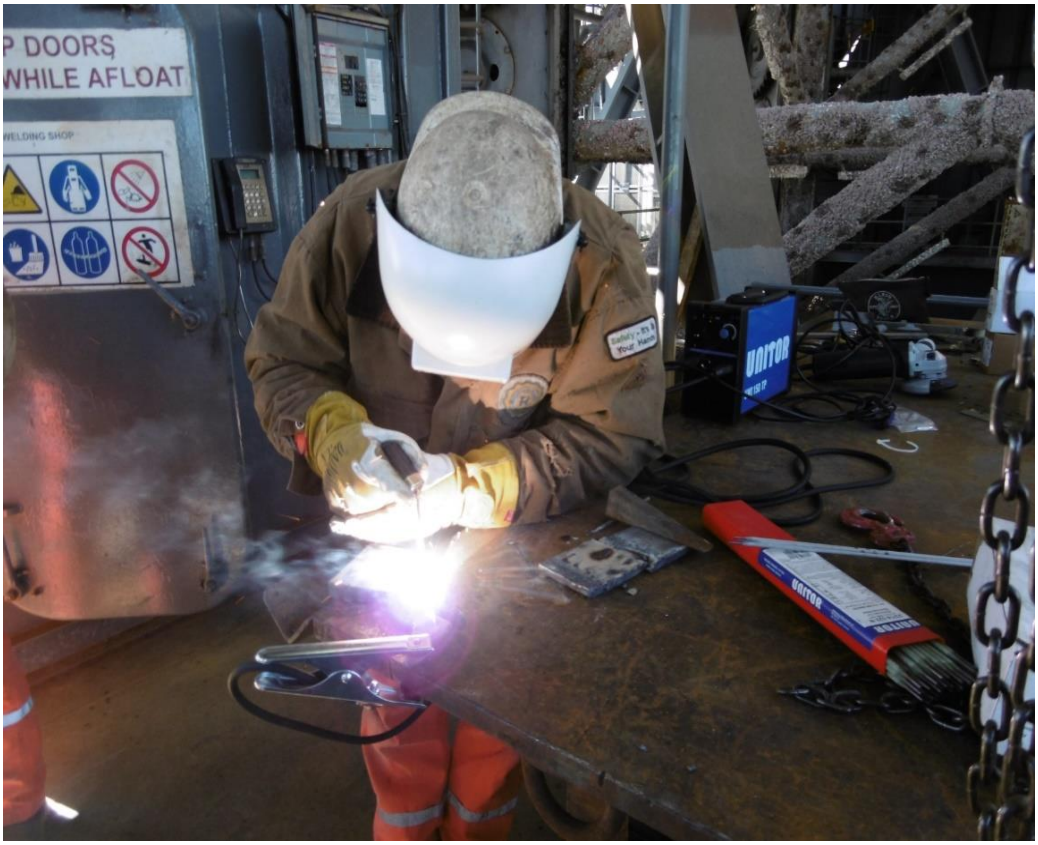
Required Welding skills onboard a vessel, & Welders Approvals

Using competent crew members onboard a ship to perform maintenance welding during voyage make good sense. a.o. to avoid a costly flying squad.
However, what welding skills should he or she inherit, and is it beneficial to have a person that is approved according to a class standard onboard as welder?
This article seeks to establish some basic facts regarding welding performed onboard, and to inform of the pro and cons concerning level of skill.

Essential facts

In most cases the welding onboard will be maintenance welding, not production welding. There are some exceptions like onboard heavy lifters performing large sea fastening jobs, or onboard pipe laying vessels.

In maintenance welding onboard, it will be a great variety of base materials to be welded and cut and not the repeated well-known base material that is typical for a fabrication workshop.
The welder onboard must be able to identify the base metal, choose the right consumable and follow the correct welding procedure. All this very often without the guidance of a foreman or another superior.



In a fabrication workshop the parts are clean, pre-cut and ready to be welded.

There are no" ready to be welded" joints onboard. The welder has to do edge preparation himself. Rust, paint, oil and the old weld must be removed or the crack must be gouged or grinded out before welding. This requires the use of cutting, grinding or gouging equipment**.**

Welders with a fabrication welding background are used to turn tables and positioning equipment placing the object in the horizontal position that make welding so much easier.

Onboard a vessel positioning equipment are not available. Welding onboard require skill in welding in all positions.

A fabrication workshop is designed for hot work. No flammable materials around. Fume extractors and fresh air ventilation systems are in place.

Onboard a vessel the only location meant for safe welding and hot work will be the workshop. Outside the workshop, where many of the jobs will have to be performed, a number of safety precautions will have to be in place before work can commence. The consequences of not adhering to correct safety procedures can be both hazardous for the crew and damaging to the vessel.

The welding methods used in shore-based production welding will in most cases be semi-automatic MIG/MAG type of welding methods.

In maintenance welding onboard Electrode/ Stick welding is the preferred method because of simplicity and its ability to cope with a variety of base materials without long set up time. On to that comes intricate work on thin walled seawater and stainless-steel pipes that require TIG welding and Brazing.

The above are important factors to consider when selecting welders for maintenance welding onboard. A welder with a fabrication welder background do not necessarily have the necessary skills and understanding for maintenance welding onboard a ship.

Most vessels will befit from having a good “all-round” welder onboard that can perform:

- Electrode/Stick arc welding. More than 80% of all welds onboard a vessel will be fillet welds. It is therefore important that he master this type of joint in all positions for plates and pipes.
- TIG welding of seawater pipes (Cunifer, York Albro) and stainless steel.
- Oxy Acetylene Gas cutting and gouging. If vessel is equipped with plasma cutting equipment it is of importance that he also knows how to operate this type of equipment. Operating plasma cutting equipment require a completely different technique than oxy-acetylene equipment.
- Brazing (especially silver brazing/capillary bracing). Skill to perform brazing is needed in order to repair small more intricate items like small diameter pipes.
- Knowledge of how to identify metals and choose the correct consumable and the right welding procedure.
- Safety conscious toward the working environment and in handling electric welding equipment and oxy- acetylene equipment/ cylinders.
- If the vessel is a chemical carrier there will be a need for the welder to also have the specific skills towards welding and handling stainless steel. Wrong handling of stainless steel is just as much a source for bad welding results as the welding itself.

Sum up:

Avoid recruiting fabrication welders from shore without sufficient background and experience from the demanding work onboard.
Make sure the welder has attended an approved marine academy that offer welding training. These courses aim at giving shipboard welders the necessary skill and confidence to perform their tasks in a safe and proper manner.

The need for an approved welder according to a class standard onboard.

First, let's look at the difference between "Welding Procedure Approval" and "Welder Approval".

Welding Procedure Approvals

Various procedural standards, such as ISO 15614, give the requirements for the preparation of test pieces and their subsequent examination to show that a particular combination of welding process, consumable and material can be made to produce an acceptable welded joint. The weld procedure test requirements are drawn up so that the same welding procedure can be recognised as approved for a range of other combinations of the 'essential variables' detailed in the procedure such as welding position and thickness.

Welder Approvals

A welder approval test, e.g. in accordance with ISO 9606 (EN 287) is designed to prove that a particular welder is competent to weld with the specific process, consumables and position. However, the welder approval test plate is not subject to the same extensive destructive testing as the weld procedure tests. As with the weld procedure approval, the welder who has passed an approval test in a particular combination of essential variables will also be approved to weld within the range of essential variables given in the specification.

The fundamental difference, therefore, between a Procedure approval and a Welder approval is that the procedure approval is carried out to demonstrate that a weld, made in accordance with the procedure, will have the necessary mechanical properties such as tensile strength, ductility and toughness. The welder approval test demonstrates that the welder has a sufficient level of skill such that he can deposit a weld of the correct quality, free of welding defects.

Welder Approval Qualification Tests

Welder certification is based on specially designed tests to determine a welder's skill and ability to deposit sound weld metal. The main part of the welder's test consists of welding one or more test pieces which are then examined using non-destructive and destructive methods.
The extent of certification is described by a number of variables, which include the specific welding process, type of deposited metal, thickness, joint design, position, backing, and others. Most often, the test is conducted in accordance with a particular code.
Depending on product requirements the test can be administered under the supervision of a national or international organization, such as the American Welding Society (AWS), or American Society of Mechanical Engineers (ASME), but manufacturers may specify their own standards and requirements as well.

Most certifications expire after a certain time limit and have different requirements for renewal or extension of the certification.
In the USA, welder qualification is performed according to AWS D1.1, ASME Section IX and API 1104 standards, which are also used in some other countries. Some States have their own Welder Qualifications that supersede AWS Qualifications, but most are according to AWS, ASME or API.

In Canada, welder qualification is carried out according to CSA Standards and ASME. The ASME code is typically used for pressure vessel and pressure piping applications, and CSA Standards are used for structural, general manufacturing and non-pressure applications. There are 3 major CSA Standards to which welders may be qualified: CSA W47.1 for steels (including stainless steels), CSA W47.2 for aluminum, and CSA W186 for reinforcing bars. Under these CSA standards, welder qualification testing is carried out every 2 years by the Canadian Welding Bureau to ensure ongoing competence.

In Europe, the European Committee for Standardization (CEN) has adopted the ISO standards on welder qualification ISO 9606, to replace the old European EN 287 series. Operators of automated welding systems are certified according to EN 1418. In Europe welders are often certified by third party like DNV/GL, LR or BV. Welders involved in the manufacture of equipment that falls within the scope of the Pressure Equipment Directive must be approved by a competent third party which may be either a notified body or a third-party organization recognized by a Member State.

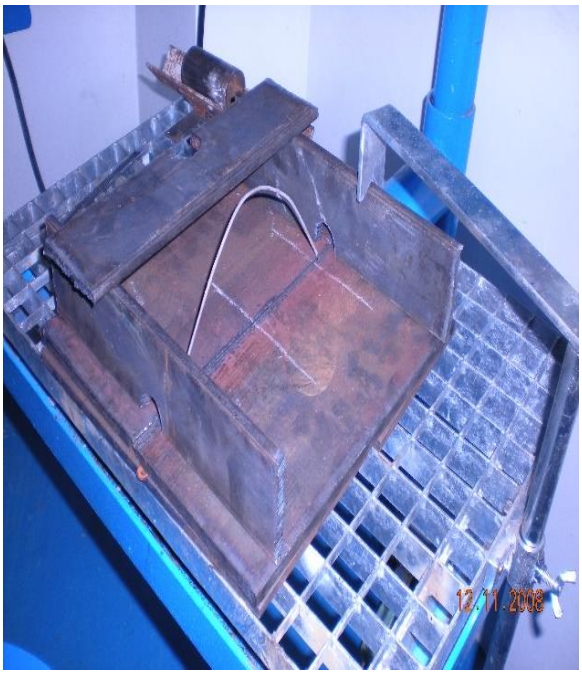
Once a welder passes a test (or a series of tests), their employer or third party involved will certify their ability to pass the test, and the limitations or extent they are qualified to weld, as a written document (welder qualification test record, or WQTR).

Normally this document is valid for a limited period (usually for two years), after which the welder must be retested.
Some Qualifications are only valid for a single project, while others are valid long as welders do perform that specific type of welding regularly at least once within a set period (this period is typically 6 months).
Welders must maintain a log to demonstrate they have maintained their Qualifications.

A welder's qualification test for crew members from vessels will in most cases be done according to ISO 9606 (manual arc welding) and certified by DNV/GL, LR or BV. It will be natural to choose the society that the vessel is classified according to.

A welder qualification test is demanding. The welder must therefore be given sufficient time to receive training before the actual test. It is strongly recommended that the training and test is done at a marine academy that have welding training courses to welder qualification level. There are several reasons for this:

- Test plates and pipes with a high degree of accuracy toward edge preparation will need to be available.
- Consumables like electrodes will need to be pre heated to sufficient level before use. All this is absolutely necessary if a successful result is to be achieved.
- Instructors need to train the applicant to sufficient standard prior to the test and notify, based on a pre-test, that the applicant will be ready for the test.
- Arrange and communicate with class society regarding test date and details (surveyor to witness test),
- Arrange for non-destructive testing (NDT) like radiographic and for issue of certificate if successful.



There are a number of limitations to a welder's certificate known as 'essential variables'. If the welder has to weld outside the range of welder qualification a new qualification test is required.

1. Welding process. Normally each welding process only qualifies the actual welding process. A change of welding process requires a new qualification test.
2. Product type (plate or pipe). There are a number of limitations but in general pipes covers weld in plates.
3. Type of weld (butt or fillet). Butt welds do not qualify fillet welds or vice versa.
4. Filler material group (Base material). There are 6 filler material groupings. Welding with a filler material in one group qualifies the welder for welding with all other filler materials within the same group. In some cases, also other groups. As an example: If the welder qualifies for welding ship quality steel he is not qualified for welding stainless steel. This will require a new qualification test.
5. Filler material type. Welding with Low Hydrogen Basic coated electrodes qualifies for Rutile coated electrodes but not vice versa. Cellulosic electrodes have separate qualification.
6. Dimension (material thickness and outside pipe diameter) For butt welds the dimension limitations is based on outside pipe diameter and deposited thickness according to a table. For fillet welds the dimension limitations is based on material thickness according to a table.
7. Welding position. There are a number of limitations according to welding positions.
8. Weld detail(s) (material backing, gas backing, flux backing, consumable insert, single side welding, both side welding, single layer, multi-layer, leftward welding, rightward welding).

Period of validity and revocation of qualification:

The welder's qualification begins from the date of welding and is valid within the following:
The welder qualification shall be retested every 3 years.
The welder qualification shall be revalidated after 2 years.
The welder qualification is valid as long as the following fulfils:
– The welder is working for the same company/ manufacturer.
– The manufacturer has a verified quality requirement according to ISO 3434-2 or ISO 3834-3.
– The manufacturer has documented that the welder has produced welds of acceptable quality where weld position, weld type, material backing or no material backing conforms to the examination.
The chosen method shall be stated on the certificate.
Regardless of the chosen method the welder certificate has to be confirmed every 6 months by the responsible person for welding.
This conformation shows that the welder has worked within the range of qualification of the certificate.
If this confirmation hasn't been done the welder certificate is invalid.
When there is a specific reason to question a welder's ability to make welds that meet the product standard quality requirements, the qualifications shall be revoked. All other qualifications not questioned remain valid.

EN ISO 9606-1 gives more detailed information regarding the test requirements including essential variables.

Sum up:

Ask yourself: Is there a repeated demand for certified welding work onboard? If yes, could this need be more economically covered by having a certified welder from a shore-based company sent onboard? Keep in mind that certification of a welder is costly and the certificate might not cover the actual repair that needs to be done in the specific situation. If it is required to have a certified welder onboard we suggest the following:

- Analyse the type of work you want him or her to perform (Welding method, base material, consumable, plate and/or pipes, wall thickness, positions etc.
- Arrange for an approval that will cover most of the work onboard.
- Arrange with the appropriate classification society to perform the certification.
- Check that you can give sufficient work to the approved welder to upkeep his or her approval. If there are a large number of vessels in the fleet an approved welder can ambulate from vessel to vessel to perform welding that require approval. Check this out.
- Arrange for the welder to receive sufficient training before the actual test. Preferably do the training at a marine academy that have welding training courses to this level. Avoid doing the training and test onboard. Ask the training location to do a pre-test of the applicant in order to establish if he or she is capable to pass the test inside reasonable training time.

It should be noted that most repair and maintenance welding on board does not require certified welders, but dedicated persons with good knowledge of the possibilities and limitations of the various welding/brazing/cutting processes and their applications, and skill in using them.

Training to this level can also be given at an approved marine academy that offer welding training, and include information on the few specific cases where a welder with a valid certificate for the process and application at hand needs to be called in.
To do an ordinary welding training course to this level onboard during voyage is also fully possible. With necessary requirements towards welding equipment, consumables and base materials in place this can easily be arranged.

For further information:
Fill in the contact form at TE Andersen Consulting and ask to be sent the pdf power point presentation EN ISO 9606-1 that gives more detailed information regarding the test requirements including essential variables.