



SAFETY ASSESSMENT
FEDERATION

Guidance

In-Service Inspection Procedures

NDT of Rivet Heads

REFERENCE: NDTC 04

ISSUE: 01

DATE: 25/03/2022

DOCUMENT INFORMATION:

REFERENCE:	NDTC 04
ISSUE:	01
DATE:	25/03/2021
PREPARED BY:	NDT Committee (TC5)
APPROVED BY:	TC 1 and TSC

DOCUMENT HISTORY RECORD:

ISSUE:	DATE:	CHANGE DETAIL:
01	25/03/2021	Initial Document

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SITUATION

The following guidance document has been produced to be utilised by the owner/user, the Competent Person (along with their own procedures) and the NDT practitioner when flaw detection of rivets is requested. The reason to carry out NDT is to detect cracking in the shank of the rivets where this is specified by the Competent Person.

The Management of Steam Locomotive Boilers, Railway safety publication 6 from the Office of Rail Regulation states: -

“31 - On completion of the examination under steam pressure, the boiler should be drained and the firebox stays tested either by traditional hammer testing, or by any other suitable non-destructive test not involving the excessive grinding of rivet or stay ends if: (a) the boiler is new or fresh from major repair; (b) repairs have been carried out necessitating a full hydraulic pressure test; (c) a boiler is brought back into use after having been laid up for a period in excess of one year.

“As stated, the cumulative strength of each rivet must be considered in its own right as it is the combined strength of each rivet that maintains the overall strength of the joint. Each failed rivet can be compared to an individual weld defect. Whilst an individual rivet failure may not be catastrophic, a number of rivet failures in the same location will significantly weaken a joint which may in turn lead to movement within the seam overlap region resulting in ligament cracking.

“The ligament cracking is an additional failure mechanism to consider but does not involve flush grinding so can be excluded from this discussion. Get enough failed rivets and either or both mechanisms will apply with resultant consequences.”

Specific guidance may vary as to the requirement for pre-inspection preparation dependent upon the shape of the rivet head (where the ultrasonic probe is to be seated) and the acoustic properties of the rivet material.

The application of a hammer test regime by the Competent Person (with sufficient experience) is acceptable, however, this may be supplemented/replaced by ultrasonic testing.

The periodicity, location and percentage of rivets to be examined will also be dependent upon whether the pressure vessel is an air receiver, a steam receiver or a locomotive type of boiler.

This procedure is not to be utilised as a standalone inspection technique and will be requested as part of a suite of inspection techniques including ultrasonic inspection of the riveted lap joint, ultrasonic thickness survey of the base materials and possible magnetic particle inspection of any suspect areas detected by the Competent Person or the owner/user.

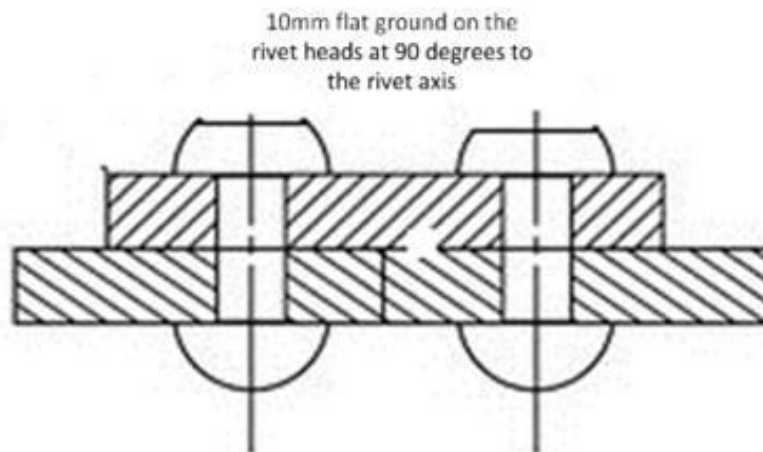


GUIDANCE

There are many types of rivet head design as shown in the diagram below and the criteria for rivet head preparation for ultrasonic examination is governed by the ability of the NDT practitioner to seat the ultrasonic probe on the rivet head allowing good sound propagation and back wall echo signal.

To achieve the above the criteria for probe seating is normally that on rounded or pointed rivet heads the NDT practitioner may require a small flat of approximately 10mm (5 pence piece) to be ground on the head in advance of the inspection visit ensuring that this is at 90° to the rivet axis. (See the diagrams below)





The reasoning behind the above approach is as follows:-

- On each rivet flattened the outer sharp edge can be removed by flapper disc, for cosmetic purposes, giving almost the same appearance as the adjacent rivets.
- When investigating for defects such as shear and partial shear (both by defect signal and loss of backwall echo), necking, and noting various rivet dimensions as per our procedure, we found this method to be the most accurate and repeatable test.
- Full probe contact can be achieved.
- Errors due to mode conversions, spurious indications and geometric issues can normally be discounted.
- The acceptance and rejection criteria of the inspection are to be agreed between the Competent Person, the owner/user and the NDT practitioner prior to the inspection being carried out in line with the Competent Person's own criteria (e.g. evidence of cracking and/or significant reduction of the total volume of the rivet head may be cause for rejection).

NB – Reduction in volume of the rivet head shall be taken into account prior to undertaking any preparation by the Competent Person and the User.