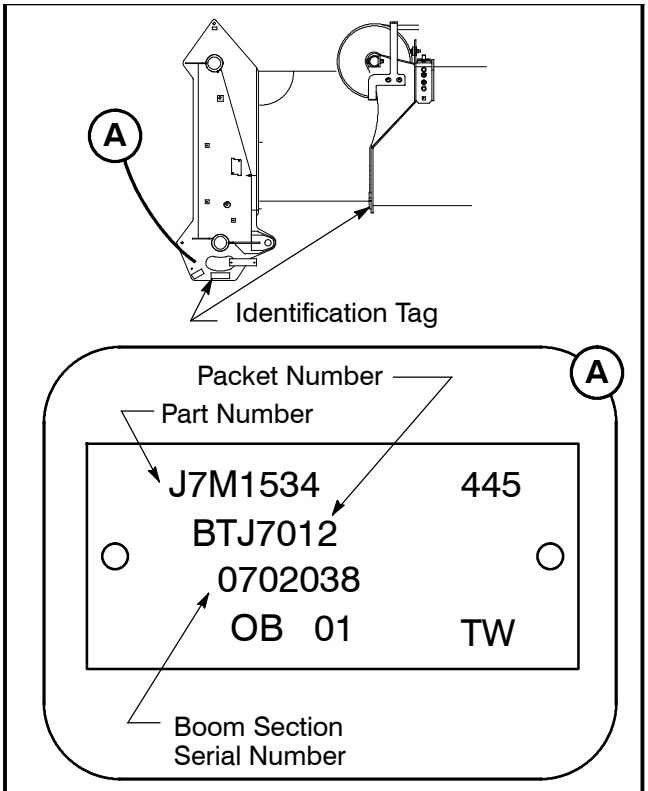
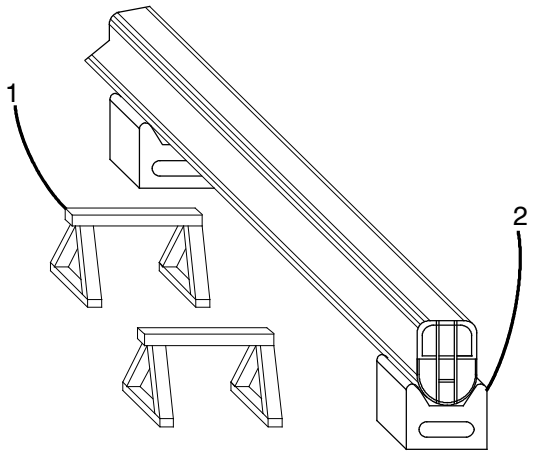


Figure 10
Typical Identification Tags

Documentation & Analysis

1. The specific inspection criteria on the “Hydraulic Boom Field Inspection Form” must be followed in order to evaluate the boom section properly. A sample of the form is shown on pages 7- 12.
2. The information gathered should be given to a LBCE Representative or Product Specialist at the factory for proper evaluation.



1. Use Typical Saw Horses When Placing Section On Flat
2. Use Form Fit Saw Horse When Placing Section On Round

Figure 11
Set Boom Section On Stable Blocking

General Inspection

All inspection procedures suggested in this document must be performed on a non- working boom which has been disassembled and separated into individual sections. For boom disassembly procedure, see SM Keysheet Area 17- 1. These sections are then to be positioned and secured in such a manner that the work can be performed in a safe, proper fashion.

The inspection equipment needed are such standard items as: portable light
wire brush
probe
digital inclinometer
24 inch (*60cm*) straight edge
10X magnifying glass
marker (chalk, crayon, etc.)
string line
two magnetic blocks of equal size
magnetic particle compound
dye penetrant
other nondestructive testing equipment

DANGER

Secure boom sections to adequate, stable supports during inspection. Boom sections are extremely heavy. Unexpected movement of boom sections could cause damage, injury, or death. Properly stabilize boom sections before beginning work.

Figure 12
Digital Inclinometer

WARNING

Solvents and cleaning solutions can be hazardous. Serious personal injury may result from misuse of these products. Read and follow all the manufacturer's recommendations concerning solvents and cleaning solutions.

1. Thoroughly clean the entire boom section with an approved cleaning solvent. Remove all mud, dirt, grease, oil, etc., so adequate inspection may be performed. Allow the boom section to air dry.
2. Throughout the inspection, you will be asked to collect data from different locations on the boom section. Positions of "TOP", "BOTTOM", "LEFT", and "RIGHT" are to be interpreted as if the boom were installed on the crane, viewing the boom from the operator's seat.
3. Set boom section on blocking or sawhorses of equal height approximately 4 ft (*1.2m*) from each end of the subject boom section. Make sure the width of the blocking or sawhorses is greater than the width of the boom section. See Figure 11.
4. Observe closely those areas where the paint has been chipped, wrinkled, or missing, or contains faint rust lines or marks.
5. Other types of damage, such as dents in the top, bottom, or side plates, brackets with dents or cracked welds, interference between boom sections, etc. requires review by a LBCE representative to determine if boom section can be repaired.
6. Inspect boom foot pin hole, in the base section, to be sure the bushing is tight, uniform, and concentric within the machined hole. Replace bushing if necessary.
7. The nature and dimensional location of any deformity should be recorded on the "Hydraulic Boom Field Inspection Form".

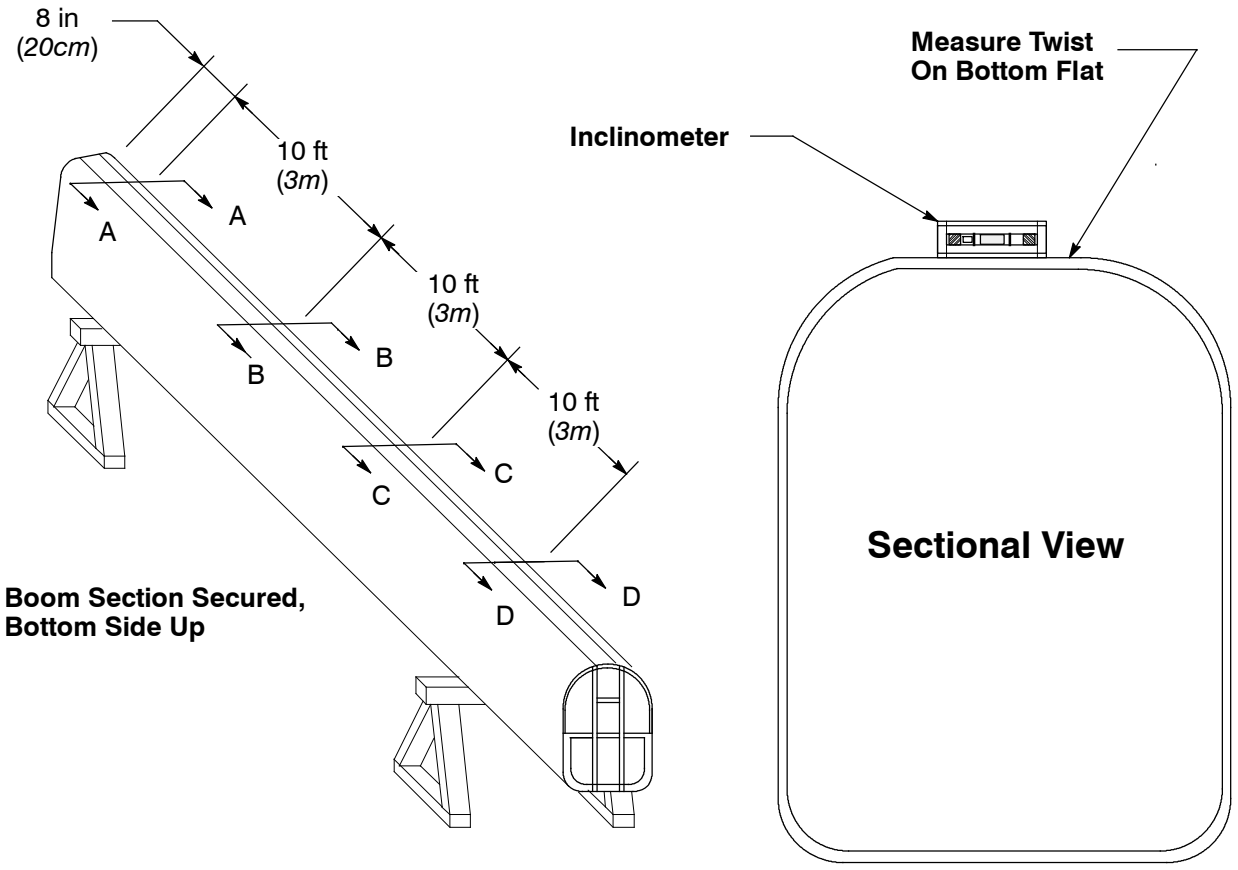


Figure 13
Boom Section Twist

Boom Section Twist Inspection

Boom section twist is the axial relationship from the rear of the section to the front of the section. This inspection also helps to determine if the boom section is straight. To inspect for twist, the boom section should be placed bottom side up on blocking or sawhorses. Inspect in four places per "Hydraulic Boom Field Inspection Form" and record values. An digital inclinometer will be required with an accuracy of ±5°.

Refer to Figure 13.

1. Level the boom section, from end to end, on two equal size saw horses. The boom section should be bottom side up.
2. Adjust the position of the boom section, at Location A- A, to achieve level reading from side to side. (If equipped, use Zero feature on inclinometer.)
3. Maintain the boom section in this position during the remainder of twist inspection.
4. Move inclinometer to next location (Location B- B).
5. Record the location and inlinometer reading per the diagram above, using the "Hydraulic Boom Field Inspection Form".
6. Repeat Steps 4 through 5 every 10 ft (*3.1m*) down the length of the boom section (Location C- C, Location D- D).

Note: Location D- D on the base section should be located directly above the boom foot pin.

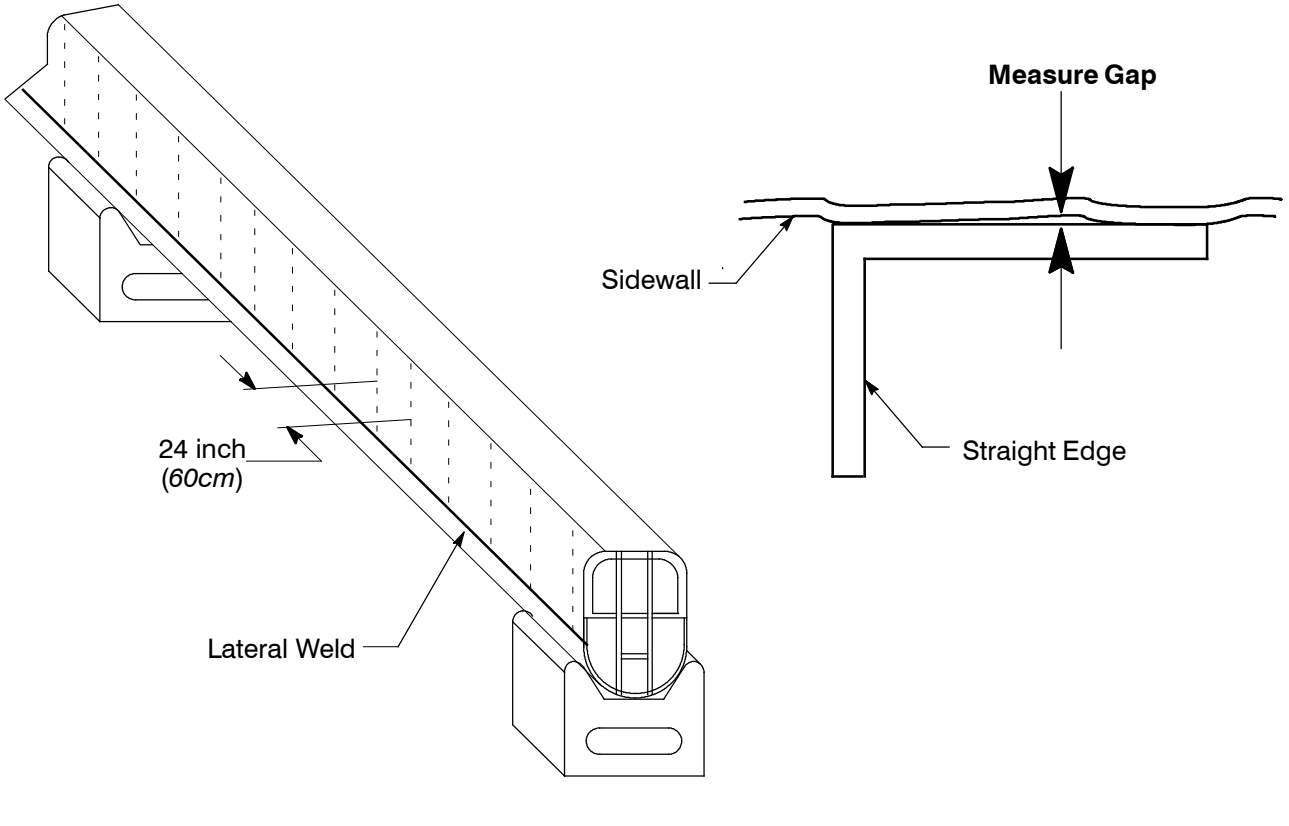


Figure 14
Sidewall Flatness

Sidewall Flatness

Sidewall flatness is a measurement of the waviness of the vertical left and right hand walls of the boom. To inspect flatness, the boom section should be right side up on blocking or saw horses. Inspect the entire length of each side of the boom, beginning at the weld seam at the rear. Continue up and down the length of the boom in 24 inch (*60cm*) increments, recording the specific location on the sidewall where it is least flat.

Refer to Figure 14.

1. Position boom section on its bottom surface so the head machinery or collar clears the ground. Secure the boom section to sturdy saw horses or blocking.
2. Starting at the base of the section, divide and vertically mark the boom section in 24 inch (*60cm*) segments, along both sidewalls of the boom section.
3. Measurements will be taken along the entire length of the boom section, above the lateral weld. Be sure to mark the boom section along its entire length and on both sides.
4. Using a straight edge, locate and measure the largest gap in each marked segment along the boom section.
5. Record the size and location of each gap on the “Hydraulic Boom Field Inspection Form”.

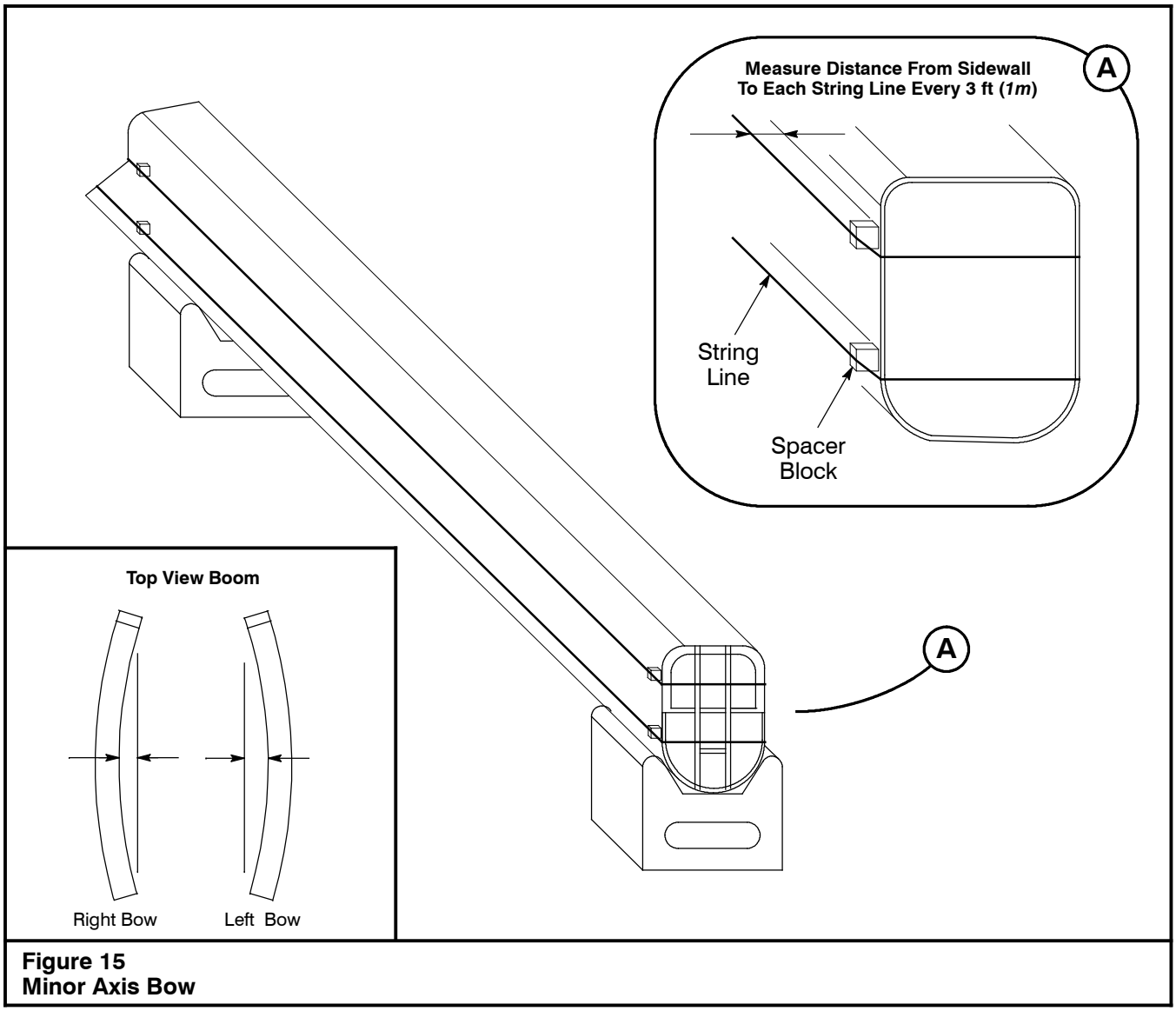


Figure 15
Minor Axis Bow

Minor Axis Bow

Minor axis bow is when the boom section is bowed to the left or right. To inspect the boom section for this condition, the boom section must be in the upright position. Take measurements every 3 ft (*1m*) and record measurements on the "Hydraulic Boom Field Inspection Form".

Refer to Figure 15.

1. Position boom section on its bottom surface so the head machinery or collar clears the ground. Secure the boom section to sturdy saw horses or blocking
2. Starting at the base of the section, divide and vertically mark the boom section in 3 ft (*1m*) segments.
3. Measurements will be taken at the top and the bottom of the flat portion of the sidewall, down the entire length of both sides of the boom section.
4. Position spacer blocks, of equal size, at each end of the boom section. Be sure the spacer block is resting on the flat portion of the sidewall.
5. Pull a string over each spacer block and tie it to the very end of the boom section. See Figure 15.
6. The string must be taut and span clearly between the spacer block at each end of the boom section.
7. Measure and record the distance between the sidewall and the string at each of the vertically marked locations.
8. Relocate the spacer blocks and string to the opposite side of the boom section.
9. Repeat Steps 4 through 8 for the other side of the boom section.

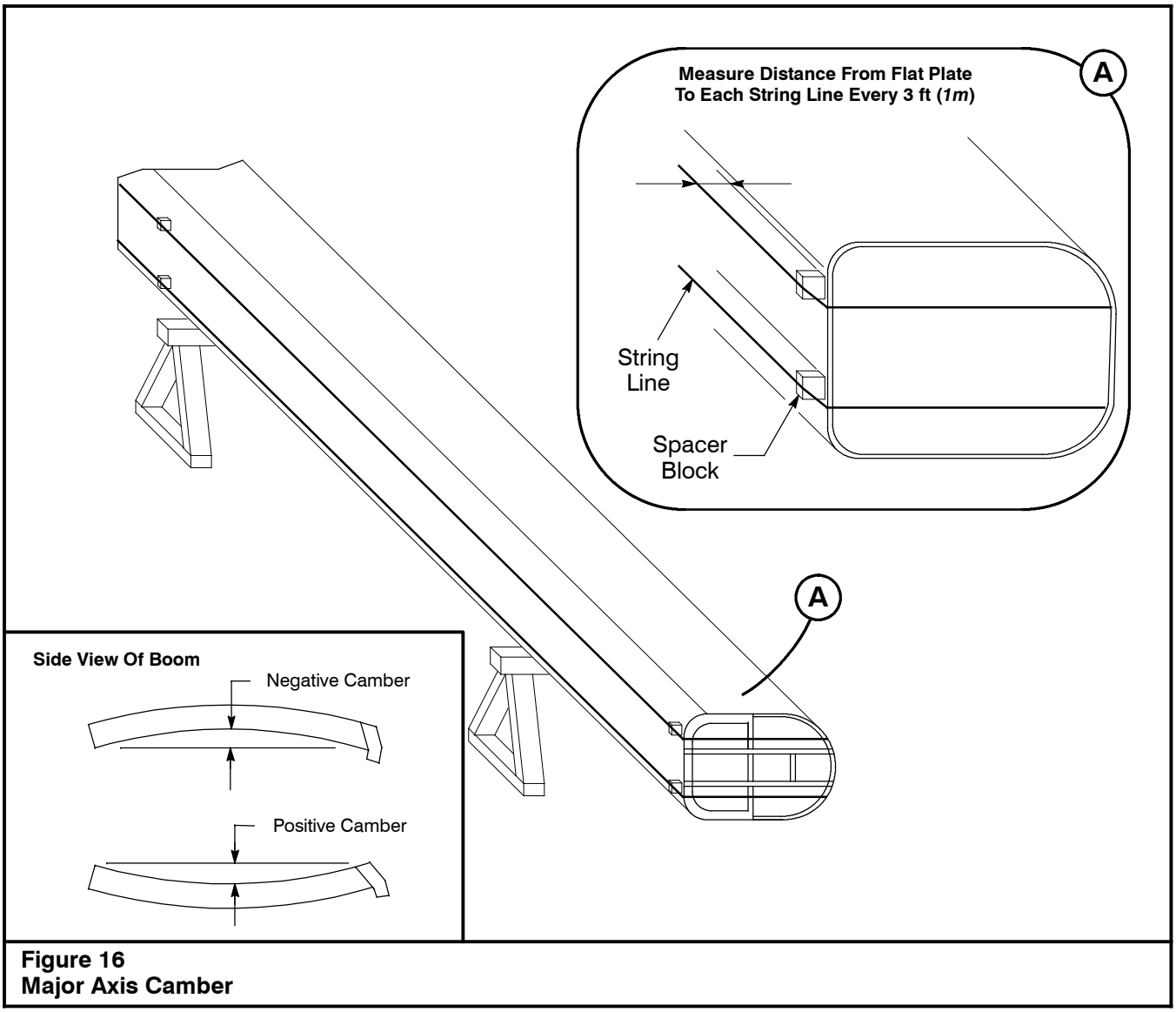


Figure 16
Major Axis Camber

Major Axis Camber

Major axis camber is when the boom section is bowed up or down. To inspect the boom section for this condition the boom section must be positioned on its side. Take measurements every 3 ft (*1m*) and record measurements on the "Hydraulic Boom Field Inspection Form".

Refer to Figure 16.

1. Position boom section on its side so the head machinery or collar clears the ground. Secure the boom section to sturdy saw horses or blocking.
2. Starting at the base of the section, divide and vertically mark the boom section in 3 ft (*1m*) segments.
3. Be sure to mark the boom section along the entire length.
4. Measurements will be taken on both the top and the bottom of the boom section down its entire length.
5. Position spacer blocks, of equal size, at each end of the boom section.
6. Pull a string over each spacer block and tie it to the very end of the boom section.
7. The string must be taut and span clearly between the spacer block at each end of the boom section.
8. Measure and record the distance between the flat surface of the boom section and the string at each of the marked locations.
9. Relocate the spacer blocks and string to the opposite surface.
10. Repeat Steps 6 through 9 for the opposite surface.

Hydraulic Boom Field Inspection Form

This form is used to collect and document inspection data for Link–Belt® two piece, formed, telescopic boom sections used on hydraulic cranes. Detailed inspection procedures are outlined in Service Manual document SM17–1–53.0 and should be performed by qualified individuals with knowledge and experience in steel fabrication. The information collected should be given to a LBCE Representative and forwarded to a Product Specialist at the factory for proper evaluation.

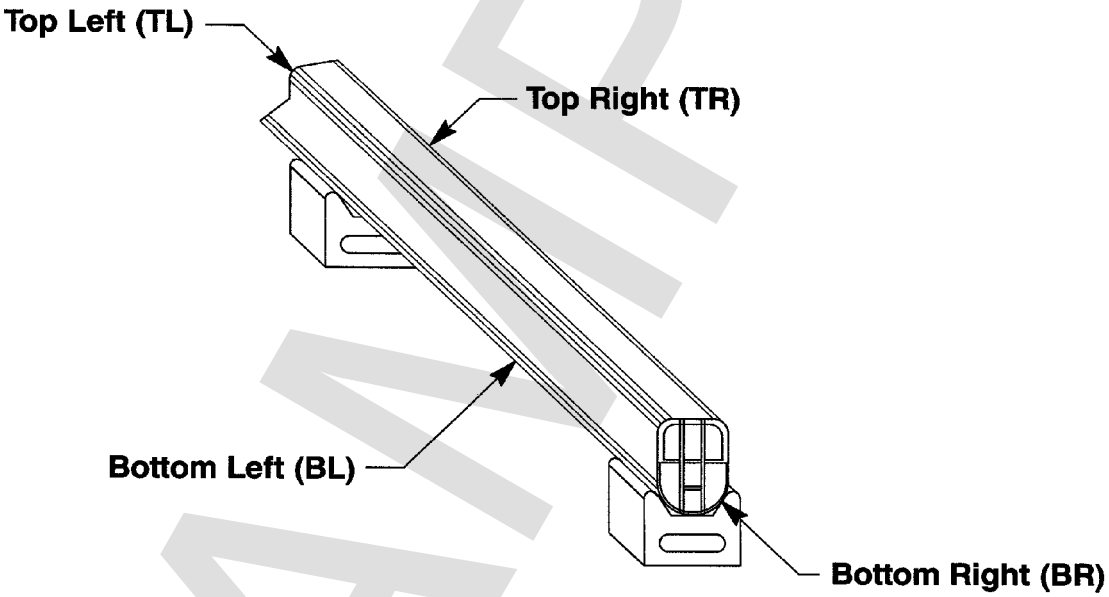
Crane Model Number: RTC-80100II Crane Serial Number: J7J2-6014

Date: 8/5/02 Hourmeter Reading: 1292

Section: OUTER Section Part Number: J7M1427

Section Serial Number: 0802133 Inspected By: RTC

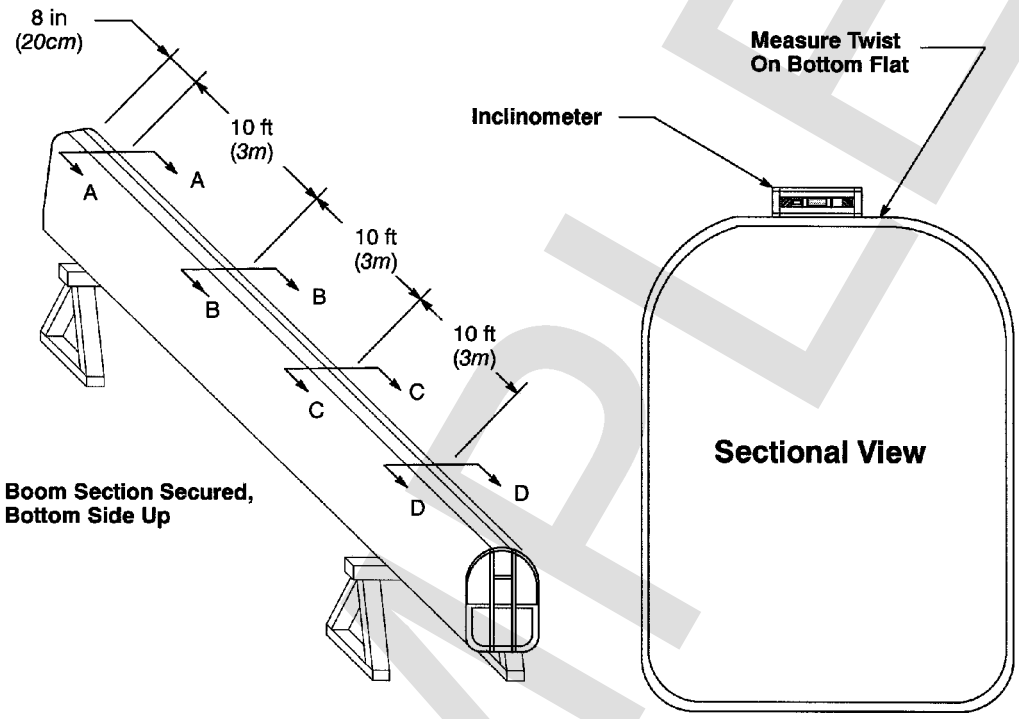
Position Nomenclature

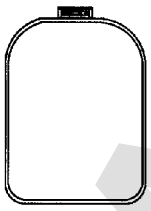


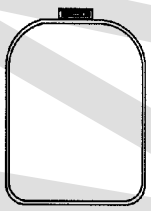
Correct documentation is critical to arrive at an accurate analysis of the condition of a boom section. Throughout this inspection form, you will be asked to collect data from different locations on the boom section. Positions of "TOP", "BOTTOM", "LEFT", and "RIGHT" are to be interpreted as if the boom were installed on the crane, viewing the boom from the operator's seat. The illustration above clearly defines the location of each of the boom sections four main locations. The abbreviation for each of these four locations is also given in parenthesis.

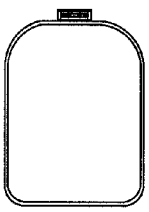
F00075

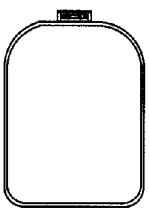
Hydraulic Boom Field Inspection Form




Location A–A
Inclinometer Reading: 0.0°


Location B–B
Inclinometer Reading: 0.7°


Location C–C
Inclinometer Reading: 0.2°


Location D–D
Inclinometer Reading: 0.5°

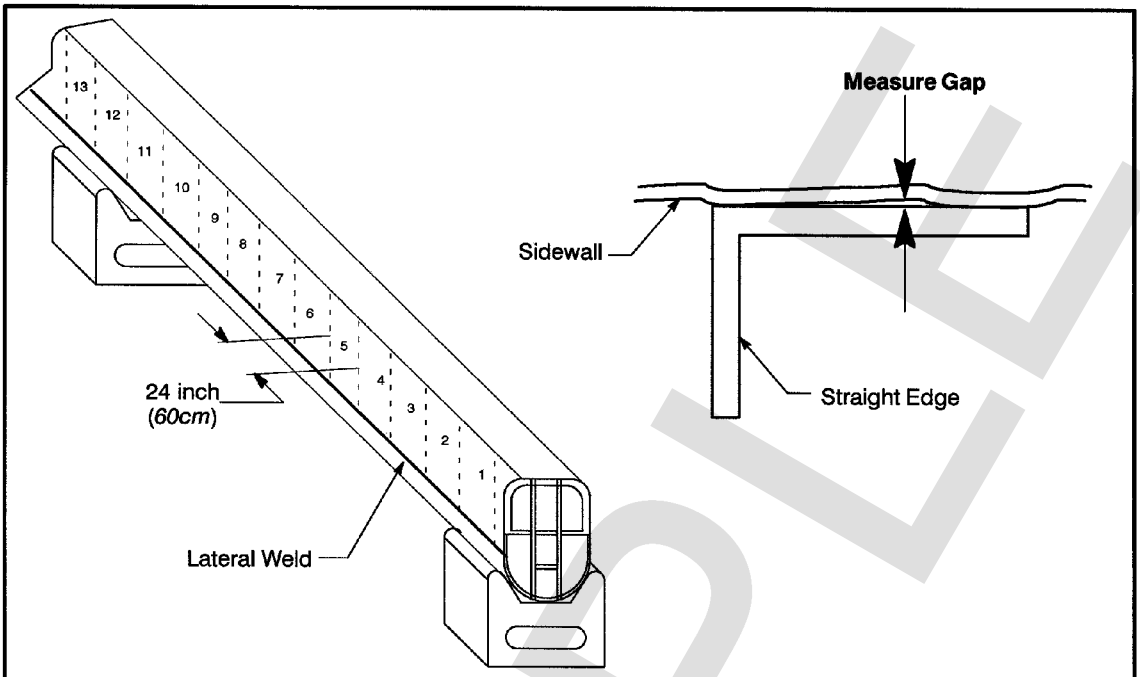
Twist Inspection

1. Level the boom section, from end to end, on two equal size saw horses.
2. Adjust the position of the boom section, at Location A–A, to achieve level reading from side to side.
3. Maintain the boom section in this position during the remainder of twist inspection.
4. Move inclinometer to next location (Location B–B).
5. Record inclinometer reading per the diagram above.
6. Repeat Steps 4 through 5 every 10 ft (*3.1m*) down length of boom section, (Locations C–C & D–D).

Note: Location D–D on the base section should be located directly above the boom foot pin.

F00075

Hydraulic Boom Field Inspection Form



1. Place and secure the boom section on two equal size saw horses.
2. Divide and vertically mark the boom section, in 24 inch (*60cm*) segments, along both sidewalls.
3. Measurements will be recorded along the entire length of the boom section, above the lateral weld.
4. Using a straight edge, locate and measure the largest gap in each marked segment along boom.
5. Record the size and location of each gap below.

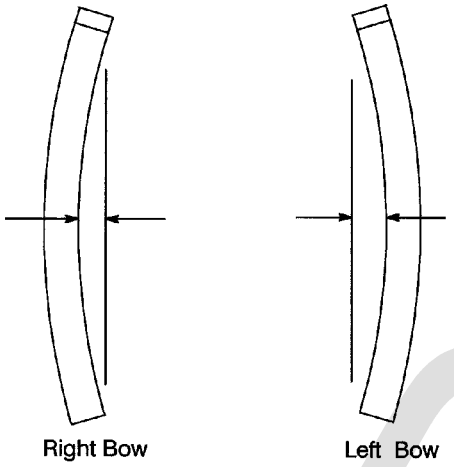
Sidewall Flatness Inspection Data

Left Sidewall Location				Right Sidewall Location			
1	0.08	16	0.10	1	0.03	16	0.06
2	0.03	17	0.07	2	0.05	17	0.07
3	0.03	18	0.06	3	0.06	18	0.07
4	0.06	19		4	0.05	19	
5	0.07	20		5	0.03	20	
6	0.05	21		6	0.03	21	
7	0.03	22		7	0.07	22	
8	0.03	23		8	0.10	23	
9	0.03	24		9	0.09	24	
10	0.05	25		10	0.06	25	
11	0.06	26		11	0.07	26	
12	0.05	27		12	0.03	27	
13	0.05	28		13	0.03	28	
14	0.03	29		14	0.03	29	
15	0.03	30		15	0.07	30	

F00075

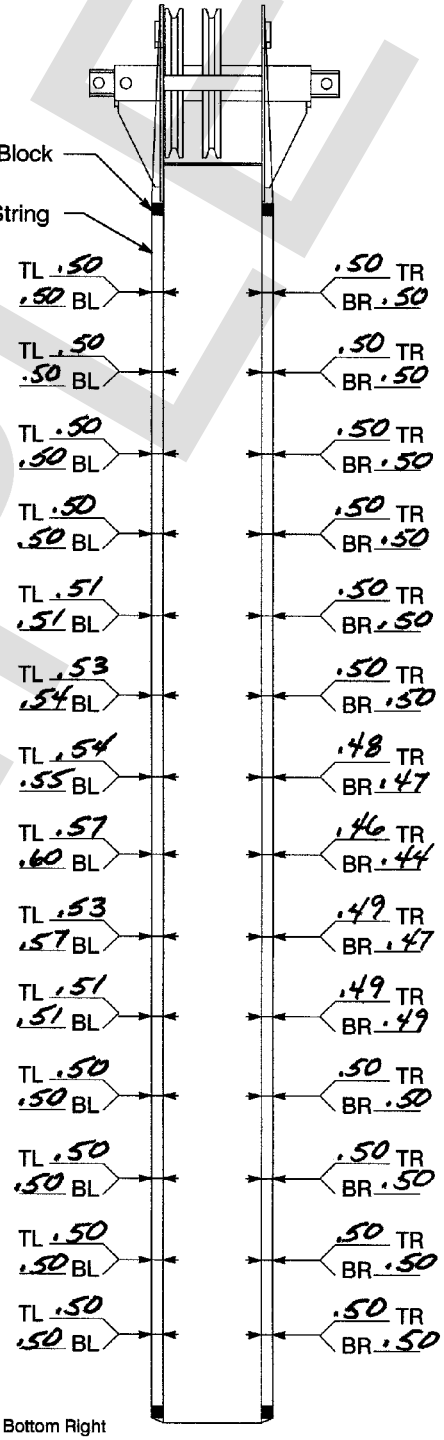
Hydraulic Boom Field Inspection Form

Minor Axis Bow Inspection



Top View Of Boom Section (Exaggerated Bow)

Top View of Boom Section on Sawhorses



Spacer Block Thickness: 0.50 INCH

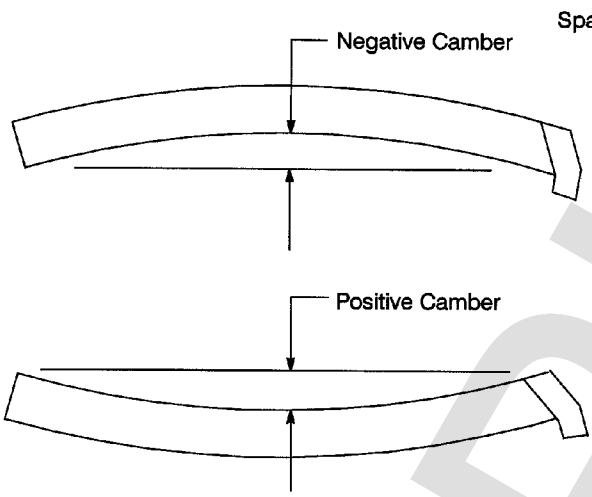
1. Position boom section on its bottom surface so the head machinery or collar clears the ground. Secure the boom section to sturdy saw horses or blocking
2. Starting at the base of the section, divide and vertically mark the boom section in 3 ft (*1m*) segments.
3. Measurements will be taken at the top and the bottom of the flat portion of the sidewall, down the entire length of both sides of the boom section.
4. Position spacer blocks, of equal size, at each end of the boom section. Be sure the spacer block is resting on the flat portion of the sidewall.
5. Pull a string over each spacer block and tie it to the very end of the boom section.
6. The string must be taut and span clearly between the spacer block at each end of the boom section.
7. Measure and record the distance between the sidewall and the string at each of the vertically marked locations.
8. Relocate the spacer blocks and string to the opposite side of the boom section.
9. Repeat Steps 4 through 8 for the other side of the boom section.

TL = Top Left BL = Bottom Left TR = Top Right BR = Bottom Right

F00075

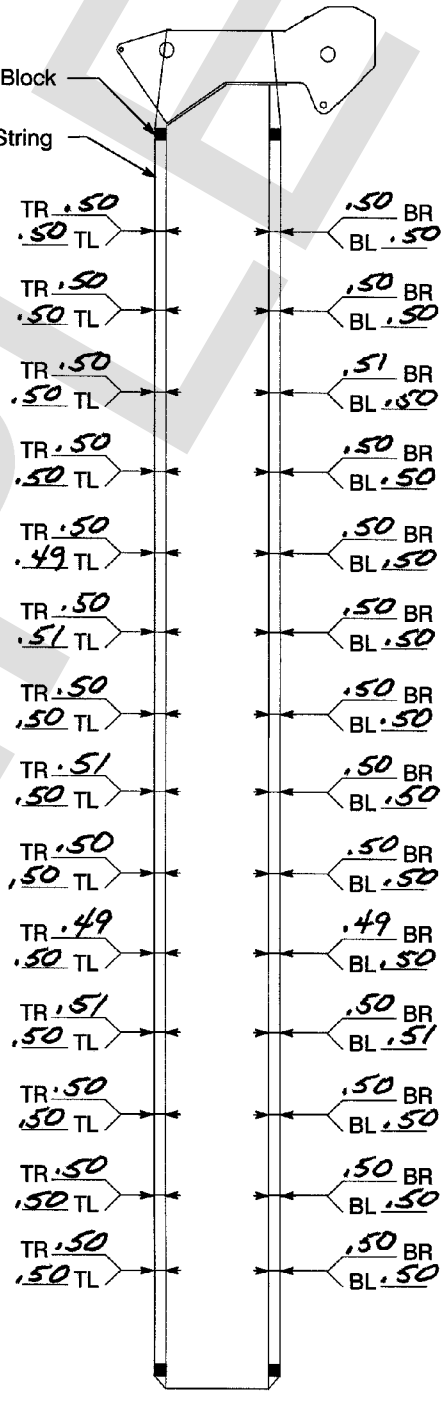
Hydraulic Boom Field Inspection Form

Major Axis Camber Inspection



Right Side View Of Boom Sections (Exaggerated Camber)

Top View of Boom Section on Sawhorses



Spacer Block Thickness: 0.50 INCH

1. Position boom section on its side so the head machinery or collar clears the ground. Secure the boom section to sturdy saw horses or blocking.
2. Starting at the base of the section, divide and vertically mark the boom section in 3 ft (*1m*) segments.
3. Be sure to mark the boom section along the entire length.
4. Measurements will be taken on both the top and the bottom of the boom section down its entire length.
5. Position spacer blocks, of equal size, at each end of the boom section.
6. Pull a string over each spacer block and tie it to the very end of the boom section.
7. The string must be taut and span clearly between the spacer block at each end of the boom section.
8. Measure and record the distance between the flat surface of the boom section and the string at each of the marked locations.
9. Relocate the spacer blocks and string to the opposite surface.
10. Repeat Steps 6 through 9 for the opposite surface.

TL = Top Left BL = Bottom Left TR = Top Right BR = Bottom Right

F00075

Hydraulic Boom Field Inspection Form

Notes: A SMALL AREA, ABOUT 2 INCHES IN DIAMETER, OF BLISTERED PAINT WAS OBSERVED ON THE BASE SECTION. THE OPERATOR SAID HE NOTICED IT AT THE END OF HIS SHIFT. HE KNOWS IT WAS NOT THERE ON THE PREVIOUS DAY. THE OPERATOR REMARKED THAT ALL LIFTS MADE THAT DAY WERE WELL WITHIN CAPACITY.

THE SPOT IS LOCATED ON THE RIGHT HAND SIDE OF THE BASE SECTION, 12 INCHES OR SO BEHIND THE SIDE WEAR SHOE ACCESS HOLE.

Notes:

Notes:

Link-Belt Cranes Lexington, Kentucky www.linkbelt.com