WELDING PROCEDURE

SPECIFICATION

NO.: RSRPS007

FOR

52K DWT BULK CARRIER

Rudder Stock Repair Procedure

I. Rudder Repair Procedure Specification (RPS)

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Rudder Stock Repair Procedure Specification (RSRPS) ***No. RBRPS 007***

Key way of Rudder Stock and Tiller Damage:

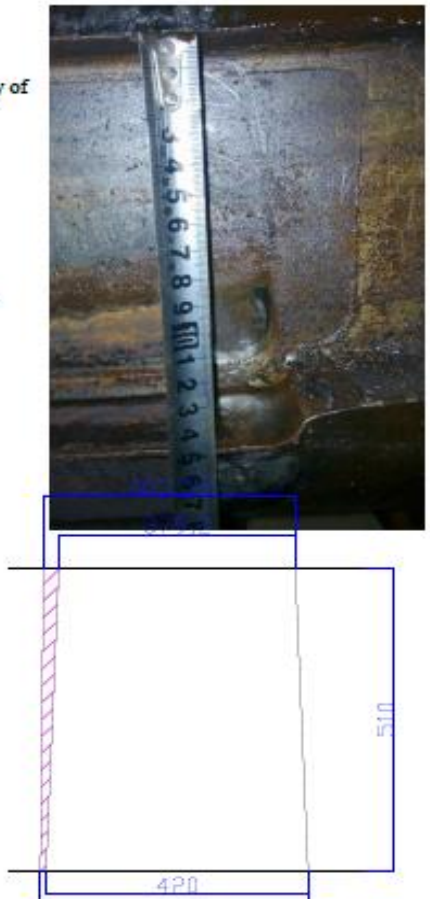
When dismantled the tiller from rudder stock, we noticed the key way of rudder stock and tiller are damaged as per picture indicated.

As per measurement, for each 100mm intervals, the readings are:

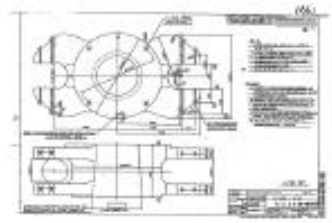
Tiller: 138.5, 137.8, 138.3 138.9, 136;

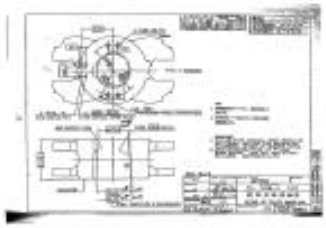
Rudder Stock: 143, 142.4, 144, 149, 136;

These readings are complied with the ruler on the picture 1 indicated.



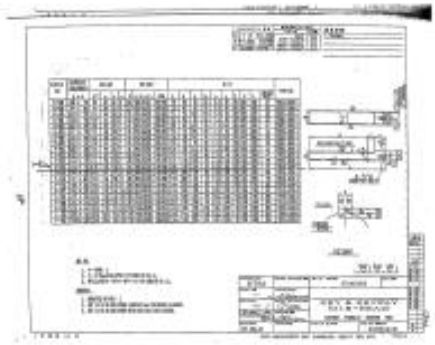
As per sketch, Tiller's Keyway shall be oneside is 1:12.5 taper, and another side shall be 1:100 Inclination.





The Key:

The Material of key is SF590A forging steel, which equals to Chinese standard 45# steel. We arrange forging the same material for the new key. The angle, radius and surface tolerance shall be fulfill maker's requirement as per sketch.



NDT test: no find any cracks on the rudder surface, as well as tiller surface.

Alignment of Rudder Stock:
When rudder stock aligned at lathe machine, and centering with screw hole, we have following readings:

Upper Pintle Bearing FWD	Upper Pintle Bearing	Tiller Bearing	Thrust	Tiller Cone FWD	Tiller Cone End
0	0	0	0	0	0
0.05	0.17	0.66	1.45	2.8	4
0.02	0.24	0.88	1.6	1.07	1.45
0.04	0.18	0.07	0.4	0.5	0.8

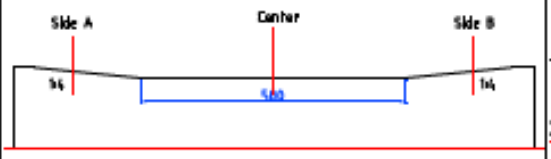
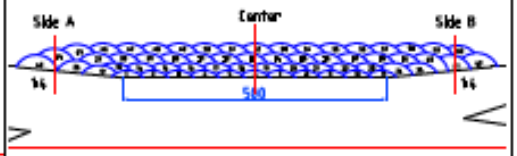
Further to picture of the keyway on rudder stock:

From above picture, we can obviously noticed the keyway seriously deformed. And the readings of the alignment on rudder stock is also confirmed the twisting of keyway.
Since the keyway twisted, then the screw hole on top rudder stock is also changed centering position. Even though we may delete the misalignment due to this centering hole, we assume the actually misalignment of the tiller cone area is about 2.8mm. In this case, the only repair method is welding. We prepared our welding procedure as bellowing:

Annealing:
In order to release stress inside the rudder stock, especially cone area, the first step is annealing treatment. We will use computerized type high frequency heating equipment with heating speed control function to control the heating process. Normally we control the heating speed is 50oC/hour which will not input too much heating energy to cause rudder stock deformation.
Same cooling speed at 50oC/hour will be applied to the cooling space as well.

Welding:
After annealing treatment, we will weld 5mm at each single side of the rudder stock, then machining.

Joint preparation details (Sketch 1):

Joint design	Welding sequences
	

Base Metal

Material Specification:	Forged Steel 35#
Diameter:	500 mm

Filler Metal:

Welding Material Standard:	GB/T8110-2008
Brand of welding rod:	Tianjin Jinqiao
Specification:	ER 50-6
Welding wire diameter:	1.2 mm
Joint Type:	Build-up Welding
Direction:	Flat

Preheat

Preheating Temperature (°C)	125 - 200
Interpass Temperature (°C)	150 - 200

Gas

	Percent Composition		
	Gas	Mixture	Flow Rate
Shield	CO2	99.9%	20-25 L/min
Trailing	N/A	N/A	N/A
Backing	N/A	N/A	N/A

Welding details:

Run	Process	Size of filler metal	Current [A]	Voltage [V]	Type of current/polarity	Wire speed [m/min]	Travel speed* [cm/min]
1	*131(MIG)*	*Φ1.2*	*140~200*		*DC-RP*	*7~9*	*35~55*
2	*131(MIG)*	*Φ1.2*	*140~200*		*DC-RP*	*7~9*	*35~55*
3	*131(MIG)*	*Φ1.2*	*140~200*		*DC-RP*	*7~9*	*35~55*
4	*131(MIG)*	*Φ1.2*	*140~200*		*DC-RP*	*7~9*	*35~55*
5	*131(MIG)*	*Φ1.2*	*140~200*		*DC-RP*	*7~9*	*35~55*
6	*131(MIG)*	*Φ1.2*	*140~200*		*DC-RP*	*7~9*	*35~55*
7	*131(MIG)*	*Φ1.2*	*140~200*		*DC-RP*	*7~9*	*35~55*
8	*131(MIG)*	*Φ1.2*	*140~200*		*DC-RP*	*7~9*	*35~55*
9	*131(MIG)*	*Φ1.2*	*140~200*		*DC-RP*	*7~9*	*35~55*
N	*131(MIG)*	*Φ1.2*	*140~200*		*DC-RP*	*7~9*	*35~55*

Filler Metal Classification:

Brand name:	*MG50-6*	**Preheating temperature:**	125 - 200 °C
Manufacturer:	Golden Bridge	**Interpass temperature:**	*150 - 200°C*
Wire Diameter:	1.2mm	**Gouging/backing:**	*gg*
Gas / flux:		**Post-weld heat treatment:**	200- *250°C*
Shielding:	CO2	**Straightening Temperature:**	
Backing:		**Heating and cooling rate:**	*50 °C/h*

Machining:

Normally as per class's rules, we shall fill up of existing keyway, then make new keyway at 180o opposite position. In order to save time, we will repair the existing keyway by welding, then milling as per request. Since new rudder stock will be bigger, then we may consider to skimming on tiller inner surface to reach a good surface result, then skimming of rudder stock into the same tapping and same size to fulfill blue marking test.