

Yaw Brake Retrofit for Mitsubishi MWT-1000A Turbines

Purpose:

- Eliminate oil leakage from seals (internal passage >> oil bottles)
- Reduce noise during yaw operation (improved pad material)
- Reduce brake pad movement during operation (improved pad material fit)
- Reduce cost for overall maintenance (less downtime)
- Offer a simple and rigid upgrade (increase uptime)
- Increase safety and efficiency during service (use of lifting tool)

The Svendborg Brakes upgrade is a “drop-in” yaw brake system replacement using our BSAB 90 brake. This brake design offers several critical technical advantages and has been installed in a Mitsubishi MWT-1000A in Japan since 2016. The results from the upgrade after >12 months of testing (still running) exceed customer expectations.

Below is a short comparison between the existing and new yaw brake system.

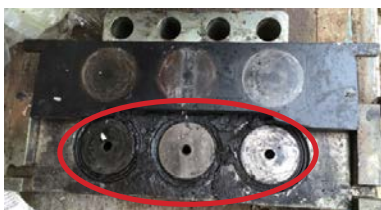
ORIGINAL - 4x Akebono Brakes

- Mounting
 - Large spacer between the caliper halves installed
 - M27 mounting bolts
 - Each caliper half included 3x 75mm diameter pistons
 - Brake mounted to machine frame through block



Fig 1: Assembly inside Nacelle before retrofit.

- Seal system
 - Material unknown
 - Internal seals are placed single layer on each cylinder (Dust boots not included)



UPGRADE - 4x Svendborg Brakes

- Mounting
 - Large spacer between brake halves eliminated. Replaced with thin spacer between brake and machine frame (due to body height difference)
 - M27 mounting bolts with same bolt pattern (additional washer used for 0.5mm high tension assembly)
 - Each caliper half included 2x 90mm diameter pistons
 - Brake mounted to machine frame through existing block



Fig 2: Assembly inside Nacelle after retrofit

- Seal system proven on thousands of turbines
 - High wear resistant seal material
 - Advanced seal compression for better
 - Low pressure performance
 - Internal seals are placed as double layers on each cylinder (Upper seals function as dust boots)

- Tubing
 - Existing rubber tubing includes a short hose between the caliper halves. Periodical replacement is necessary due to deterioration
 - Leaking oil cannot be observed before actual leakage from piston. Thus, observing deterioration of damaged seals is not possible without overhauling. The oil reservoir is fixed under the caliper.
- Poor oil leak detection:

Bulky, open drip tray for capturing oil from leaking seals. Exposes brake disc, pads and environment considerably to oil contamination.



- Friction material options for yaw pads
 - Unknown material composition
 - Pad type : NS238H
 - Prone to hardened dust material build-up causing reduced friction/increased slip and increased noise.

- Tubing
 - Maintenance free Steel tubing between both caliper halves
 - Any potential oil leakage from piston seal is collected into container bottle through internal passage. Allows early detection of seal failure and proactive maintenance (less downtime).
- Advanced oil leak detection:

The 2-seal design captures any leaking oil in the drain bottle, allowing for visual leakage detection, and prevents oil contamination of brake disc and pads.



- Friction material options for yaw pads
 - Standard pad: PSAS Features: friction level up to 0.45



Noise optimized pads: SB1002 Features: friction up to 0.4 with improved noise performance



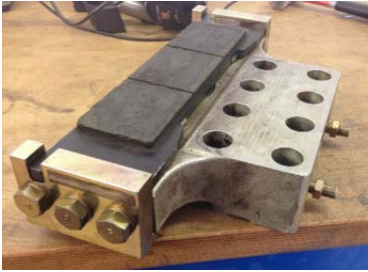
Noise optimized pads: SB1003 Features: friction up to 0.43 with improved noise performance



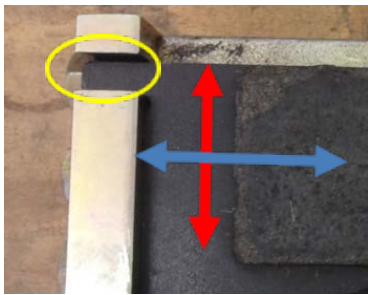
Our recommendable pad is SB1002. Our pads do not contain banned/dangerous materials, e.g. asbestos, as well as copper materials. It has a long life duty.

TECHNICAL BULLETIN | Yaw Brake Retrofit for Mitsubishi MWT-1000A Turbines

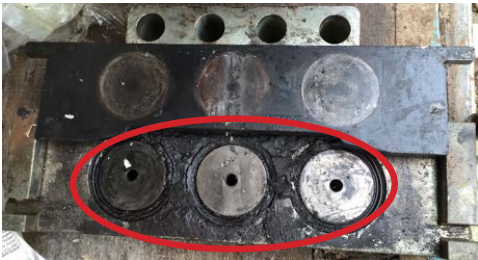
- Pad assembly done with removable pad holder (increase of parts quantity and possible bolts or pad nails damages)



- Radial direction (red arrow) only held by small form fit notch



- Consequence of weak pad guidance:
More wear and tear on all pads, pistons, pad holders, resulting in external seal leakage



- Simple and rigid pad pocket design for tight fitted pads



- Pad is guided and held all around the edges. Ideal guidance in radial and tangential direction



- Advantage of strong pad guidance and tight fit:
Less brake pad impact on piston resulting in long life of seals and pistons. 5 years life is realistic sometimes even 10 years.

Summary of Advantages with Svendborg Brakes UPGRADE

- Initial supply from MHI
- Improved piston seal system
- Improved steel tubing between caliper halves
- Advanced oil leak detection system
- Reduced pad noise
- Increase pad performance (less slippage)
- Improved Pad guidance
- No large spacer needed
- Robust, proven and simplified yaw brake design
- Better service and parts availability for aftermarket
- Less downtime

Disadvantages

- Leakage problems
 - No advanced oil leak detection system
 - Pad noise and slippage
 - Increased downtime
 - High cost for after market parts
 - Long lead times
 - Limited support
- Not originally supplied by MHI
(However, vital spare parts are stocked in Denver)

Lifting Tool for Retrofit

Japanese made calipers being pre-checked for unloading work using lifting tool LBS90



Lifting tool Model LBS90 in action on service for removal and installation of BSAB 90 calipers. Increasing Safety significantly while reducing working time up to 50% (incl. number of workers).



Newly developed lifting tool:

Highly efficient tool which can handle both removal and installation of Akebono brakes and Svendborg BSAB 90 brakes.

