

Linee guida per la scelta del materiale
di saldatura e Procedure per la
riparazione degli stampi in H11 -H13
per Pressofusione leghe di Alluminio e
Magnesio



PREAMBLE:

This document serves to assist die welders in selecting an appropriate welding material and weld heat treatment procedure for H13 type dies, cores, and inserts for high-pressure die casting (HPDC) of Aluminium and Magnesium alloys.

SCOPE:

The document describes a desirable weld procedure for the preparation, pre-heat, and post-heat treatment for weld repair of H13 tool steel with the aim of providing an optimum trouble free service.

1.1 OCCUPATIONAL HEALTH, SAFETY & ENVIRONMENT:

1.2 PERSONAL PRECAUTIONARY MEASURES REQUIRED DURING WELDING:



1.3 UV RADIATION:

Welding is associated with extremely high ultra-violet (UV) radiation which can burn exposed skin and eyes. Wear a welding helmet with appropriate UV eye protection and low-flammability clothing that covers all exposed skin.

1.4 FUMES & GASES:

Welding tool steel produces fumes and gases, which can be harmful to your health. Always weld in a well-ventilated area and avoid breathing in welding fumes and gases. Whenever possible use mechanical ventilation to improve air-quality, and keep work-pieces and weld wires free from oils and paints.

1.5 EYE PROTECTION:

Safety glasses must be worn at all times during welding to prevent eye injuries.

1.6 NOISE:

The turbulent nature of welding arcs generates a high level of noise. Always wear hearing protection when welding particularly when welding in foundry areas.

1.7 ELECTRICITY:

Direct current welding supplies and RF generators are sources of high magnetic fields and electrical power that can kill. Do not weld in wet areas and regularly inspect electrical cables for wear and damage.

2.1 MATERIAL SPECIFICATIONS:

2.2 COMPOSITION OF TOOL STEEL:

The tool steel being welded shall meet the following material composition for H13: -

Element	Weight %
Carbon	0.37-0.42
Manganese	0.20-0.50
Phosphorus	0.025 max
Sulphur	0.005 max
Silicon	0.80-1.20
Chromium	5.00-5.50
Vanadium	0.80-1.20
Molybdenum	1.20-1.75

2.3 TYPICAL COMPOSITION OF WELD MATERIALS:

There are many weld materials available on the market. The following are just some weld materials and their compositions available from weld material suppliers.

Wt %	C	Cr	Mo	Mn	V	Si	Ni	Co	Ti
E&C 45355W	0.01	0.14	3.8	0.09	-	0.05	16.0	12.1	1.7
Marlok C1650	0.02	0.06	4.5	0.09	-	0.03	13.7	10.8	0.2
E&C TIG- TECTIC 680	0.1	30.4	0.16	1.9	-	0.34	8.4	-	
UTP A73G2	0.34	5.5	1.82	-	-	0.46	0.51	-	0.27
E&C XHD6804	0.17	13.4	2.6	0.05	-	0.4	0.35	13.7	-
E&C TIG 50216	0.07	5	1.5	0.5	1	1	-	-	-

3,1 LINEE GUIDA PER SALDATURA STAMPI DA PRESSOFUSIONE

3.1 GUIDELINE FOR WELDING DIE CASTING DIES:

3.2 DIE FAUILURE REQUIRING WELDING REPAIR:

During high pressure die-casting (HPDC) of aluminium alloys the tool steel dies, inserts, and cores undergo severe operating conditions such as high pressure, rapid temperature changes, and erosion from fast moving molten metal. Heat checking, Gross cracking, and Erosion are the three main causes of die failure that require weld repair, see Figure 1. Although welding will never be as good as an un-welded area, knowledge regarding the correct weld procedure and material to apply, can reduce the risk of cracking and sustain die life and cast quality.

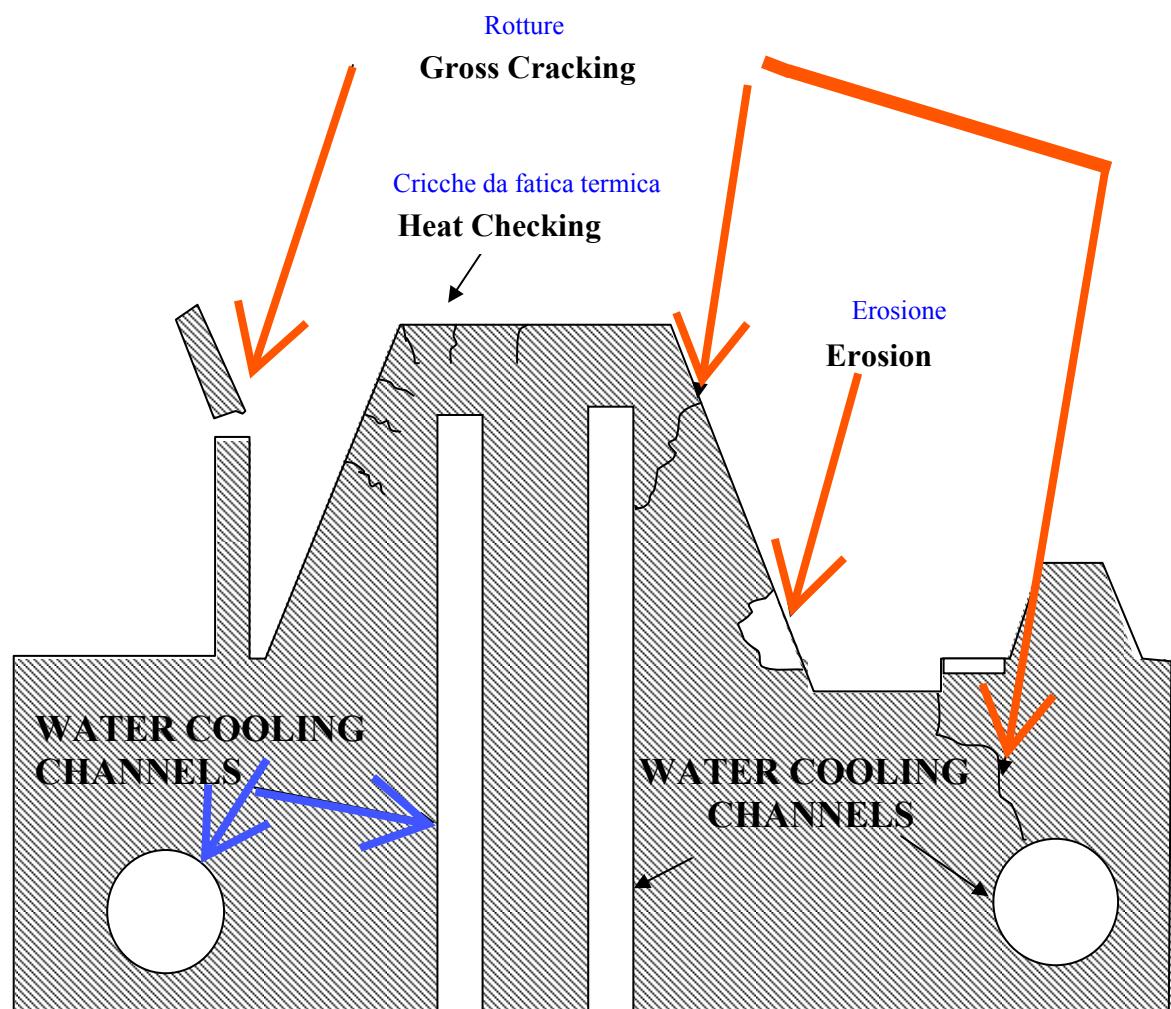


Figure 1. Schematic representation of typical die failure areas requiring welding

Figure 1. Rappresentazione schematica di aree tipiche di rottura che richiedono una riparazione di saldatura.

3.3 PROCEDURA DEL PROCESSO DI SALDATURA

3.3 WELDING PROCESS PROCEDURE:

A welding procedure has been developed for the die casting industry. Each step has been linked to form a flow diagram, starting from the identification of the area to be welded, heat treatment procedure (if necessary), and final weld hardness achieved.

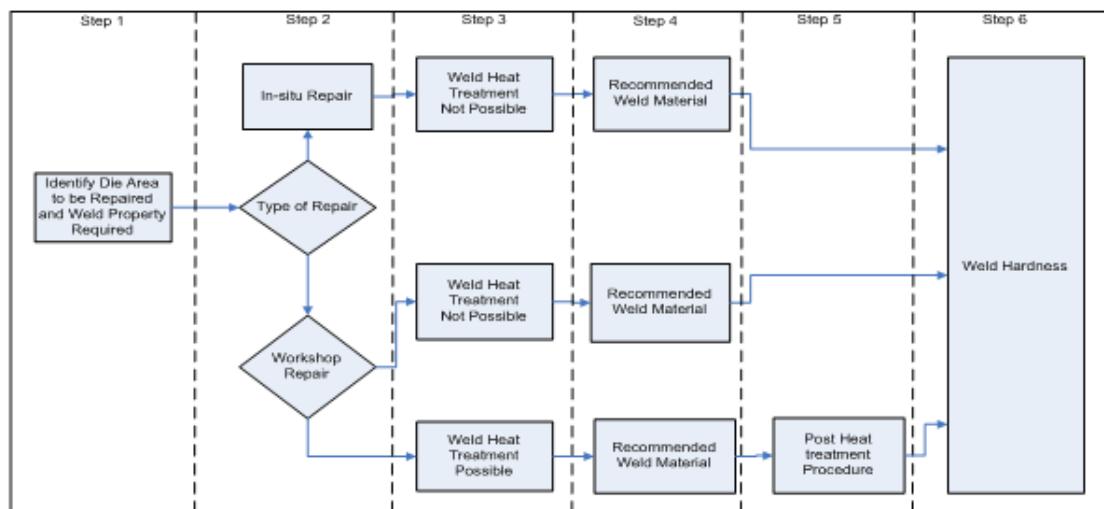
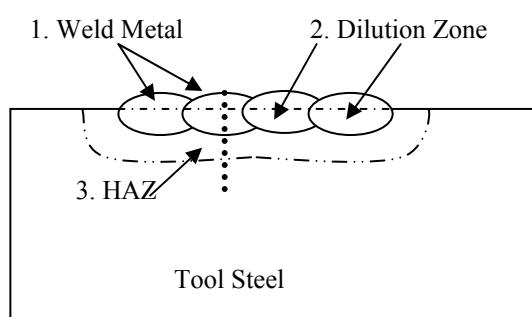


Figure 2. Flow diagram showing six-step welding procedures

3.4 THE WELD AREA:

The welded area comprises of three main regions as shown in the diagram below: -

1. **Weld metal** on the surface made up of weld material only
2. **Dilution zone** below the weld metal is an area where both weld metal and substrate material have mixed to form an alloy
3. **Heat Affected Zone (HAZ)** is the area composed of the tool steel substrate exposed to the high temperatures during welding and has usually softened the tool steel substrate in this area.



3.5 DIE SURFACE PREPARATION:

1. Machine or grind all damaged die areas which require welding, see figure 3.
2. Ensure all cracks, build-up, oxide, and any foreign substances are removed.
3. Clean any oil, grease, or other residue from weld areas and rod material with a solvent that leaves no residue and contains no chlorine.
4. Ensure full weld penetration can be achieved by removing all heat check and cracking damage.

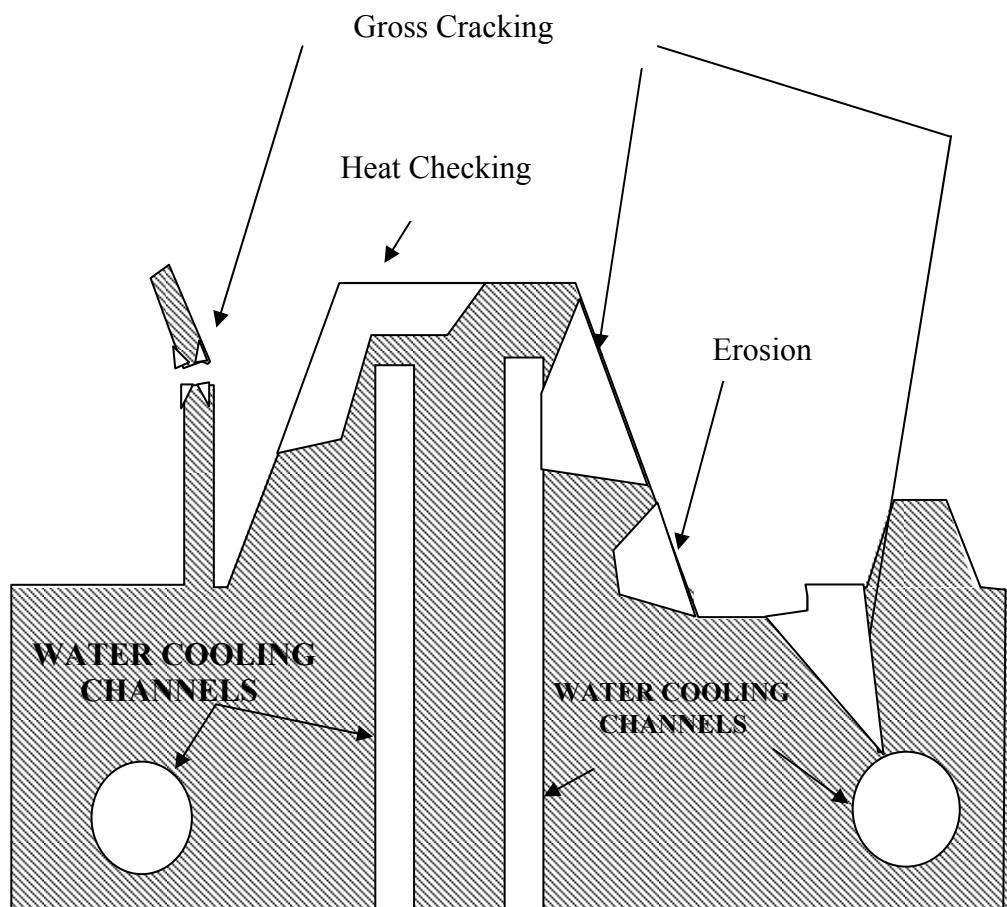


Figure 3. Schematic representation of weld surface preparation for each die failure area

3.6 WELD MATERIALS SELECTION:

There are many factors to consider when determining which weld material to select for die repairs: -

- Often the area-requiring repair welding cannot be removed from the machine and welding needs to be carried out in-situ. In this case post-heat treatment is not possible and a weld material must be selected so that the weld properties are achieved without heat treatment after welding.
- Thermal fatigue crack repairs may require more than one type of weld material for satisfactory repair. Ideally, a soft weld is required for the first weld layer and a hard weld material for subsequent surface layers.
- Erosion affected areas such as the gate area require hard weld layers that resist wear of the molten metal injection process.

3.7 PRE-HEATING DIE AREA:

Pre-heating eliminates hydrogen embrittlement by removing moisture and reduces thermal stress during welding. It is important to pre-heat die areas before welding and preheating should be carried out in a furnace with the following conditions where possible: -

- Pre-heat temperature should not exceed 350°C and not lower than 150°C
- Heat the die uniformly and maintain temperature throughout welding procedure
- Manual gas pre-heating can be used for in-situ welding procedures.
- Maintain heat uniformity and temperature.

3.8 DIE WELDING:

Ensure weld machine parameters are set according to manufacturers recommendations for the weld wire material.

- Ensure arc shield gas is on
- Weld deposits are to be applied evenly to avoid creating pores in subsequent layers
- Plan welding sequence to balance stresses. For example, if thick sections are to be welded, weld on alternating sides. Do not weld multiple passes on one side, and then make all the weld passes on the other side.
- Clean each pass, after it is applied, using wire brush or other suitable equipment.
- Do not quench or fan cool welds.
- Allow welds to cool in still air and welded areas greater than 50mm thick should be slow cooled under a thermal blanket or insulation chips.

3.9 POST HEAT TREATMENT & STRESS RELIEVING:

Post heat treatment should be carried out immediately after welding while the die is still hot. This will minimise crack formation and relieve thermal stresses created by microstructural changes during welding.

Generally, post heat-treating and stress relieving is carried out at 500°C for at least 3 hours. Weld material manufacturers should be consulted regarding the correct post heat treatment procedure for their weld materials.

DISCLAIMER:

While every effort has been made and all reasonable care taken to ensure the accuracy of the material contained herein, the authors, editors and publishers of this publication shall not be held to be liable or responsible in any way whatsoever and expressly disclaim any liability or responsibility for any injury or loss of life, any loss or damage costs or expenses, howsoever incurred by any person whether the purchaser of this work or otherwise including but without in any way limiting any loss or damage costs or expenses incurred as a result of or in connection with the reliance whether whole or partial by any person as aforesaid upon any part of the contents of this Guidance Note. Should expert assistance be required, the services of a competent professional person should be sought.



La Vostra Linea diretta con Innovazione e Qualità

SALDATURA MARLOK®

GENERALI

Poiché l'acciai per lavorazioni a caldo al cromo MARLOK® è essenzialmente senza Carbonio, questo gli conferisce un'eccellente saldabilità. MARLOK® viene saldato con il processo GTAW (gas tungsten. arc welding, TIG). La procedura di saldatura è facile da seguire poichè nessun preriscalo è necessario, non occorre mantenere temperature elevate durante il processo di saldatura e nessun speciale tipo di raffreddamento dopo saldatura è necessario.

Va notato che la saldatura e la zona termicamente alterata (HAZ) del MARLOK® sono molli dopo saldatura, pertanto deve essere tassativamente eseguito un trattamento termico di precipitazione.

Su materiale già indurito:

Saldatura + invecchiamento in forno salita max: 150°C /ora a **500°C per 3 ore** -raffreddamento in aria

Comparazioni di procedimenti di saldatura tra Marlok e Acciai tipo H11-1.2343 – H13-1.2344 -1.2367

MARLOK®

ACCIAIO AL CROMO PER LAVORAZIONI A CALDO

- | | |
|--|---|
| 😊 Nessun preriscalo | 😊 Il preriscalo è tassativo |
| 😊 Non occorre mantenere la temperatura durante la saldatura | 😊 La temperatura durante la saldatura deve essere mantenuta |
| 😊 Nessuna richiesta per il raffreddamento dopo saldatura | 😊 Raffreddamento molto lento è richiesto dopo saldatura |
| 😊 La saldatura è dolce e facile da lavorare | 😊 La saldatura è dura e difficile da lavorare |
| 😊 Il detensionamento viene eseguito con il trattamento di post saldatura | 😊 Rinvenimenti di distensione sono richiesti dopo saldatura |
| 😊 Le proprietà del materiale sono simili tra il | 😊 Le proprietà del materiale sono considerevolmente |

PARAMETRI E PROCEDURE

Metodo di Saldatura:	Gas tungsten arc welding (GTAW) (Tig)
Posizione di Saldatura:	1G, 2G
Gas Protettivo:	Argon SR, 99.99% Ar
Flusso Gas :	8 - 12 litri/min.
Tipo di Saldatura:	manuale
Cordoni di Saldatura	
Elettrodo Singolo, passate multiple.	

Bacchetta Ø	Corrente A	Voltaggio V	DC/AC Polarità	Velocità di passata
1.2 mm 3/64"	120 - 140	15 - 17	DC	7 - 10 cm/min
2.4 mm 3/32"	190 - 210	17 - 19	DC +	2 3/4 - 4 inc/min 12 - 18 cm/min 4 3/4 - 7 inc/min

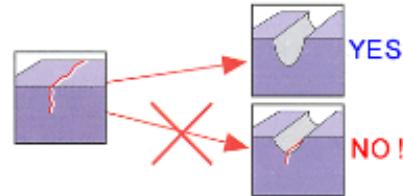


Procedura di Saldatura per MARLOK® C1650

Note: No preriscaldo

1.

Rimuovere completamente le cricche prima della saldatura. Usuare liquidi penetranti o polveri magnetiche per ispezionare che la cricca sia stata rimossa. Pulire la zona di saldatura da grassi, sporco o ossidazioni.



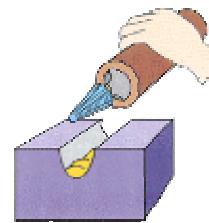
2.

Usare solamente elettrodi in MARLOK® C1650. ricordarsi di rimuovere il rivestimento protettivo dalle bacchette TIG, usando carta vetrata o acetone



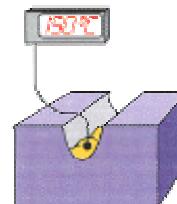
3.

Rimuovere il film di ossido che si forma dopo saldatura tra una passata e l'altra usando un utensile in carburo o una smeriglio.



4.

Non superare i 150°C durante la saldatura



5.

Evitare correnti d'aria durante la saldatura e mantenere il flusso di protezione dell'Argon



Dopo Saldatura di stampi già Invecchiati eseguire trattamento di invecchiamento a:

500° C per 3 ore

OTTIMI RISULTATI SI OTTENGONO UTILIZZANDO ELETTRODI DI MARLOK PER SALDARE STAMPI USURATI IN ACCIAI H11 – 1.2343 H13 - 1.2344- 1.2367