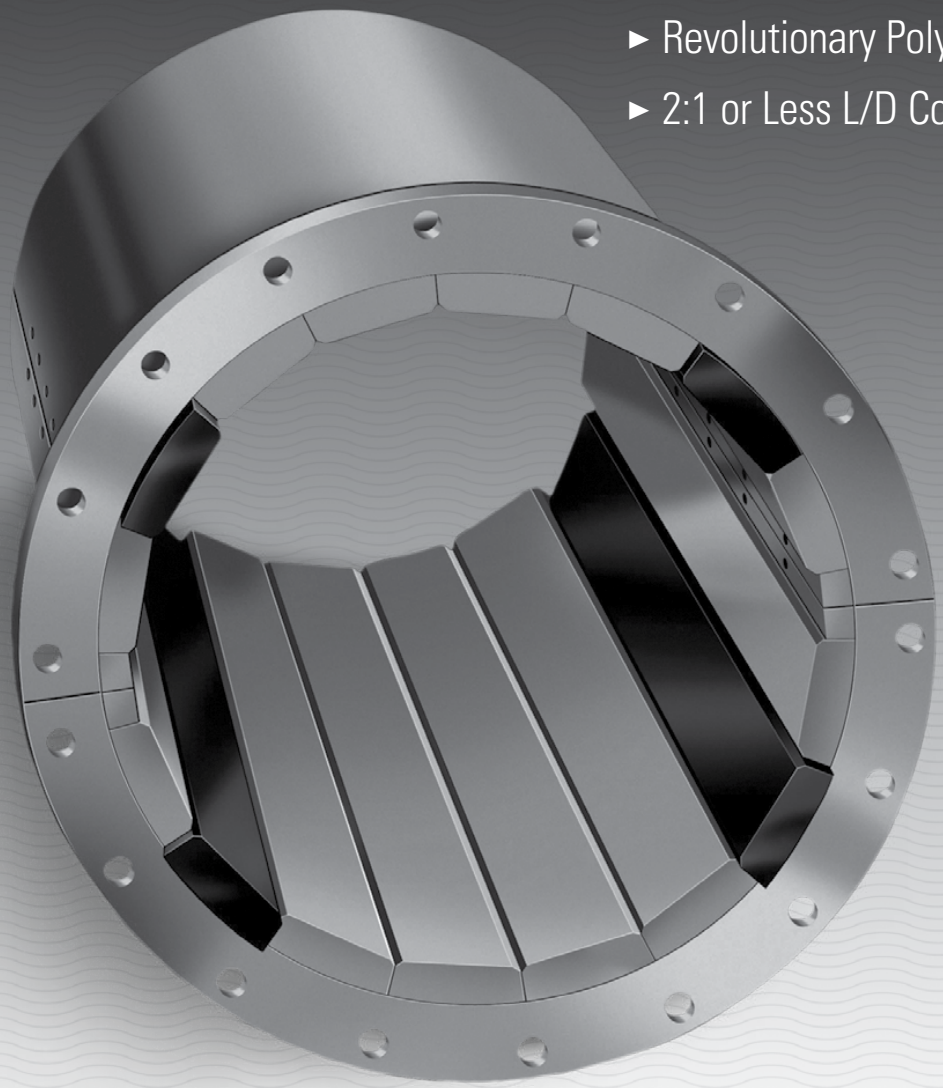
DURAMAX®

DMX® Locking Stave System

- Revolutionary Polymer Alloy
- 2:1 or Less L/D Configuration



BUREAU VERITAS

RINA

INSTALLATION GUIDE

Duramax Marine® is an ISO 9001:2015 Certified Company

DURAMAX MARINE®

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I. DURAMAX® DMX®-LSS BEARINGS WITH LOCKING STAVE BEARINGS

DESCRIPTION

DMX®-LSS Bearings with Locking Stave Bearings are made up of keystone-sided staves of DMX® material and molded rubber locking staves that, when fitted together in a housing, form a cylindrical bearing. The staves slide individually into place and can be removed without removing the shaft. When fully inserted, the "locking" rubber stave ends protrude a specified length from the housing. This is correct, do NOT cut the staves.

Once the staves are inserted, a compression head (split in two 180º segments) is bolted to the bearing housing (see Fig. 1). This compresses the staves, which thereby lock together to produce a tight fictional bond with the housing. Water grooves in the bearing provide an ample supply of lubricating water, and permit abrasive particles to exit the bearing minimizing wear and damage.

EXAMPLE SHOWN: Refer to project specific drawing for DMX/rubber stave configuration.

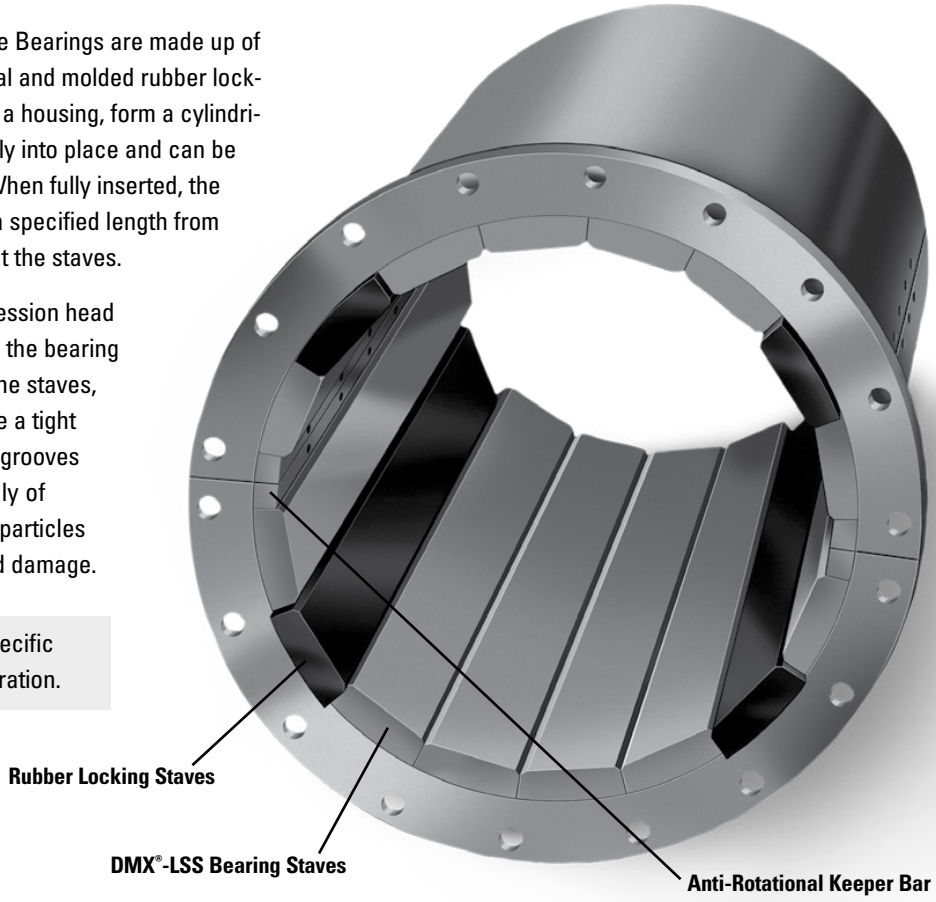
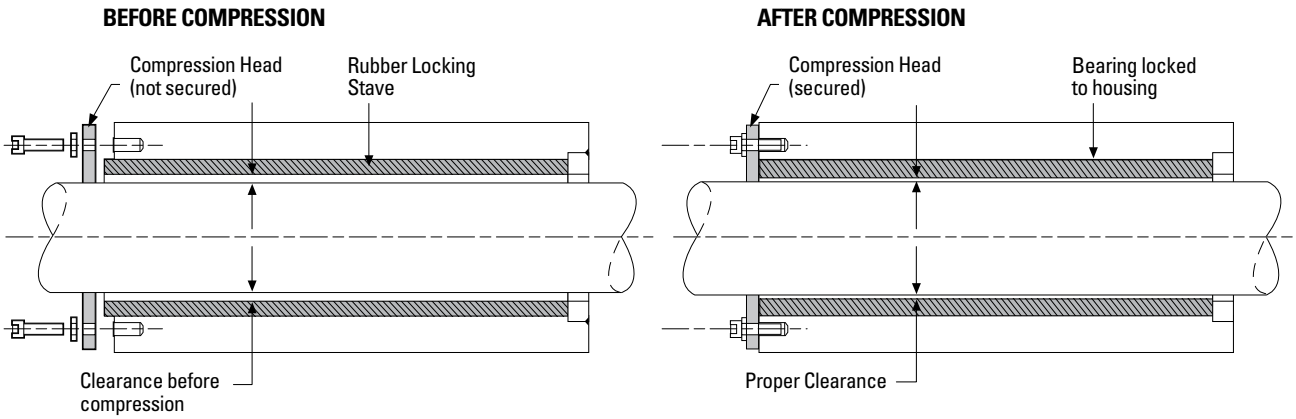


Fig. 1



NOTE: NEVER CUT STAVE LENGTH.
If there is any doubt consult your local agent / technical representative or manufacturer.

Only rubber locking staves will be longer than the housing. When compression head has been secured, rubber locking staves will expand axially to lock DMX® staves in place.

II. INSTALLATION PROCEDURE **WITH SHAFT REMOVED**

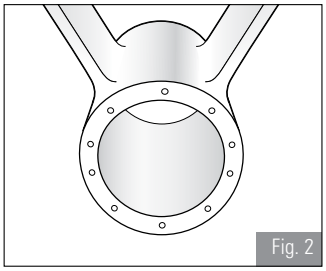


Fig. 2

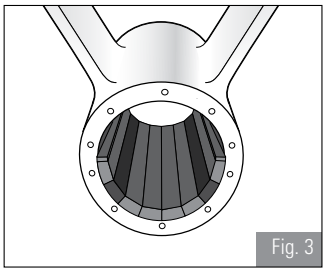


Fig. 3

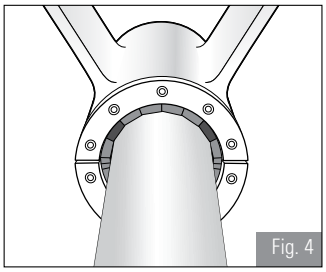


Fig. 4

1. Verify that all housing dimensions, especially inside diameter, inside length, and keeper bar are identical to drawing.
2. Clean housing properly (see Fig. 2).
3. Install anti-rotational keeper bar(s) if applicable.
4. Insert staves in lower half of housing per drawing starting with the bottom and working up to 9 and 3 o'clock positions (see Fig. 3). Place spacers (dummy shaft) in the bearing and insert staves in upper half of the housing. Insert plastic shims (supplied with bearings) between the rubber locking staves and spacers as needed. This will hold the rubber locking staves against the housing until bearing is secured (see Fig. 4).
5. Lubrication should not be necessary under normal circumstances. If a lubricant is used, ONLY lubricate the sides of the last stave, on either side of the anti-rotational keeper bars, before installation. Glycerine or a water soluble lubricant is acceptable.

   The last stave can be chilled in ice water or freezer to help facilitate installation. DO NOT USE DRY ICE.

   Use a wooden mallet or piece of wood and hammer for driving the last stave.

   You will notice that the rubber locking stave ends protrude from the housing. This is correct, do NOT cut the staves!
6. Install compression head halves, with socket head cap screws and lock washers and tighten them lightly. Tighten all screws in a torque pattern until the compression head is tight against the housing. Be sure all screws are tightened firmly.
7. Remove spacers and shims and using wooden mallet tap all staves to seat against housing inside diameter.
8. Measure and record the bearing inside diameter. Confirm dimensions against project specific drawing.
9. Check shaft journal dimensions in area of bearing.

   Diameters should be identical to Dimensional Data or specified propeller shaft drawing.
10. After all bearings are installed and correct dimensions are confirmed the propeller shaft can be installed (see Figs. 4).

    Clean the shaft properly and lubricate the shaft journals in place of forward and aft bearing. Also lubricate the running surface of the bearing. Glycerine is an acceptable lubricant. Move the shaft carefully forward into the stern, until it is in its place.
11. Jack the propeller shaft in multiple directions against the DMX®-LSS staves to obtain a positive seating, of the staves, against the housing internal diameter be protected from compression set. Compression set occurs when rubber sustains a prolonged concentrated load. Properly supporting the shaft during maintenance while in dry dock or winter storage, so that the rubber bearing faces are not compressed by the shaft, prevents this type of distortion.
12. Confirm proper over shaft clearance with feeler gauges.

III. REPLACEMENT PROCEDURE **WITH SHAFT IN PLACE**

1. Untighten socket head cap screws and remove compression head halves (see Fig. 5). Insert coarse threaded eyebolt or self-expanding bolt in the hole of one of the upper staves (either rubber locking or DMX®-LSS). Withdraw the first stave with the help of a pulley.

   After the first stave is removed the remaining staves can usually be withdrawn by hand.

2. Jack up the shaft and withdraw the lower half-staves.

3. Clean housing properly (see Fig. 6).

4. Insert staves in lower half of housing (per drawing) starting with the bottom and working up to 9 and 3 o'clock positions. Insert plastic shims (supplied with bearings) between the rubber locking staves and propeller shaft. This will hold rubber locking staves against the housing until bearing is secured (see Fig. 7).

5. Lubrication should not be necessary under normal circumstances. If a lubricant is used, ONLY lubricate the sides of the last stave before installation. Glycerine or a water soluble lubricant is acceptable.

   Use a wooden mallet or piece of wood and hammer for driving the last stave.

   You will notice that the rubber locking stave ends protrude from the housing. This is correct, do NOT cut the staves!

6. Lower the propeller shaft onto the bearing and repeat steps 4 and 5 for upper half of bearing.

7. Raise propeller shaft until it is centered inside the bearing (no load is on bearing staves). Install compression head halves, with socket head cap screws and spring washers and tighten them lightly. Tighten all screws in a torque pattern until the compression head is tight against the housing.

   Be sure all screws are tightened firmly (see Fig. 8).

8. Jack up the shaft, in multiple directions, against the bearing staves to obtain a positive setting against housing.

9. Remove shims and lower propeller shaft onto bearing.

10. Measure and record clearance between shaft journal and bearing staves.

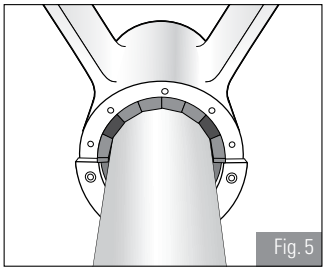


Fig. 5

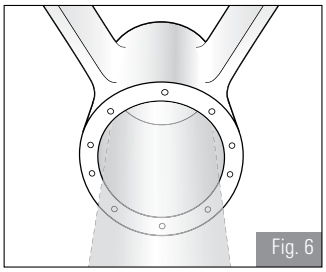


Fig. 6

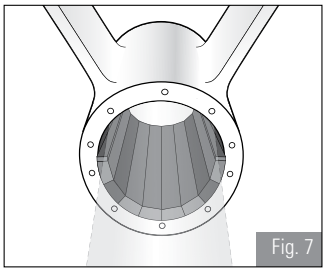


Fig. 7

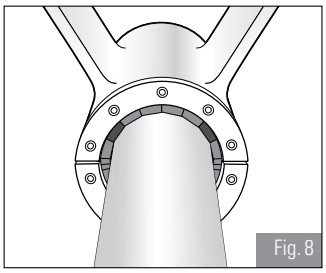


Fig. 8

IV. TOOLING AND LUBRICANT

TOOLING

1. **For mounting and dismantling compression head:**

   Use an appropriate hex key, extended with a pipe for leverage, to initially break free, if necessary.

2. **For driving in staves:**

   Use a wooden mallet or a piece of wood (to protect staves from damage) and sledgehammer.

3. **For holding rubber locking staves to housing before compression:**

   Use plastic spacers provided with bearings.

4. **For withdrawing staves:**

   Use a M24 coarse threaded "eye" bolt or a 19 mm self-expanding bolt (yard supply) with a pulley (yard supply) to withdraw the first stave of each bearing set.

5. **For installing staves (to support upper half staves aft bearing):**

   Use a wooden dummy (yard supply) with outside diameter of the propeller shaft journal + 000 or minus 7 mm and the length of approximately 2/3 bearing length to hold staves in place until last stave is driven in.

LUBRICANT

1. Use a water soluble soap that is environmentally acceptable.
2. It should not contain acids, ammonia, chlorine or any other harmful additive.
3. Glycerine can be used as a lubricant.
   NEVER use oil or grease as lubricant.

NOTE: Lubricate the running surface of the staves only and also the sides of the last stave.

NEVER lubricate the back of the staves or the housing, it will reduce the frictional bonding between staves and housing.

V. STORAGE OF BEARING

To assure extended shelf life, the bearing should be protected from compression set, age hardening and extensive heat or cold during storage.

Compression set occurs when the bearing must sustain a prolonged concentrated load.

Age hardening results from degradation of the rubber by environmental forces and pollutants.

DMX®-LSS Bearings with Locking Stave Bearings can be stored for at least 10 years as long as the following precaution is taken into account.

a. The bearing should be stored in its original box.

b. At moderate temperature between 1º and 32ºC.

c. Away from high voltage electrical equipment.

d. Away from ozone producing sources. Protect from exposure to ultra-violet light (including sunlight and fluorescent lights).

VI. INSPECTION (with shaft in place)

1. Measure the clearance between shaft journal and bearing, with feeler gauges and record. The wear of bearing + shaft journal can be found by subtraction of the original running clearance.
2. For visual inspection of the bearing follow the replacement procedure section III.
3. Measure the wear of bearing + shaft journal with the wear down gauge and record.
4. The running clearance can be found by adding the original running clearance.

VII. MAXIMUM WEAR

This is the clearance, measured with feeler gauges, between shaft or sleeve journal and bearing. A micrometer also can be used if the propeller shaft is withdrawn.

It includes both bearing and journal wear. Although the inside diameter of the compression head and the depth of the water grooves in the bearing will allow more wear, we advise not to exceed the maximum wear.

Excessive wear can cause too much shaft deflection, and as a consequence, damage of seals and shaftline bearings.

The advised maximum wear values relate to the water lubricated bearings only. They do not take into account any requirements of the seal manufacturer.

STERN TUBE AND STRUT WATER-LUBRICATED BEARING CLEARANCES*

A DIAMETER OF JOURNAL		**B** MINIMUM OPERATING CLEARANCE OF BEARINGS		**C** TOTAL CLEARANCE AT WHICH BEARING SHOULD BE RENEWED	
INCH	MM	INCH	MM	INCH	MM
1.0	25	0.015	0.380	0.070	1.780
1.5	38	0.016	0.410	0.081	2.060
2.0	51	0.017	0.430	0.091	2.310
2.5	64	0.018	0.460	0.100	2.540
3.0	76	0.020	0.510	0.107	2.720
4.0	102	0.022	0.560	0.120	3.050
5.0	127	0.025	0.640	0.131	3.330
6.0	152	0.027	0.690	0.142	3.610
7.0	178	0.030	0.760	0.153	3.890
8.0	203	0.032	0.810	0.164	4.170
9.0	229	0.032	0.810	0.175	4.450
10.0	254	0.037	0.940	0.185	4.700
11.0	279	0.040	1.020	0.195	4.950
12.0	305	0.042	1.070	0.206	5.230
13.0	330	0.045	1.140	0.216	5.490
14.0	356	0.047	1.190	0.226	5.740
15.0	381	0.050	1.270	0.235	5.970
16.0	406	0.052	1.320	0.244	6.200
17.0	432	0.055	1.400	0.253	6.430
18.0	457	0.057	1.450	0.261	6.630
19.0	483	0.060	1.520	0.269	6.830
20.0	508	0.062	1.570	0.275	6.990
21.0	533	0.065	1.650	0.281	7.140
22.0	559	0.067	1.700	0.286	7.260
23.0	584	0.070	1.780	0.290	7.370
24.0	610	0.072	1.830	0.294	7.470
25.0	635	0.075	1.910	0.297	7.540
26.0	660	0.077	1.960	0.300	7.620
27.0	686	0.080	2.030	0.303	7.700
28.0	711	0.082	2.080	0.306	7.770

*Above information provided for reference. Customer preference or vessel particular conditions take precedence. Renewal clearances may exceed above values.

VIII. INITIAL OPERATION & MAINTENANCE OF BEARING

Due the very low wear characteristic of DMX®-LSS the bearing will not fully break in until approximately 700 hours of propeller shaft operation. This is not cause for concern as the starting friction with a new bearing is already very low.

We recommend the following break-in and initial quay side testing protocol.

1. When the ship is laying idle (through the life of the ship and most especially during construction) rotate the propeller shafts at least 450 degrees (5/4 rotation) a minimum of 1 time per week. This will keep the bearing clean from biological fouling and prevent the shaft from sticking to the bearing.
2. Before initial quay test a diver should be sent to inspect and clean the bearing. It should be assured that there are no water flow obstructions at both sides of the bearing.
3. During initial quay testing and bearing break-in the bearings should be force lubricated.
4. Rotate the propeller shafts at 30 rpm with forced lubrication for 30 minutes. Stop the propeller shaft and let it rest for 30 minutes. Repeat this cycle of 30 minutes rotating and 30 minutes at rest for at least 8 cycles. We understand that during quay testing a minimum rpm is used for safety purposes while moored. If higher rpm can be used for this breaking in, please do so.
5. Propeller shaft torque should be monitored during quay side testing and appropriate actions taken to prevent damage.

The above protocol is subject to change depending on specific details of quay side testing protocol.

DMX® application - D650 French Fremm

DMX® application - dredge Taurus

DMX® application - USN Hayes

DMX® application - Flovel India hydro turbine main guide bearing

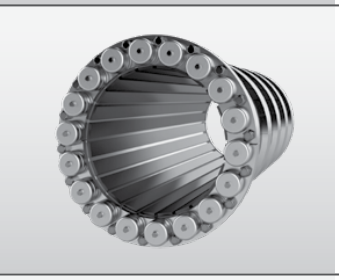
Notes

INNOVATION.
EXPERIENCE.
RESULTS.

Duramax Marine® is committed to providing excellence in every product we manufacture. Our Johnson Cutless® marine and industrial bearings, heat exchangers, impact protection systems and sealing systems are known worldwide for their engineered quality and dependable performance. Please contact the factory for information on any of the following Duramax Marine® products:

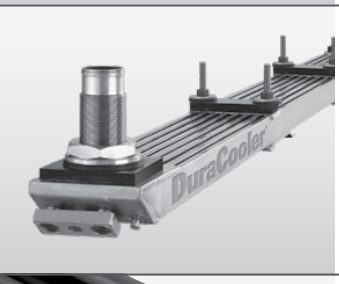
JOHNSON CUTLESS® WATER-LUBRICATED BEARING SYSTEMS

Johnson Cutless® Sleeve and Flanged Bearings



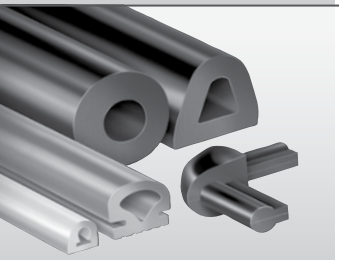
DURAMAX® ADVANCED WATER-LUBRICATED BEARING SYSTEMS

Johnson® Demountable Stave Bearings
ROMOR®I Stave Bearings and Segmental Housings
ROMOR® C- Partial Arc Bearings
DMX® Polymer Alloy Bearings
DuraBlue® Bearings, Rudder & Pintle Bushings, Thrust Washers, and Wear Pads
Industrial Pump Bearing Systems



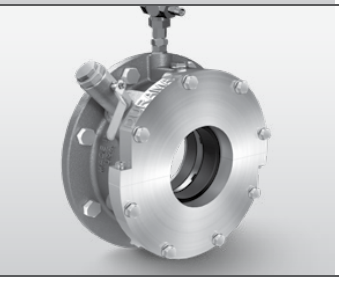
DURAMAX® HEAT EXCHANGE SYSTEMS

DuraCooler® Keel Coolers
Duramax® Demountable Keel Coolers
Duramax® BoxCoolers



DURAMAX® IMPACT PROTECTION SYSTEMS

Johnson® Commercial Dock Bumpers, Fenders & Tow Knees
LINERITE® Composite Batterboard Systems



DURAMAX® SHAFT SEALING SYSTEMS

DryMax® Shaft Seal
Duramax® Mechanical Shaft Seal
Johnson® Heavy-Duty Air Seal Stuffing Boxes
Duramax® Ultra-X® High Performance Compression Packing

17990 Great Lakes Parkway
Hiram, Ohio 44234 U.S.A.
PHONE 440.834.5400
FAX 440.834.4950
info@DuramaxMarine.com
www.DuramaxMarine.com

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