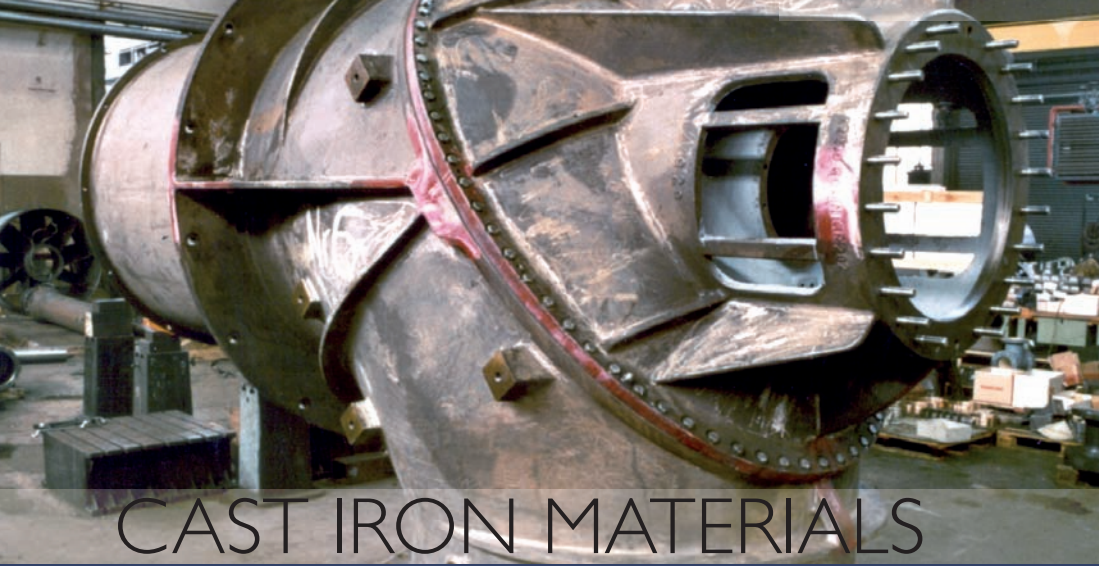


**UTP.**



**Your reliable partner for the welding of  
cast iron materials**



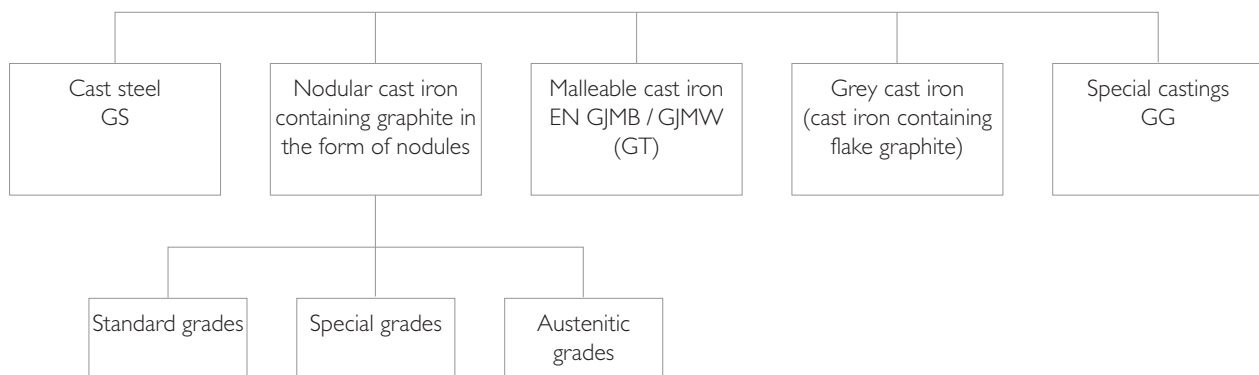
# CAST IRON MATERIALS

## ■ Welding of cast iron materials

The present brochure gives you an overview of the different types of cast iron and the respective UTP special welding consumables suitable for production, repair and construction welding. Cast irons with different metallurgical compositions can be selected, depending on the field of application. The parts produced by casting generally have a high compressive strength and good vibration damping properties. Furthermore, these parts can be processed on cutting machines. The good mechanical and dynamic properties can be optimally increased by a corresponding over-dimensioning of the parts with minor economic consequences.

For more than 50 years now, UTP has played a leading role in the development of suitable welding consumables, in particular for the welding of iron-carbon casting materials, as shown in Table 1. Tailored to the demands of the base materials available on the market, our wide range of users worldwide can choose from welding consumables with outstanding welding properties.

## ■ Iron-carbon cast iron



We want to concentrate on the three most important types of cast iron that are predominantly used in industry:

- Grey cast iron containing flake graphite  
EN 1561 GJL  
(Grey cast iron, DIN 1691, GG)
- Malleable cast iron  
EN 1562 GJMB  
(DIN 1692 GTS)
- Nodular cast iron containing graphite in the form of nodules  
EN 1563 GJS  
(DIN 1693 GGG)

The following table shows an overview of the typical reference analyses and ranges of the mechanical steel grades:

## ■ Welding of cast iron materials

Designation		Cast iron containing flake graphite GJL EN 1561 (GG DIN 1691)	Malleable cast iron GJMB EN 1562 (GTS DIN 1692)	Cast iron containing graphite in the form of nodules GJS EN 1563 (GGG DIN 1693)	Cast steel GS (DIN 1681)
Typical reference analysis in %	C	3,3	2,5	3,6	0,1 - 0,5
	Si	2,0	1,4	2,5	0,4
	Mn	0,6	0,4	0,1 - 0,6	0,6 - 1,6
	S	< 0,2	< 0,2	0,01	0,03
	Mg	-	-	0,04	-
Tensile strength $R_{p0,2}$ /MPa		100-400	350 - 700	350 - 800	380 - 700
Yield strength $R_m$ /MPa		not pronounced	200 - 550	220 - 500	190 - 420
Elongation at break		0,5	12 - 2	22 - 2	25 - 12
Hardness in HB		100 - 300	130 - 270	130 - 330	120 - 250

In grey cast iron, the proportion of carbon not remaining in solution in the iron precipitates in the form of graphite flakes. In nodular cast-iron, the carbon precipitates as spheroidal graphite owing to additions of inoculants (Mg) to the heat prior to casting.

With more rapid cooling a lower proportion of the carbon precipitates as graphite. Thus, with the same chemical composition, the structural and mechanical properties can be influenced by different cooling rates. By more rapid cooling, smaller amounts of carbon precipitate and therefore larger amounts remain in solution in the iron, influencing the metallurgical micro-structure (pearlite) and increasing the tensile strength.

Thus ferritic nodular cast iron and malleable cast iron are produced by appropriate heat treatment, i. e. thermal posttreatment.

Compared to structural steels and cast steel, cast iron containing flake graphite (grey cast iron) possesses practically no elongation, i. e. yield strength. Shrinkage stresses due to welding and heat input can hardly be reduced without damaging the base material.

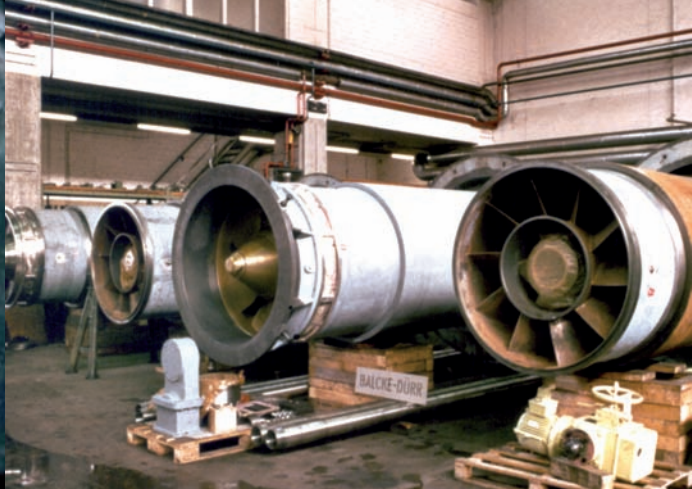
Shrinkage stresses arising as above are, however, absorbed quite readily in nodular cast iron; it can have almost similar mechanical properties to cast steel.

Grey cast iron containing flake graphite is weldable only with care. The suitability of such a material for welding depends largely on the microstructure (ferritic, ferritic-pearlitic, pearlitic) and on certain impurities. Because of the very low elongation properties, particular care must be taken to avoid shrinkage stresses during preheating, during welding itself and the cooling period.

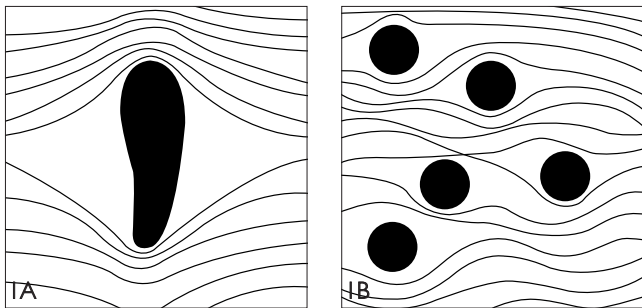
Accordingly the temperature gradients in the joint and throughout the workpiece must preferably be kept to a minimum.

By applying these measures the danger of stress cracks, which normally occur in such base material, is reduced.

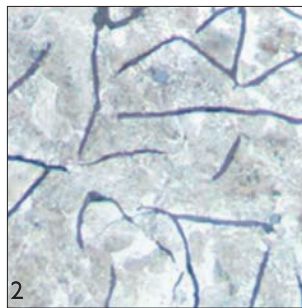
In addition, cracking of the base material can be further reduced by peening the short and narrow beads, especially where restrained seams call for this.



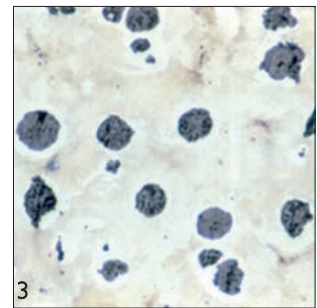
# CAST IRON MATERIALS



**Fig 1:** Diagram of stress lines in grey cast iron with graphite flakes (A). As a result of lading and the notch effect, stress concentrations are evident. The stress lines are more favourable in the case of nodular cast-iron, where graphite precipitates in the form of spheroids (B), resulting in good mechanical properties.



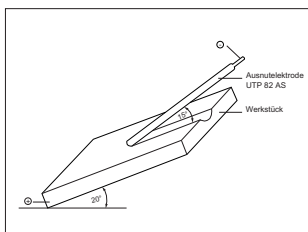
**Fig 2:** Cast iron with flake graphite GG 25. The precipitate carbon in the form of flake graphite is clearly recognizable (500 x).



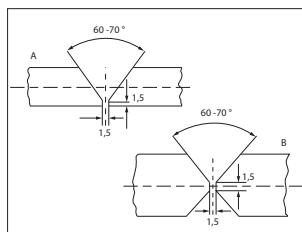
**Fig 3:** Cast iron containing graphite in the form of spherical graphite is clearly recognizable (200 x).

## ■ A distinction is made between three different fields of application for the welding of cast iron

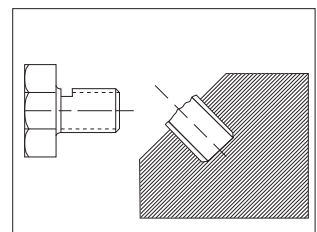
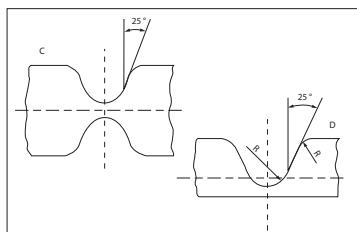
1. Production welding  
In order to guarantee configurational and dimensional specifications together with aesthetic properties, welds are made during the production of cast components. The elimination of casting defects and the correction of undersize components come under this heading particularly. In this respect, many successful welds with outstanding mechanical properties have been made on austenitic and ferritic nodular cast iron grades.
2. Repair welding  
Cast iron machine components cracked due to mechanical overloading, fatigue and aging, broken-off and worn surfaces, can be repaired permitting their continued use.
3. Construction welding  
Cast components are joined together or to other components made from dissimilar alloys (steels) by welding to make up an integral fabrication.  
The joining of steel tubes or wear-resistant austenitic manganese steel parts to components made from cast iron can be considered under this heading. Other examples are the welding of tubular sockets and T-pieces as well as joining flanges to centrifugally cast pipes made from nodular iron for water and gas installations. Also the production of inlet shafts to sewerage systems can be cited.



Representation of gouging procedure with UTP 82 AS using a leading angle of approx. 15°.



Various edge preparations for cold welding cast iron.



Sketch showing the use of threaded pins for the reinforcement of weld on oily cast iron.

## ■ Electrodes for welding of cast iron

UTP-Typ ISO 1071 DIN 8573 AWS A5.15	Welding process EN 287-1 AWS	Weld material reference analysis	Mechanical grades of steel	Hardness	Type of current	Appro- vals	Properties and applications
<b>8</b> E Ni E Ni-BG 2 2 E Ni-Cl	111 SMAW	C 1.2 Fe 0.5 Ni Rest	Rp0,2 ca. 220 MPa	ca. 180 HB	= - / ~	DB,	Pure nickel electrode for the cold weld of grey, malleable and steel castings and for the joining of these materials to steel, copper and copper alloys, particularly for repair and maintenance. Very good welding properties, spatter-free without undercuts, very good slag detachability. Hammer welded material.
<b>8 C</b> E Ni E Ni-BG 2 2 E Ni-Cl	111 SMAW	C 0.9 Fe 1.5 Ni Rest	Rp0,2 ca. 220 MPa Rm ca. 460 MPa A ca. 25 %	ca. 180 HB	= - / ~	DB	Graphite-based coated cast iron cold weld electrode with pure nickel core wire. It is suitable for build-up and joint welding on all common cast iron grades. A particular field of application are alloying coats and buffer runs on alloyed grey cast grades, in particular in mould construction.
<b>8 Ko</b> E NiCu-2 E NiCu-BG 1 2 E NiCu-B	111 SMAW	C 0.8 Fe 1.0 Cu 30.0 Ni Rest	-	ca. 160 HB	= - / ~	-	Nickel-copper electrode for production welding in the same colour on grey cast iron using the cold weld method (blowhole welding).
<b>88 H</b> E Ni E Ni-BG 2 2 E Ni-Cl	111 SMAW	C 0.8 Mn 0.7 Fe 2.0 Cu 2.0 Ni Rest	Rp0,2 ca. 250 MPa	ca. 180 HB	= - / ~	-	Pure nickel electrode for the cold weld of all common grey cast iron grades. It is particularly suitable for filling blowholes and for building up worn grey cast iron workpieces and as a first pass for connection welding on very oily castings.
<b>83 FN</b> E NiFe E NiFe-1 BG 23 E NiFe-Cl	111 SMAW	C 1.3 Ni 52.0 Fe Rest	-	ca. 190 HB	= + / ~	-	Graphite-based coated nickel-iron electrode suitable for build-up and joint welding on all common cast iron grades. It is preferably used when high melting rates are required. <b>Yield 115 %</b>
<b>84 FN</b> E Ni E Ni-BG 2 2 (mod.) E Ni-Cl (mod.)	111 SMAW	C 1.1 Fe 8.0 Cu 0.5 Ni Rest	-	ca. 180 HB	= - / ~	-	Graphite-based coated nickel-iron electrode. It is particularly suitable for repair welds on cast iron materials that have aged or are oily due to their use. <b>Yield 130 %</b>
<b>85 FN</b> E NiFe E NiFe-1 BG 2 3 E NiFe-Cl	111 SMAW	C 1.2 Ni 54.0 Fe Rest	Rp0,2 ca. 320 MPa	ca. 200 HB	= + / ~	-	Nickel-iron electrode for joint and build-up welding on grey cast iron, nodular cast iron and malleable cast iron as well as for mixed compounds with steel. Universally applicable for repair, production and construction welding using the cold welding method. Very good welding properties, spatter-free without undercuts, very easy slag removal, high mechanical strengths.
<b>86 FN</b> E NiFe E NiFe-1 BG 12 E NiFe-Cl	111 SMAW	C 1.2 Fe 45.0 Ni Rest	Rp0,2 > 340 MPa Rm > 500 MPa A > 18 %	ca. 220 HB	= - / ~	DB	Graphite-based coated nickel-iron electrode with high mechanical grades. It is suitable for joint and build-up welding on cast iron with lamellar grey cast iron (GG 10 - GG 40) and on nodular cast iron (GGG 40 - GGG 70). Universally applicable for repair, production and construction welding.
<b>GNX-HD</b> E NiFe E NiFe-1 BG 23 E NiFe-Cl	111 SMAW	C 1.1 Ni 55.0 Fe Rest	Rp0,2 > 340 MPa Rm > 500 MPa A5 18 %	ca. 220 HB	= + / ~	-	Graphite-based coated nickel-iron electrode with high melting rate. It is outstandingly suitable for repair, production and construction welding on all cast iron grades.



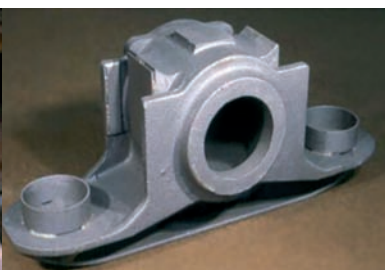
# CAST IRON MATERIALS

## Electrodes for welding of cast iron

UTP-Type ISO 1071 DIN 8573 AWS A5.15	Welding process EN 287-1 AWS	Weld material reference analysis	Mechanical grades of steel	Hardness	Type of current	Approvals	Properties and applications
<b>81</b> E Fe E Fe-1 ~ E St	111 SMAW	C 1.0 Si 0.5 Mn 0.5 Fe Rest	-	ca. 350 HB	= + / ~	-	Iron-based electrode for partially alloyed passes on poor cast iron and for wear-resistant build-up welds on grey and nodular cast iron using the cold weld method.
<b>807</b> - E Fe-2 -	111 SMAW	C 0.05 Si 0.4 Mn 0.5 V 10.0 Fe Rest	Rp <sub>0,2</sub> ca. 400 MPa Rm ca. 500 MPa A 10 %	ca. 180 HB ca. 230 HB	= +	-	Nickel-free special electrode for machinable build-up welds. A special field of application are repair operations on new castings and worn castings when colour matching and machinability are demanded.
<b>5 D</b> - E FeC-G-BG 40 E Cl-B	111 SMAW	C 3.0 Si 3.0 Mn 0.4 Fe Rest	Rp <sub>0,2</sub> 350 - 550 MPa	ca. 220 HB	= - = + ~	-	Graphite-based coated hot welding electrode for colour-matched and structure-matched welding on nodular cast iron.

## Wires for welding of cast iron

UTP-Type ISO 1071 DIN 8573 AWS A5.15	Welding process EN 287-1 AWS	Weld material reference analysis	Mechanical grades of steel	Protective gases	Approvals	Properties and applications
<b>Protective gas wires for welding of cast iron</b>						
<b>A 8051 Ti</b> SC NiFe2 MSG NiFe-2 ER NiFe-Cl	135 141 GMAW GTAW	C 0.1 Mn 3.5 Ni 55.0 Fe Rest Ti +	Rp <sub>0,2</sub> > 300 MPa Rm > 500 MPa A 25 % Kv ca. 200 J	Argon M12 (Ar + 2,5 % Co2)	-	Nickel-iron protective gas wire for joint and build-up welding on grey and nodular graphite cast iron and malleable cast iron as well as for mixed compounds with steel, copper and copper alloys. Repair, production and construction welding using the cold weld method.
<b>Cored wires for welding of cast iron</b>						
<b>AF 8051 Mn</b> TZC NiFeT3-Cl MF NiFe-1-S -	136 FCAW	C 0.3 Si 0.2 Mn 10.0 Fe 45 Ni Rest	Rp <sub>0,2</sub> 320 MPa Rm 600 MPa A 25 %	Ar (1 l) Ar + O2 (M12) Ar + O2 (M21)	-	Nickel-iron cored wire for MAG welding on all common cast iron grades. Main field of application lies in the repair of castings (build-up welding). The weld metal has high mechanical strength. It is ductile, crack resistant, has good resistance to corrosion and can be processed by machine cutting.



## Stick electrodes for welding of cast iron

UTP-Type ISO 1701 DIN 8573 AWS A5.15	Welding process EN 287-1	Weld material reference analysis	Bare stick	Flux-sheat- hed stick	Hardness	Flame setting	Properties and applications
<b>Stick electrodes for autogenous welding of cast iron</b>							
<b>5</b> FeC-I G FeC-I-G0 R-Cl	311 Autogen	C 3.2 Si 3.5 Mn 0.6	●		ca. 200 HB	neutral	Colour-matched and structure-matched welding rod for hot cast iron welding on grey cast iron. The weld metal can be processed by machine cutting.
<b>5 M</b> FeC-I G FeC-I-G0 R-Cl	311 Autogen	C 3.2 Si 3.5 Mn 0.6		●	ca. 200 HB	neutral	Flux cored welding rod for autogenous welding of grey cast iron grades. Colour-matched and structure-matched weld metal.

## Powder for cast iron spraying

UTP-Type EN 1274	Reference analysis	Grain size	Hardness	Properties and applications
<b>Metal powder for melting for cast iron materials</b>				
<b>HA-3</b> 2.2 - 106/20	C 0.03 Fe 0.5 B 1.3 Si 2.3 Ni Rest	- 106 +20 µm	205 - 260 HV	Self-fluxing nickel-based metal powder alloys for joints and build-ups on all common cast iron materials with the HA-BOND burner. Good machine cuttability.
<b>HA-6315 G</b> 2.1 - 106/20	C 0.04 Fe 0.5 Si 2.0 B 1.2 Cu 20.0 Ni Rest	- 106 + 20 µm	170 - 240 HV	Self-fluxing nickel-based metal powder alloys for joints and build-ups on all common cast iron materials with the HA-BOND burner. Good machine cuttability, colour-matched build-up metal on grey cast iron, good ductility
<b>HA-6320</b> 2.2 - 53/20	C 0.03 Fe 0.5 B 1.4 Si 2.4 Ni Rest	-53 + 20 µm	190 - 260 HV	Self-fluxing nickel-based metal powder alloys for joints and build-ups on all common cast iron materials with the HA-Bond burner; specially designed also for edge build-ups, smooth and clean surface, good machine cuttability





## Sales Program

### Welding consumables:

Stick electrodes for welding nickel and nickel alloys  
Stick electrodes for hardfacing  
Special stick electrodes for welding different kinds of steel  
Stick electrodes for welding cast iron  
Stick electrodes for chamfering and cutting  
Stick electrodes for welding non-ferrous metals  
Stick electrodes for welding stainless, acid- and heat resistant steels  
Silver solders, brazing alloys, soft solders  
Fluxes  
Stick electrodes for welding low- and medium-alloyed steels  
MIG/MAG wires and TIG rods  
Flux-cored wires  
Submerged arc welding wires and fluxes

### Flame and Plasma spraying powders:

Metal powders  
EXOBOND powders  
UNIBOND powders  
HABOND powders  
PTA powders (Plasma)

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*If it can be welded – we know how.*



UTP is a certificated company.  
TÜV Certification according to DIN EN ISO 9001  
DIN EN ISO 14001