Section 1

Typical Duties of Welding Inspectors

1 General

Welding Inspectors are employed to assist with the quality control (QC) activities that are necessary to ensure that welded items will meet specified requirements and be fit for their application.

For employers to have confidence in their work, Welding Inspectors need to have the ability to understand/interpret the various QC procedures and also have sound knowledge of welding technology.

Visual inspection is one of the non–destructive examination (NDE) disciplines and for some applications may be the only form.

For more demanding service conditions, visual inspection is usually followed by one or more of the other non-destructive testing (NDT) techniques – surface crack detection and volumetric inspection of butt welds.

Application Standards/Codes usually specify (or refer to other standards) that give the acceptance criteria for weld inspection and may be very specific about the particular techniques to be used for surface crack detection and volumetric inspection, they do not usually give any guidance about basic requirements for visual inspection.

Guidance and basic requirements for visual inspection are given by:

BS EN 970 (Non–destructive Examination of Fusion Welds – Visual Examination)

2 Basic Requirements for Visual Inspection (to BS EN 970)

BS EN 970 provides the following:

- Requirements for welding inspection personnel.
- Recommendations about conditions suitable for visual examination.
- The use of gauges/inspection aids that may be needed/helpful for inspection.
- Guidance about information that may need to be included in the inspection records.
- Guidance about when inspection may be required during the stages of fabrication.

A summary of each of these topics is given in the following sections.

3 Welding Inspection Personnel

Before starting work on a particular contract, BS 970 states that Welding Inspectors should:

- Be familiar with relevant standards*, rules and specifications for the fabrication work that is to be undertaken
- Be informed about the welding procedure(s) to be used
- Have good vision – in accordance with EN 473 and should be checked every 12 months

(standards may be National or Client)*

BS EN 970 does not give or make any recommendation about a formal qualification for visual inspection of welds. However, it has become industry practice for inspectors to have practical experience of welding inspection together with a recognised qualification in Welding Inspection – such as a CSWIP Qualification.

4 Conditions for Visual Inspection

Illumination

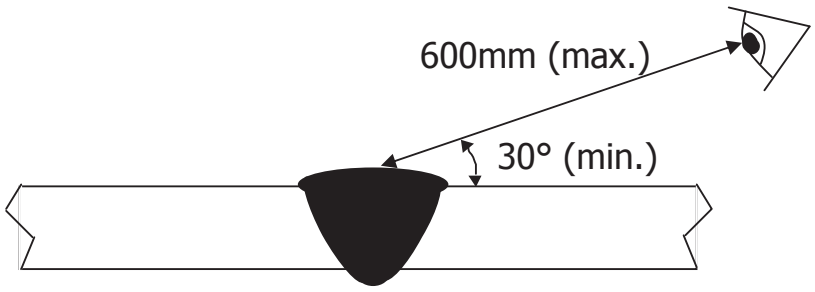
BS EN 970 states that the minimum illumination **shall** be 350 lux but recommends a minimum of 500 lux*.

** normal shop or office lighting*

Access

Access to the surface, for direct inspection, should enable the eye to be:

- Within 600mm of the surface being inspected
- In a position to give a viewing angle of not less than 30°



5 Aids to Visual Inspection

Where access is restricted for direct visual inspection, the use of a mirrored boroscope, or a fibre optic viewing system, are options that may be used – usually by agreement between the contracting parties.

It may also be necessary to provide auxiliary lighting to give suitable contrast and relief effect between surface imperfections and the background.

Other items of equipment that may be appropriate, to facilitate visual examination, are:

- Welding gauges (for checking bevel angles and weld profile, fillet sizing, measuring undercut depth).
- Dedicated weld gap gauges and linear misalignment (high–low) gauges.
- Straight edges and measuring tapes.
- Magnifying lens (if a magnification lens is used to aid visual examination it should be X2 to X5).

BS 970 has schematics of a range of welding gauges together with details of what they can be used for and the precision of the measurements that can be made.

6 Stages When Inspection May Be Required

BS EN 970 states that examination is normally performed on welds in the **as–welded condition**. This means that visual inspection of the finished weld is a minimum requirement.

However, BS EN 970 goes on to say that the extent of examination, and the stages when some inspection activity is required, should be specified by the Application Standard or by agreement between client and fabricator.

For fabricated items that must have high integrity, such as pressure vessels and piping or large structures inspection activity will usually be required throughout the fabrication process, namely:

- Before welding
- During welding
- After welding

Inspection activities at each of these stages of fabrication can be considered to be the **Duties of the Welding Inspector** and typical inspection checks that may be required are described in the following section.

7 Typical Duties of a Welding Inspector

The relevant standards, rules and specifications that a Welding Inspector should be familiar with at the start of a new contract are all the documents he will need to refer to during the fabrication sequence in order to make judgements about particular details.

Typical **documents** that may need to be referred to are:

- The Application Standard (or Code)
  (for visual acceptance criteria – see note below)*
- Quality plans or inspection check lists
  (for the type and extent of inspection)
- Drawings
  (for assembly/fit-up details and dimensional requirements)
- QC procedures
  (Company QC/QA procedures such as those for document control, material handling, electrode storage and issue, WPSs etc)

Note: Although most of the requirements for the fabricated item should be specified by National Standards, Client Standards or various QC Procedures, some features are not easy to define precisely and the requirement may be given as **to good workmanship standard.*

Examples of requirements that are difficult to define precisely are some shape tolerances, distortion, surface damage or the amount of weld spatter.

Good workmanship is the standard that a competent worker should be able to achieve without difficulty when using the correct tools in a particular working environment.

In practice the application of the fabricated item will be the main factor that influences what is judged to be good workmanship or the relevant client specification will determine what is the acceptable level of workmanship.

Reference samples are sometimes needed to give guidance about the acceptance standard for details such as weld surface finish and toe blend, weld root profile and finish required for welds that need to be dressed – by grinding or linishing.

A Welding Inspector should also ensure that any inspection aids that will be needed are:

- In good condition
- Calibrated – as appropriate/as specified by QC procedures

Safety 'consciousness' is a duty of all employees and a Welding Inspector should:

- Be aware of all safety regulations for the workplace
- Ensure that safety equipment that will be needed is available and in suitable condition

Duties before welding

Check	Action
Material	In accordance with drawing/WPS Identified and can be traced to a test certificate In suitable condition (free from damage and contamination
WPSs	Have been approved and are available to welders (and inspectors)
Welding equipment	In suitable condition and calibrated as appropriate
Weld preparations	In accordance with WPS (and/or drawings)
Welder qualifications	Identification of welders qualified for each WPS to be used. All welder qualification certificates are valid (in date)
Welding consumables	Those to be used are as specified by the WPSs are being stored/controlled as specified by the QC Procedure
Joint fit-ups	In accordance with WPS/drawings tack welds are to good workmanship standard and to code/WPS
Weld faces	Are free from defects, contamination and damage
Preheat (if required)	Minimum temperature is in accordance with WPS

Duties during welding

Check	Action
Site/field welding	Ensure weather conditions are suitable/comply with Code (*conditions will not affect welding)*
Welding process	In accordance with WPS
Preheat (if required)	Minimum temperature is being maintained in accordance with WPS
Interpass temperature	Maximum temperature is in accordance with WPS
Welding consumables	Inn accordance with WPS and being controlled as Procedure
Welding parameters	Current, volts, travel speed are in accordance with WPS
Root run	Visually acceptable to Code (before filling the joint) *(for single sided welds)*
Gouging/grinding	By an approved method and to good workmanship standard
Interrun cleaning	To good workmanship standard
Welder	On the approval register/qualified for the WPS being used

Duties after welding

Check	Action
Weld identification	Each weld is marked with the welder's identification and is identified in accordance with drawing/weld map
Weld appearance	Ensure welds are suitable for **all** NDT (profile, cleanness etc) Visually inspect welds and sentence in accordance with Code
Dimensional survey	Check dimensions are in accordance with drawing/Code
Drawings	Ensure any modifications are included on as-built drawings
NDT	Ensure all NDT is complete and reports are available for records
Repairs	Monitor in accordance with the Procedure
PWHT (if required)	Monitor for compliance with Procedure (check chart record)
Pressure/load test (if required)	Ensure test equipment is calibrated Monitor test to ensure compliance with Procedure/Code. Ensure reports/records are available
Documentation records	Ensure all reports/records are completed and collated as required

8 Examination Records

The requirement for examination records/inspection reports will vary according to contract and type of fabrication and there is frequently no requirement for a formal record.

When an inspection record is required it may be necessary to show that items have been checked at the specified stages and that they have satisfied the acceptance criteria.

The form of this record will vary – possibly a signature against an activity on an Inspection Checklist or on a Quality Plan, or it may be an individual inspection report for each item.

For individual inspection reports, BS EN 970 lists typical details for inclusion such as:

- Name of manufacturer/fabricator
- Identification of item examined
- Material type and thickness
- Type of joint
- Welding process
- Acceptance standard/criteria
- Locations and types of all imperfections not acceptable
  (When specified, it may be necessary to include an accurate sketch or photograph.)
- Name of examiner/inspector and date of examination