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**Some defects on Boilers**

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**نواقص موجود در بویلرها**

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**All respectful ICS surveyors**

With gratitude, respectfully,

Boilers are divided into two groups:

1) Water tube boilers
2) Fire tube boilers

Kindly as you know this item is also one of the most important Items for surveying. This technical information has been illuminated the normal damages/ defects on boilers. This technical information has been prepared and is being sent hereby.

The document related to the above mentioned subject and also the supplementary attachments are accessible through the following address on ICS Network (ICS-WAN):

*\\server\ICS Organization\Convention and LegislationDepartment\Publication/tech/2015/04*

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با سلام و احترام

از آنجائیکه بویلر در شناورهای مختلف به دو دسته Water Tube BLR و Fire Tube BLR تقسیم می شوند و همچنین جزو آیتمهای مهم بازرسی نیز می باشد، این اطلاعیه فنی در خصوص پاره ای از مشکلات و نواقص مطرح و موجود در بویلر، حضورتان ارسال می گردد.

این اطلاعیه فنی به انضمام پیوست‌های تکمیلی آن در بخش CLD از شبکه داخلی موسسه با آدرس ذیل قابل دسترسی می‌باشد.

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**موسسه رده بندی ایرانیان**

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## 1- GENERAL:

Besides being prominent elements for facilitating intended heat transfer, boiler tubes are an integral part for retaining pressure integrity in boilers. Their nature of service and exposure to thermal loads and corrosive environments create a demanding operational profile for the tubes to sustain their intended life period.

Defective tubes induce an imminent risk of the consequential loss of energy, exhaust gas and composite boilers, while they may interfere with auxiliary and/ or cargo-handling functions in oil-fired auxiliary boilers. The most preferable and/or instinctive repair method undertaken by operators is the plugging of tubes to arrest leaks and restore the boiler's integrity.

## 2- COMMON CAUSES OF LEAKS:

■ Active local pitting corrosion from the water side.

■ Cold corrosion from the exhaust-gas side (operation at reduced loads).

■ Overheating due to deposits, oil, scales, high firing rates, low water level and flame impingement.

■ Poor workmanship at terminations (expanding, seal welding, root pass corrosion)

■ Soot fires on fin/pin type water tube EGBs (soot deposits + poor circulation of water)

■ Stress corrosion cracking near weld zones with high residual stresses (butt welds).

## 3- IMPACT OF PLUGGED TUBES ON BOILERS:

### A- WATER TUBE BOILERS:

■ **Natural circulation:**

This is mostly applicable to oil-fired water tube type boilers which rely on internal natural circulation of water for effective heat transfer and to maintain the material temperature within acceptable limits. Plugged water tubes interfere with the natural circulation to various degrees, depending on their number and orientation in the boiler.

For instance, the same number of plugged tubes could have a different impact when closely located on one part of the steam/water drum adjacent to the furnace than when scattered in different locations inside the same drums. This makes objective evaluation imperative prior to commenting on the number of defective tubes which may be accepted for repairs by plugging. Thicker pressure parts, ie drums, in close vicinity to furnaces also depend on circulation in tubes for maintaining acceptable temperatures. The plugging of multiple adjacent tubes in this area can become detrimental if not evaluated. One of the most effective mitigating actions for compensating the lost natural circulation involves derating the firing rate.

The subjected image is in next page

Excessive local plugging in steam drum

- **Consequential "burn out" damage:**

Plugged and uncooled water tubes left within close proximity of the furnace have a high probability of "burn out", ie overheating and melting leading to consequential damage to the furnace wall and adjacent pressure parts. This requires additional evaluation and consideration to mitigate similar risks, including additional protection by boiler refractory material.

- **Soot fires on water tube exhaust gas boilers:**

Plugged tube banks on water tube exhaust gas boilers and economisers with extended heating surfaces (fins, pins etc.) remain uncooled and have a higher risk of initiating soot fires if deposits accumulate.
Slow steaming is also an important factor to be considered in this regard. The local smoldering of soot involves a high heat intensity that is capable of melting the uncooled metal besides possibly adversely affecting adjacent tube banks and the exhaust gas flow. In the worst case, should it cause a leak in adjacent tubes, the risk of hydrogen fires co-exists. Mitigating actions to rule out the above risks are deemed required if the plugged tube banks are not removed from the boiler. Similar risk on economisers installed in main propulsion boilers also requires careful consideration although the flue gas Oxygen content is comparatively lower in boiler uptakes than in turbocharged diesel engine uptakes.

Exhaust gas boiler soot fire: melted uncooled fin tube elements

## B- SMOKE TUBE BOILERS:

- **Exhaust gas back pressure:**

Plugged tubes reduce the effective area for exhaust gas flow besides increasing the gas velocity (thermal loads) through the remaining tubes if the load remains unchanged. The impact of increased exhaust gas back pressure in the furnace in the case of oil-fired boilers and in main engine turbochargers in the case of exhaust gas boilers is evaluated to discover probable adverse effects.

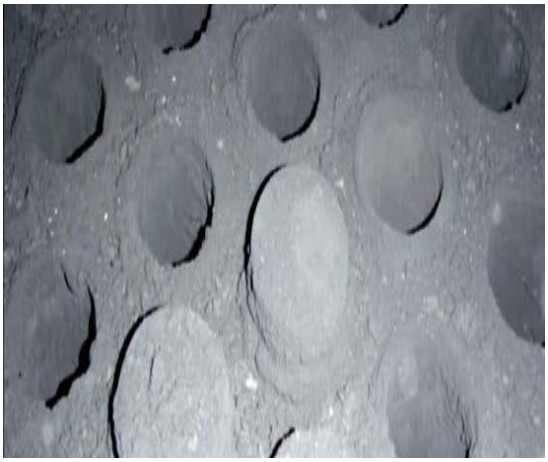
## 4- COMMON FACTORS RELATING TO BOILERS:

- **Compensatory thermal loads:**

Plugged tubes put additional heat loads on the remaining tubes if the same evaporation rate is maintained in oil-fired boilers. The reduction in the heat transfer area is compensated by a higher heat transfer rate (firing rate), i.e. temperature gradient on the remaining tubes and active heat transfer surfaces.

■ **Mechanism behind the defects:**

Defective tubes reveal prospective mechanisms prevailing in the boiler which might have an adverse impact on other tubes and pressure parts. The boiler's condition is evaluated to the best possible extent prior to commenting on repair proposals. Besides a visual inspection, NDT, hardness and hydrostatic pressure tests and thickness mapping of tubes and other pressure parts form additional means of assessing the condition. In addition to all leaks in propulsion boilers, leaks are also critical in exhaust gas boilers, where leaking tubes in the uptake can lead to the immediate disruption of main propulsion functions. Inferior boiler water management, poor heat transfer (scales, oil contamination, etc.), burner malfunction, cold corrosion, etc., are common underlying mechanisms exposed by defective tubes.



Eroded tube terminations adjacent to plugged tubes

■ **Steam generation:**

The remaining steam generation capacity affecting the safe operation of the vessel is also evaluated if applicable, although problems in this regard are rarely encountered.

## 5- CONCLUDING REMARKS:

The plugging of tubes requires prudent control and evaluation of the local and global features of the boilers and associated propulsion plants. Overlooking these factors leads to the risk of chronic and consequential damage and to time-consuming and expensive repairs in due course. Mitigating actions after evaluation may include but are not limited to reducing the firing rate/engine load and derating the pressure as applicable if proposals for repairs by plugging are eventually considered for temporary/permanent acceptance.