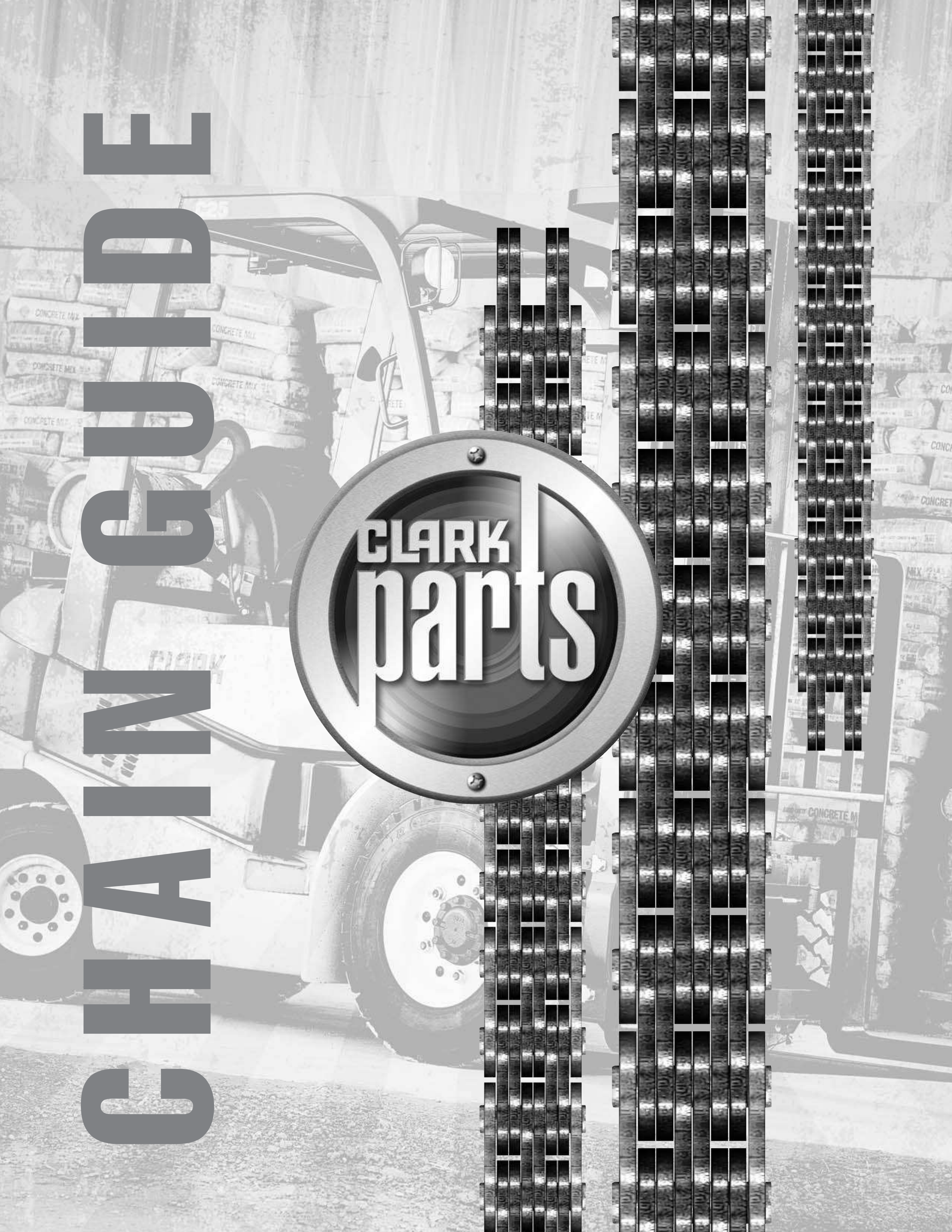
CHAIN GUIDE

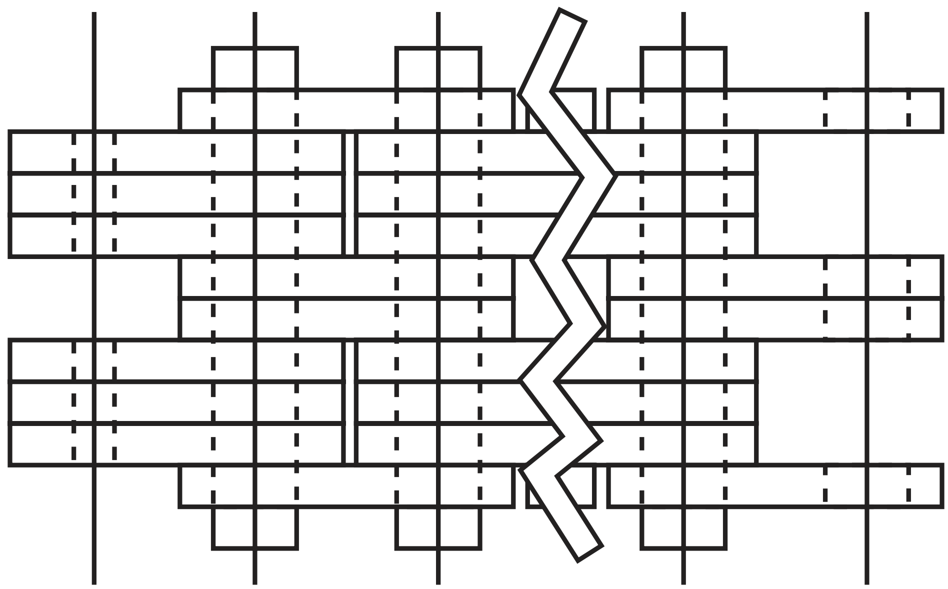


CLARK parts

Introduction to Leaf Chain

Leaf chain is primarily used in tension linkage applications. This would include hoisting chains, forklift mast chains, and counterbalance chains.

Leaf chains generally have greater strength vs. weight per foot than roller chains and run over sheaves rather than sprockets. These chains can be supplied with male or female endings to permit acceptance of a complementing female or male clevis, as desired.



"Male" Chain End
(Also called Inside Ending)

"Female" Chain End
(also called Outside Endings)

A leaf chain's normal life expectancy can be expressed as a maximum percent of elongation. This is generally 3% of pitch. As the chain flexes back and forth over the sheave, the bearing joints (pins and inside link plates) gradually incur wear due to articulation.

As with all steel bearing surfaces, the precision hardened steel joints of leaf chain require a constant film of oil between mating parts to prevent rapid wear and also to resist corrosion.

Please Note

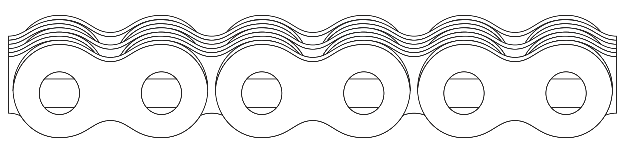
Minimum ultimate tensile strength, as defined for chains covered by this manual, is the minimum load at which an unused, undamaged chain may be expected to fail when subjected to a single tensile load cycle. Minimum ultimate tensile strength is not a measure of the load at which a chain may be applied; it is indicative only of the tensile strength quality of the chain.

Any chain tests made to verify the minimum ultimate tensile strength set by this manual are to be considered destructive. Consequently, all chain specimens subjected to such tests, failed or otherwise, are deemed unfit to application purposes.

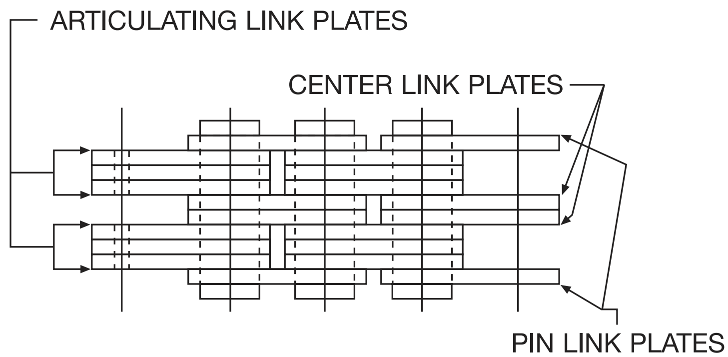
Leaf Chains

Leaf chain is constructed from the interlaced, heat-treated steel-link plates similar in contour to roller chain-link plates. Pins, used to connect the links, are made from case-hardened steel or through-hardened steel with ends headed.

Many types of leaf chain exist, but only the heavy BL series is listed in ANSI Standard B29.8. Until 1975, a lighter AL series was also listed in the standards. Due to predominant use of the heavier series in new applications and a common desire for simplification, the AL series was eliminated from the 1977 standards, although it is still listed in some manufacturers' catalogs. CLARK recommends using the heavy BL series chain due to its higher tensile strength and durability.



Assembly showing 3 x 4 lacing.



Assembly showing 4 x 6 lacing and parts.

The purpose of the standard is to assure interchangeability, and chains of one manufacturer will not necessarily be identical to those of another. However, the standard does assure that all chains will hook up with clevises made to the standard dimensions.

The general proportioning rules of the two series are as follows:

BL (heavier) series:*

1. Maximum link plate height: 0.95 x pitch
2. Thickness of link plate: approximately equal to standard roller chain of the next larger pitch, with the link plate thickness for 2-inch pitch being 9/32 inch.
3. Pin diameter: 3/8 x pitch

AL (lighter) series:

1. Maximum link plate height: 0.82 x pitch
2. Thickness of link plate: approximately 1/8 x pitch (the same as standard roller chains of identical pitch)
3. Pin diameter: approximately 5/16 x pitch

* Note: CLARK recommends using BL series chain on all applications.

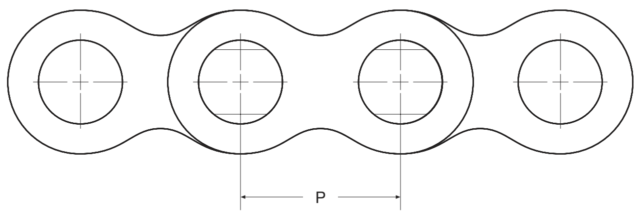
Numbering System

Due to CLARK’s Engineering recommendation of the use of BL chain, the chain described in this manual carries the prefix BL.

The last two digits of the number following the prefix denote the lacing. The right-hand digit designates the number of link plates in the articulating pitch. The digit to the left of this designates the number of plates in the pin link pitch. The digits to the left of these two digits denote the number of 1/8 inches in the chain pitch.

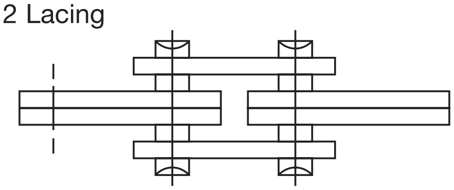
Example:
BL 523 indicates a Type BL leaf chain, 5/8” pitch with a 2 x 3 lacing – two plates in the pin link pitch and three plates in the articulating pitch.

ASSEMBLIES AND GENERAL PROPORTIONS

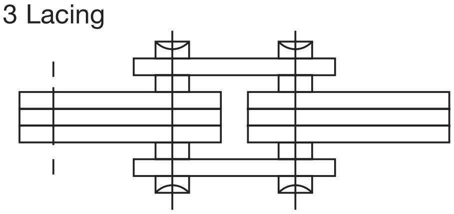


P = Chain Pitch

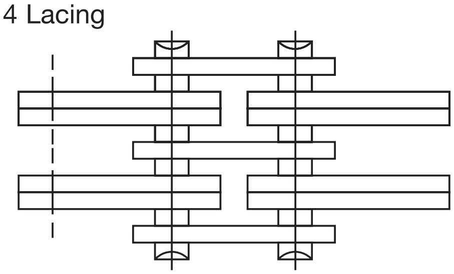
2 x 2 Lacing



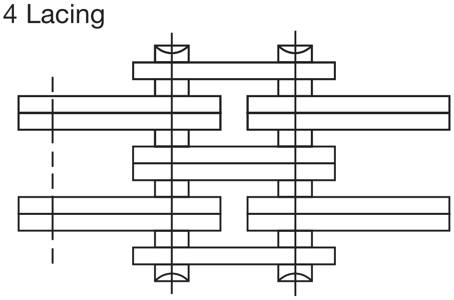
2 x 3 Lacing



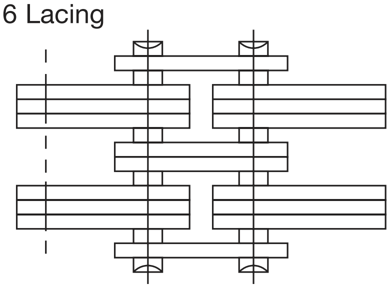
3 x 4 Lacing



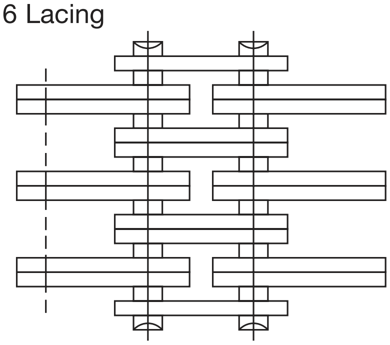
4 x 4 Lacing



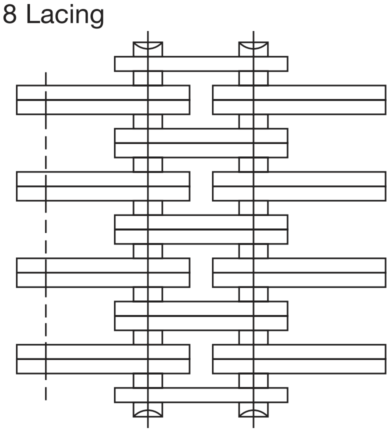
4 x 6 Lacing



6 x 6 Lacing



8 x 8 Lacing

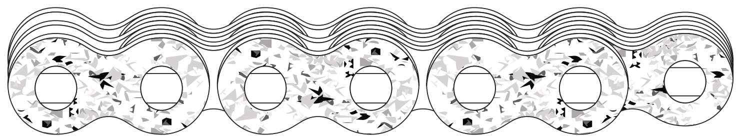


Leaf Chain Assemblies and Proportions

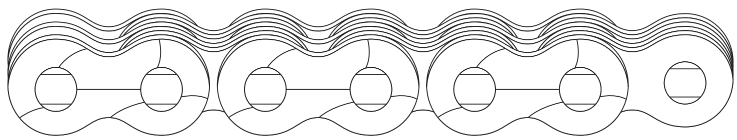
Environmental Conditions

Environments in which material handling and lifting mechanisms operate can vary widely – from outdoor moisture to mildly corrosive or highly corrosive industrial atmospheres. In addition to abrasive exposures such as sand and grit, some effects can be as follows:

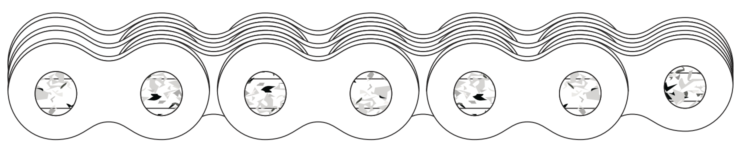
Moisture – Corrosive rusting reduces chain strength by pitting and cracking.



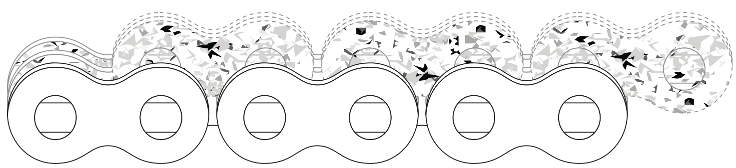
Temperature – Low temperature reduces chain strength by embrittlement. Going in and out of cold storage results in moisture from condensation.



Chemical Solutions or Vapors – Corrosive attack on the chain components and/or the mechanical connections between the chain components. Cracking can be (and often is) microscopic. Propagation to complete failure can be either abrupt or may require an extended period of time.



Abrasives – Accelerated wearing and scoring of the articulating members of the chain (pins and plates) with a corresponding reduction in chain strength. Due to the inaccessibility of the bearing surfaces (pin surfaces and plate apertures), wear and scoring are not readily noticeable to the naked eye.



Each specific application should be evaluated based on the degree of exposure and the areas of possible operation. A chain replacement schedule should be established to prevent chain failure. This schedule can be established by frequent inspection. Based on the observations, the frequency of inspection can be changed. This inspection procedure development should go on until a projected time of replacement can be predicted. A chain, by its very nature and exposure, should be considered an expendable item and a safe chain replacement schedule established.

Dynamic Impulse/Shock Loads

Following are some examples of dynamic shock loading which can impose abnormal loads above the endurance limit of leaf chain:

- High velocity movement of load, followed by sudden, abrupt stops.

- Carrying loads in suspension over irregular surfaces such as railroad tracks, pot holes, and rough terrain.

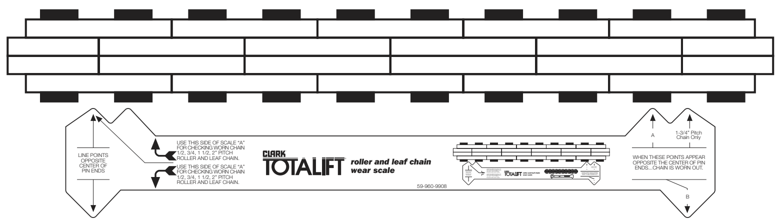
- Attempting to “inch” loads which are beyond the rated capacity of the handling of lifting mechanism.

The above load cycles and environmental conditions make it impossible to predict chain life. It is therefore necessary to conduct frequent inspections until replacement life can be predicted.

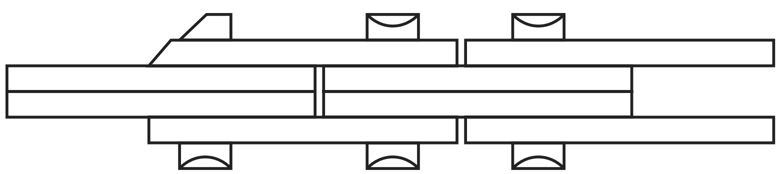
Periodic Inspections

After each 30 days of operation (more frequently in hostile environments), leaf chains should be inspected and lubricated. Inspection details are described in the “Periodic Inspection Addenda”, pages 10-12. The inspection should focus on the following:

1. **Elongation –** When a theoretical length of 12.000” per foot of new chain has elongated from wear to a length of 12.360”, it should be discarded and replaced. It is important to measure the chain in the section that moves over the sheaves because it receives the most frequent articulation. Measuring the chain near its clevis terminals could give an erroneous reading as it would not have flexed as frequently, if indeed at all, as that nearer the middle of the assembly.

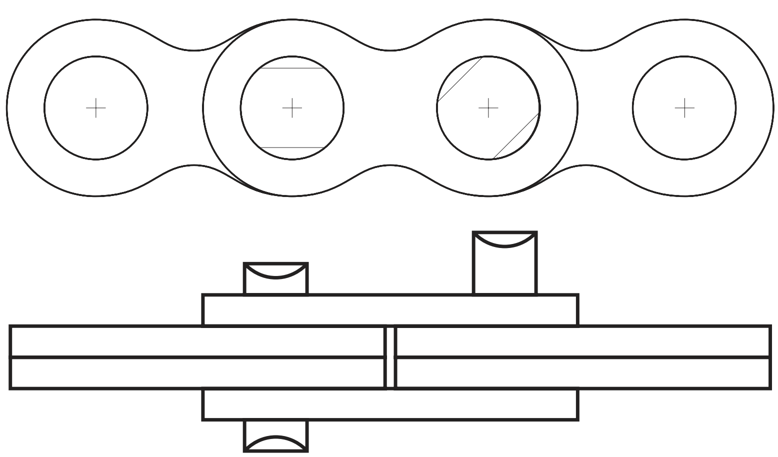


2. **Edge Wear –** Check the chain for wear on the link plate edges caused by running back and forth over the sheave. The maximum reduction of material should not exceed 5%. This can be compared to a normal link plate height by measuring a portion of chain that does not run over the sheave.



Distorted or battered plates on leaf chain can cause tight joints and can prevent flexing.

3. **Turning or Protruding Pins –** Highly loaded chain operating with inadequate lubrication can generate abnormal frictional forces between pin and link plates. In extreme instances, the torque could surpass the press fit force between the pins and the outside plates resulting in pin rotation. When chain is allowed to operate in this condition, a pin, or series of pins, can begin to twist out of a chain resulting in failure. The pin head rivets should be examined to determine if the “VEE” flats are still in correct alignment. Chain with rotated/displaced heads or abnormal pin protrusion should be replaced immediately. Do not attempt to repair the chain by welding or driving the pin(s) back in to the chain. Once the press fit integrity between outside plates and pins has been altered, it cannot be restored. Any wear pattern on the pin heads or the sides of the link plates indicates misalignment in the system. This condition damages the chain as well as increases frictional loading and should be corrected.

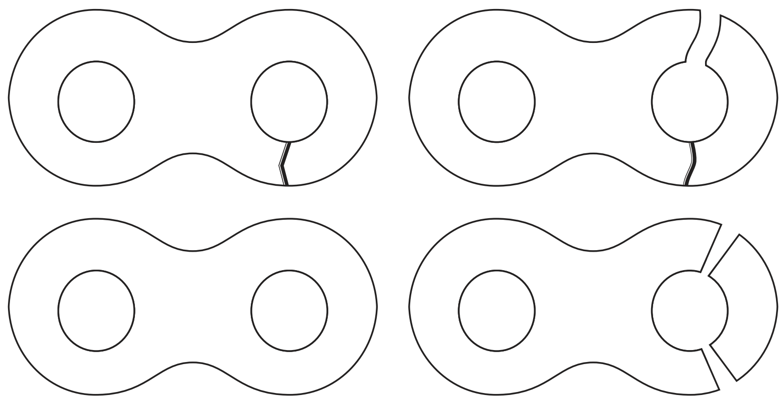


Out-of-line flats on “V” heads indicate that pins have turned in plates and/or are protruding.

Periodic Inspections (cont.)

4. **Cracked Plates –** The chains should periodically be inspected very carefully, front and back as well as side to side, for any evidence of cracked plates. If any one crack is discovered, the chain(s) should be replaced in its entirety. It is important, however, to determine the causes of the crack before installing new chain so the condition does not repeat itself.

a. **Fatigue Cracking –** Fatigue cracks are a result of repeated cyclic loading beyond the chain's endurance limit. The magnitude of the load and frequency of its occurrence are factors which determine when fatigue failure will occur. The loading can be continuous or intermittent (impulse load). Fatigue cracks almost always start at the link plate aperture (point of highest stress), are often microscopic in their early stage and are perpendicular to the chain pitch line. Unlike a pure tensile failure, there is no noticeable yielding (stretch) of the material.



Cracked plates resulting from fatigue failure.

b. **Stress Corrosion Cracking –** The outside link plates, which are heavily press fitted to the pins, are particularly susceptible to stress corrosion cracking. Like fatigue cracks, these initiate at the point of highest stress (aperture) but tend to extend in an arc-like path between the holes in the pin plate.

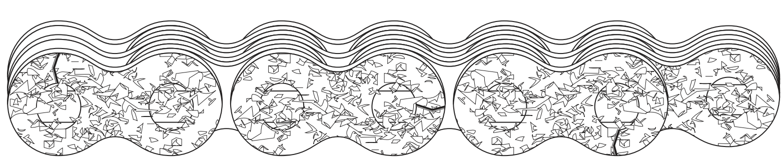
More than one crack can often appear on a link plate. In addition to rusting, this condition can be caused by exposure to an acidic or caustic medium or atmosphere.

Stress corrosion is an environmentally assisted failure. Two conditions must be present: corrosive agent and static stress. In the chain, static stress is present at the aperture due to the press fit pin. No cyclic motion is required, and the plates can crack during idle periods.

The reactions of many chemical agents (such as battery acid fumes) with hardened steel can liberate hydrogen, which attacks and weakens the steel grain structure.

For this same reason, never attempt to electroplate a leaf chain or its components. The plating process liberates hydrogen, and hydrogen embrittlement cracks will appear. These are similar in appearance to stress corrosion cracks.

If a plated chain is required, consult the manufacturer. Plated chains are assembled from modified, individually plated components which may reduce the chain rating.



Typical examples of stress corrosion cracking of leaf chain.

Periodic Inspections (cont.)

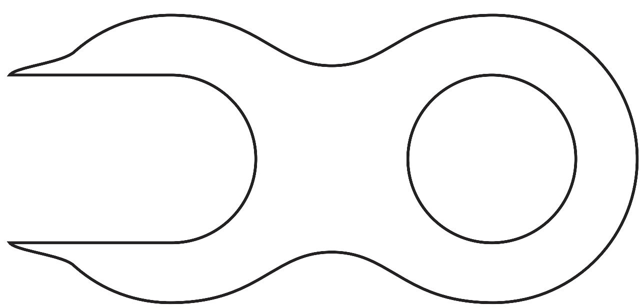
c. **Corrosion Fatigue –** Corrosion fatigue cracks are very similar (in many cases identical) to normal fatigue cracks in appearance. They generally begin at the aperture and propagate perpendicular to the chain pitch line.

Corrosion fatigue is not the same as stress corrosion. Corrosion fatigue is the combined action of an aggressive environment and a cyclic stress (not a static stress alone, as in stress corrosion).

Typical examples of corrosion fatigue leaf chain.

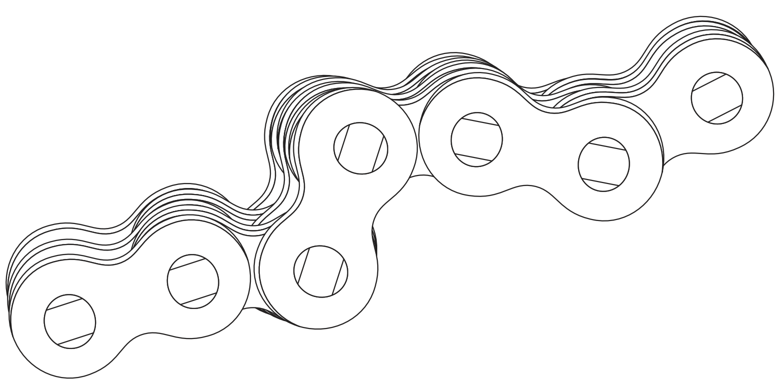
5. **Other Modes of Failure –**

a. **Ultimate Strength Failure –** This type of failure is caused by overloads far in excess of the design load.



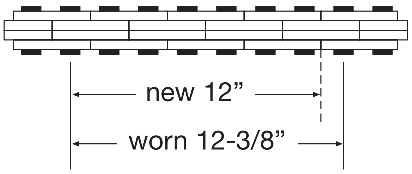
Broken plate caused by overload.

b. **Tight Joints –** All joints in leaf chain should flex freely. Tight joints resist flexure and increase internal friction, thus increasing chain tension required to lift a given load. Increased tension accelerates wear and fatigue problems.



Examples of how tight joints
prevent proper flexing of leaf chain.

Periodic Inspections Addenda

APPEARANCE AND/OR SYMPTOM	PROBABLE CAUSE	CORRECTION
Excessive Length 3% wear is .360 or approx. 3/8” 	**Wear** (Pin & Link Apertures)	**Replace Chain** Note: Tensile strength diminishes as the chain elongates as a result of wear. 3% wear elongation could reduce chain tensile strength by as much as 18%. Chain wear life can be improved by lubrication. (see page 12)
Check section of chain that runs over sheaves	Permanent deformation (stretch) from overload	Replace Chain

The following chart is based on a maximum wear elongation of 3%. The “span measurement” is based on a measurement from pin center to pin center for the number of pins indicated. Chains exceeding the maxiumum recommended “span measurements” should be replaced!

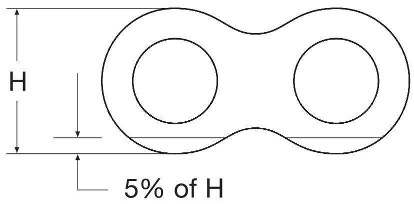
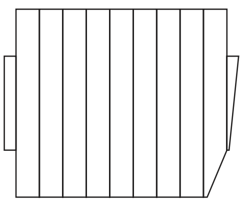
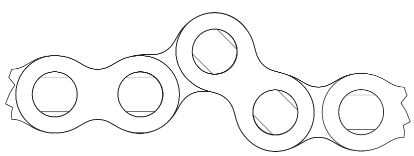
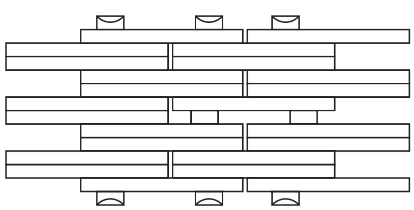
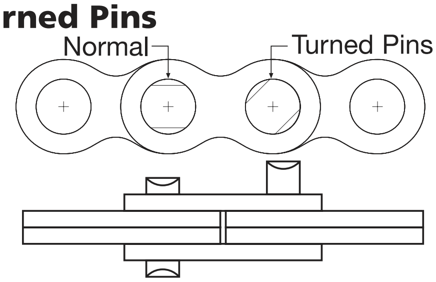
Chain Series	Chain Size (in.)	Measuring Span No. Pins (in.)	Recommended Measuring Load* (Lb)	(N)	Max Recommended Measuring Span-Meas/Pin Centers (in.)	(MM)
BL 4	1/2	25	50	222	12.35	373
BL 5	5/8	21	75	334	12.87	327
BL 6	3/4	17	110	489	12.36	313
BL 8	1	13	190	845	12.36	327
BL 10	1-1/4	11	260	1157	12.87	327
BL 12	1-1/2	9	340	1512	12.36	313
BL 14	1-3/4	8	430	1912	12.61	320
BL 16	2	7	650	2891	12.36	313
BL 20	2-1/2	6	975	4337	12.87	327

* Indicated “measuring load” is for 2 x 2 lacing. The “measuring load” must be multiplied by a lacing factor to obtain actual measuring load.

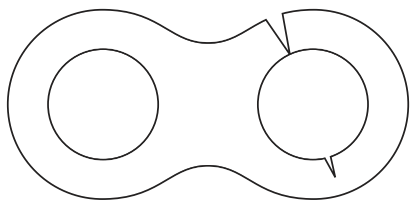
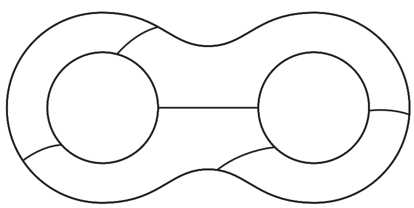
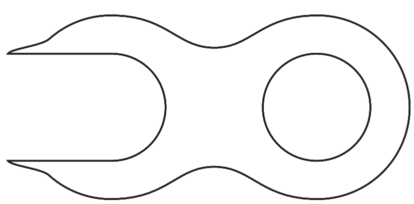
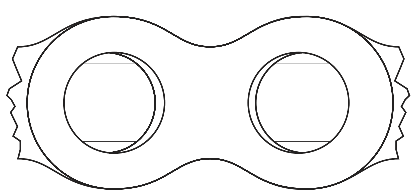
Lacing	2 x 2	2 x 3	3 x 4	4 x 4	4 x 6	6 x 6	8 x 8
Lacing Factor	1	1	1.5	2	2	3	4

Ex: Actual Meas.
Load for BL 1434 = 430# x 1.5 =645#

Periodic Inspections Addenda (Cont.)

APPEARANCE AND/OR SYMPTOM	PROBABLE CAUSE	CORRECTION
Worn Contour 	Normal Wear on sheave-bearing area. Abnormal wear rubbing guides.	Replace chain when 5%. Check alignment. Increase clearance.
Worn surfaces on outside links or pin heads 	Misalignment rubbing on guides.	Check alignment to correct clearance.
Tight Joints 	Dirt or foreign substance packed in joints. or Corrosion and rust. or Bent Pins.	Clean and relube. Replace Chain. Replace Chain.
Missing Parts 	Missing at original assembly.	Replace Chain.
Abnormal Protusion or Turned Pins 	Excessive friction by high loading and inadequate lubrication.	Replace chain. Improve lubrication and eliminate overloading conditions.

Periodic Inspections Addenda (Cont.)

APPEARANCE AND/OR SYMPTOM	PROBABLE CAUSE	CORRECTION
Cracked Plates (Fatigue) 	Loading beyond chain's dynamic capacity.	Replace chain with chain of larger dynamic capacity or eliminate high load condition or dynamic (impulse) overloading.
Arc-Like Cracked Plates (Stress Corrosion) 	Severe rusting or exposure to acidic or caustic medium, plus static press at press-fit (between pin & plate) (no cyclic stress necessary).	Replace chain and protect from hostile environment.
Fractured Plates (Tension Mode) 	High overload.	Replace chain and correct cause of overload.
Enlarged Holes 	High overload.	Replace chain and correct cause of overload.
Corrosion Pitting	Exposure to corrosive environment.	Replace chain and protect from hostile environment.
Worn Connecting Clevis Pins	Normal wear.	Replace worn components

Leaf Chain Disconnect Instructions

Introduction – This disconnect instruction is designed to permit the disassembly of chain with a minimum of hazard while protecting the design integrity of the chain. Toward that end, the following guidelines should be observed:

1. Always wear safety glasses to protect your eyes.

2. Wear protective gloves and clothing, as appropriate.

3. Be sure the chain is supported adequately during disassembly to prevent damage to chain components and avoid uncontrolled movements of the chain.

4. Use proper equipment.

5. Discard removed components. Components should not be reused.

General – Although the use of pressing equipment is preferred, this procedure assumes the use of a hammer and knockout punch. The use of pressing equipment is recommended in those cases where it is available. Disconnecting should be done on a work bench or other sturdy surface.

When disconnecting chain, an entire pin link must be removed. Discard components after removal.

Tools Needed – Grinding wheel, knockout punch, hammer, support ring, and work surface with knockout aperture.

Procedure

1. Select the pin link to be removed. Be sure both pins are in the same pin link (both pins pressed through the same outside links). With the grinding wheel, grind the heads of both pins flush with the pin link plate. This serves to prevent potential scoring damage to inside link apertures during disassembly. If chain is exposed to grinding dust, chain should be cleaned and relubricated.

2. Position the support ring over the knockout aperture of the work surface. The support ring serves to support the bottom pin link plate and avoid damage to chain components while driving the pin through the chain. This support ring should have an inside diameter slightly greater than the pin diameter and height equal to the exposed portion of the pin. The knockout aperture should permit the pin room to extend beneath the work surface as it is driven through the top pin link plate.

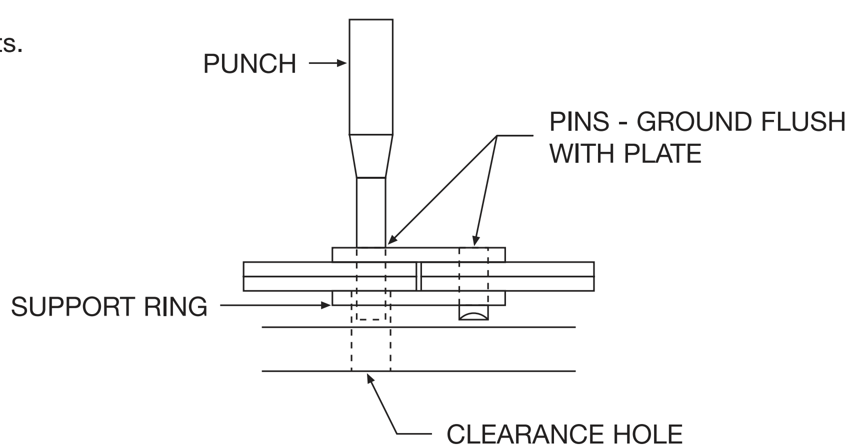
3. Standing the chain on its side, seat one pin of the designated pin link in the support ring.

4. Drive the pin through the top pin link plate with a hammer and knockout punch. The knockout punch should have a diameter slightly less than the pin link plate aperture. Use steady, controlled blows.

5. Repeat the above steps with the other pin in the pin link.

6. Remove the pin link from the chain by hand. If both pins have been completely driven through the top pin link plate, the pin link should remove easily.

7. Discard components.



Lubrication

An important consideration in field maintenance of leaf chain is LUBRICATION. In order to get satisfactory service life, periodic lubrication must be provided. Like all bearing surfaces, the precision-manufactured, hardened-steel, joint-wearing surfaces of leaf chain require a film of oil between mating parts to prevent accelerated wear.

Maintaining a lubricant film on all chain surfaces will:

a. Minimize joint wear.
b. Improve corrosion resistance.
c. Reduce the possibility of pin turning.
d. Minimize tight joints.
e. Promote smooth, quiet chain action.
f. Lower chain tension by reducing internal friction in the chain system.

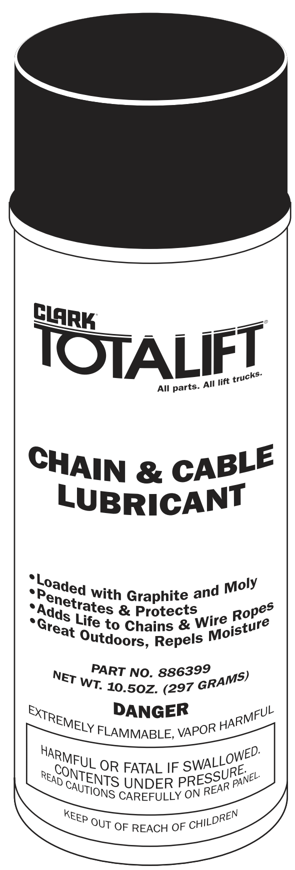
Laboratory wear tests show #40 oil to have greater ability to prevent wear than #10 oil. Generally, the heaviest (highest viscosity) oil that will penetrate the joint is best.

Whatever method is used, the oil must penetrate the chain joint to prevent wear. Applying oil to external surfaces will prevent rust, but oil must flow in to the live bearing surfaces for maximum wear life.

To prepare the chain for oiling, the leaf chain plates should be brushed with a stiff brush to clear the space between the plates so that oil may penetrate the live bearing area.

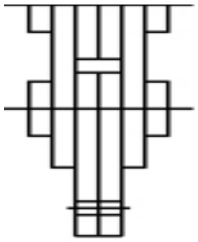
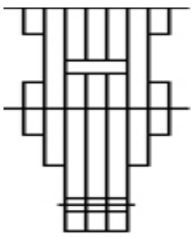
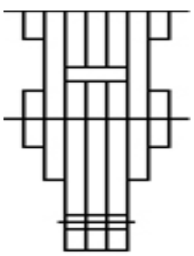
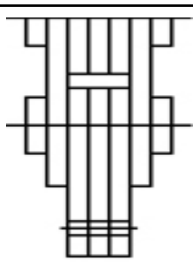
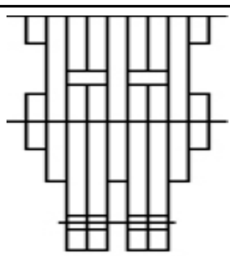
Oil may be applied with a narrow paint brush or directly poured on, but the chain should be well flooded to be sure the oil penetrates the joint.

In locations difficult to reach, it may be necessary to use a good quality oil under pressure such as an aerosol can or pump pressure spray.

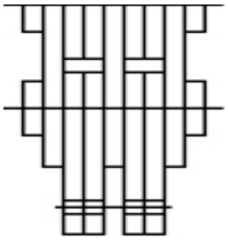
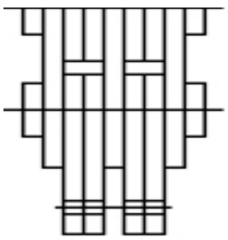
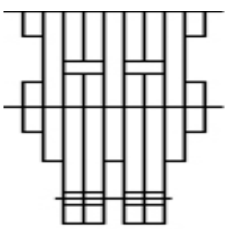
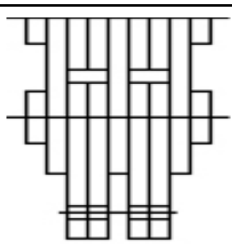
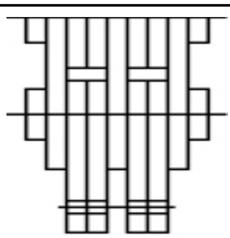


CLARK CHAIN & CABLE LUBRICANT
Part No.#886399

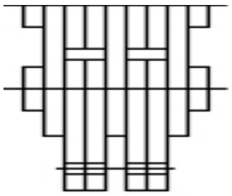
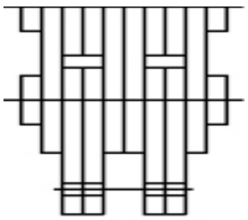
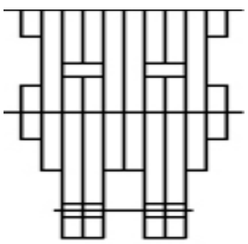
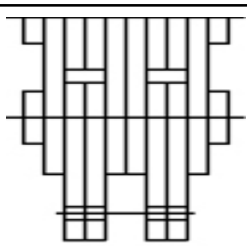
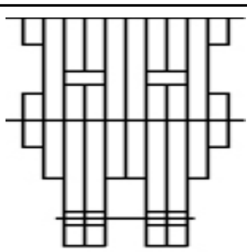
CLARK Leaf Chain

Pattern	CLARK Part Number	Length	Pitch
 2 X 2	BL822	As Req	1"
 2 X 3	BL623	As Req	3/4"
 2 X 3	BL823	As Req	1"
 2 X 3	BL1023	As Req	1 1/4"
 3 X 4	BL434	As Req	1/2"

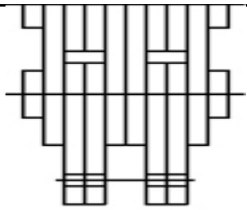
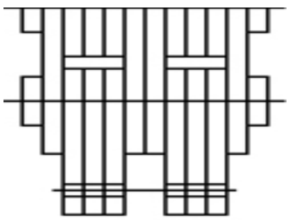
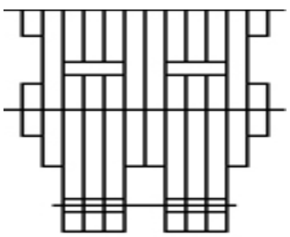
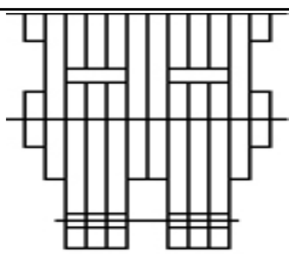
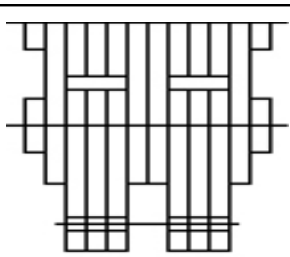
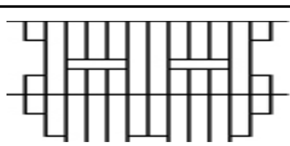
CLARK Leaf Chain

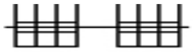
Pattern	CLARK Part Number	Length	Pitch
 3 X 4	BL534	As Req	5/8"
 3 X 4	BL634	As Req	3/4"
 3 X 4	BL834	As Req	1"
 3 X 4	BL1034	As Req	1 1/4"
 3 X 4	BL1434	As Req	1 3/4"

CLARK Leaf Chain

Pattern	CLARK Part Number	Length	Pitch
 3 X 4	BL1634	As Req	2"
 4 X 4	BL544	As Req	5/8"
 4 X 4	BL644	As Req	3/4"
 4 X 4	BL844	As Req	1"
 4 X 4	BL1044	As Req	1 1/4"

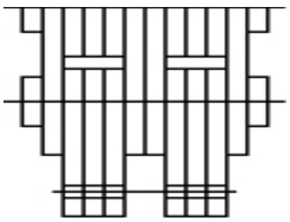
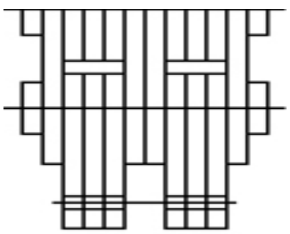
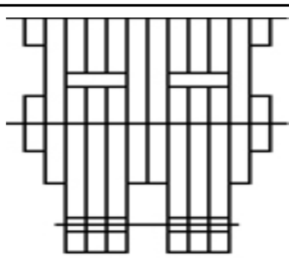
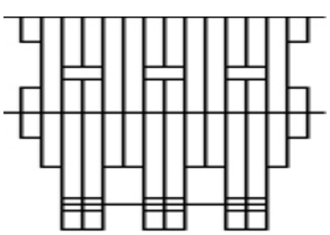
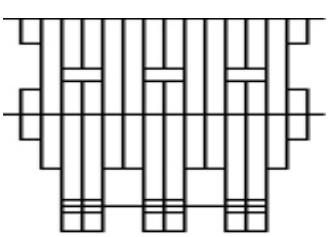
CLARK Leaf Chain

Pattern	CLARK Part Number	Length	Pitch
 4 X 4	BL1644	As Req	2"
 4 X 6	BL446	As Req	1/2"
 4 X 6	BL546	As Req	5/8"
 4 X 6	BL646	As Req	3/4"
 4 X 6	BL846	As Req	1"
	BL1046	As Req	1 1/4"

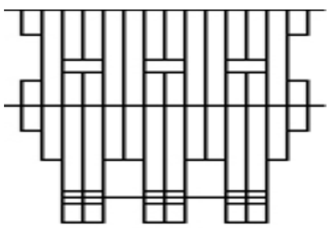
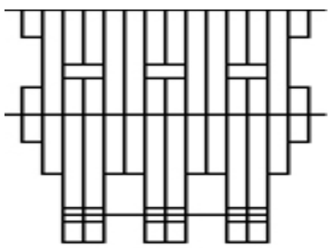
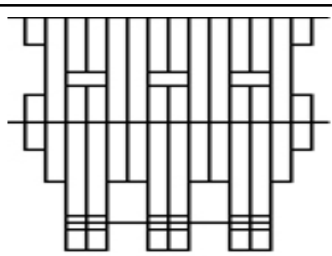
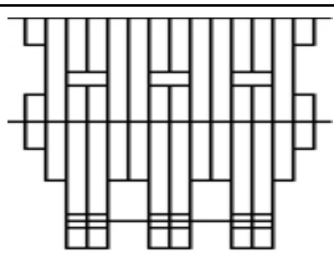
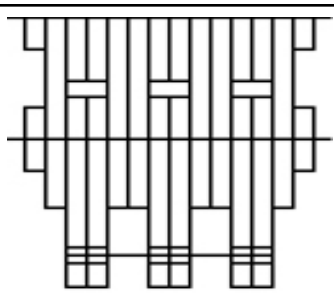


4 X 6

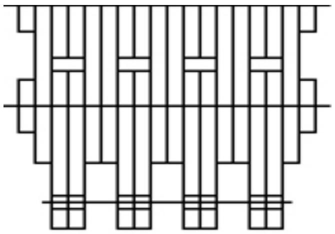
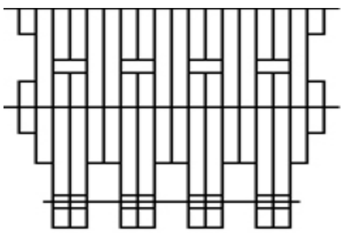
CLARK Leaf Chain

Pattern	CLARK Part Number	Length	Pitch
 4 X 6	BL1646	As Req	2"
 4 X 6	BL1246	As Req	1 1/2"
 4 X 6	BL1446	As Req	1 3/4"
 6 X 6	AL566	10 FT	1"
	AL1066	30 FT	1 1/4"
 6 X 6	BL566	As Req	5/8"

CLARK Leaf Chain

Pattern	CLARK Part Number	Length	Pitch
 6 X 6	BL666	As Req	3/4"
 6 X 6	BL866	As Req	1"
 6 X 6	BL1066	As Req	1 1/4"
 6 X 6	BL1266	As Req	1 1/2"
 6 X 6	BL1666	As Req	2"

CLARK Leaf Chain

Pattern	CLARK Part Number	Length	Pitch
 8 X 8	BL588	As Req	5/8"
 8 X 8	BL1688	As Req	2"

CLARK Roller Chain

CLARK Part Number	Length	Pitch
1822044	10"	1/4"
908723	15"	1/4"
1821912	Bulk	1/4"
908584	22.12"	3/8"
1821245	30"	3/8"
908634	40.87"	3/8"
908583	5.62"	3/8"
913195	Bulk	3/8"
915864	Bulk	3/8"
2794745	4.12"	3/8"
2794746	9.37"	3/8"
664145	10	3/8"
1701343	24.375"	3/8"
2780759	4.12"	3/8"
2782073	7.87"	3/8"
2780758	9.37"	3/8"
2753034	29"	1/2"
908643	47.5"	1/2"
614805	10	1/2"
1808073	10	1/2"
1737607	22.5"	1/2"
2750614	27.5"	1/2"
2760686	29"	1/2"
2753036	30"	1/2"
1782352	33.5"	1/2"
658100	10	1 1/4"
606942	10	1 1/4"
1804454	15	1 1/4"
606943	Bulk	1 1/4"
658101	10	1 1/2"
624227	Bulk	1 1/2"
658103	10	1 3/4"

690144	Bulk	1 3/4"

CLARK Roller Chain

CLARK Part Number	Length	Pitch
609934	10	5/8"
623962	10	5/8"
730941	10	3/4"
707092	10	69p
604745	10	3/4"
1804451	10	1"
1804452	15	1"

CLARK Rollerless Chain

CLARK Part Number	Length	Pitch
1802264	10	3/4"
1802265	15	3/4"
1802266	20	3/4"
1802267	25	3/4"
1803128	50	3/4"
1803129	100	3/4"
1802260	10	1"
1802261	15	1"
1802262	20	1"
1802263	25	1"
1803130	50	1"
1803131	100	1"
1802268	10	1 1/4"
1802269	15	1 1/4"
1802270	20	1 1/4"
1802271	25	1 1/4"
1803132	50	1 1/4"

1803133	100	1 1/4"