

MAG-ORBITAL WELDING WITH FLUX-CORED WIRES

MAG-ORBITALNO ZAVARIVANJE PRAŠKOM PUNJENIM ŽICAMA

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Ključne riječi: orbitalno zavarivanje punjenim žicama

Key words: orbital welding with cored wires

Sažetak: Orbitalno zavarivanje je postupak kod kojeg glava za zavarivanje putujući po vodilici slijedi kružnu putanju za vrijeme izvođenja zavarivanja cijevi. Operater postavlja glavu za zavarivanje u određeni položaj na vodilicu, pokreće uređaj i nadzire automatski proces zavarivanja. Pri izvođenju zavarivanja moguća je korekcija parametara zavarivanja ručno.

Abstract: Orbital welding procedure as the welding machine running on a guiding track describes a circle following the pipe diameter. The operator places the orbital welding machine in the required position, starts the process and observes the execution of the automatic welding process. Manual correction welding is possible.

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Procedure principles

The procedure is used for mechanised joining by welding of steel pipes.

Principally it is a MAG welding procedure with mechanised guiding of the torch. The designation ORBITAL welding was chosen for this procedure as the welding machine running on a guiding track describes a circle following the pipe diameter. The operator places the orbital welding machine in the required position, starts the process and observes the execution of the automatic welding process. Manual corrections during welding are possible (picture 2).

The pipe axis can be placed in horizontal or vertical position. Deviations up to 10° can be handled without any problems.

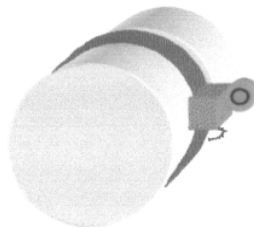


Picture 1

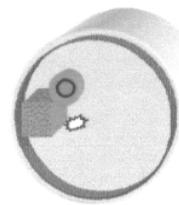


Picture 2

Circular pipe welds can be welded on the outer surface of the pipe (picture 3) as well as on the inner surface - in case of more important pipe diameters (picture 4).

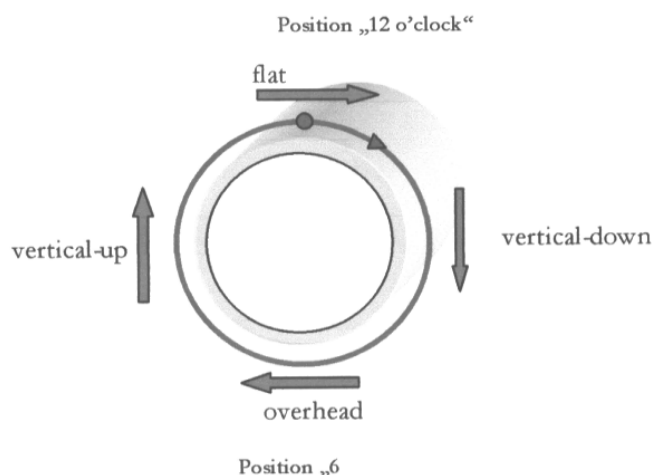


Picture 3



Picture

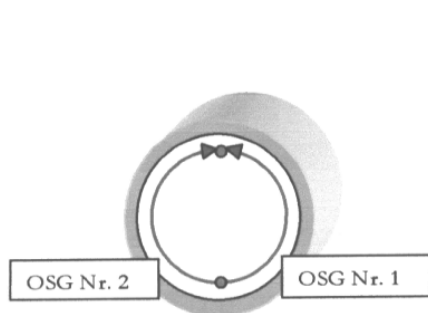
Depending on the welding position, the influence of gravity on the weld seam formation changes. As with a 360° - weld of a pipe in horizontal position all welding positions are used (flat, vertical-down, overhead, vertical-up (picture 5), it is necessary to adapt the welding parameters accordingly during the welding procedure.



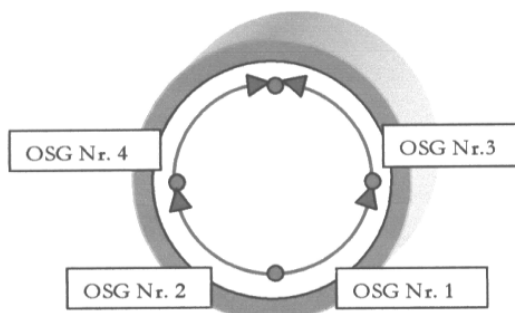
Picture 5

In contrary, with OERLIKON's MAG orbital welding process the circular welds at pipes with horizontal axis are welded in two halves from 6 o'clock to 12 o'clock position. Thus the vertical-down position can be avoided. With the use of flux-cored wires having a slag composition especially developed for positional welding the weld seams can be carried out with only one parameter adjustment. Thus, the interventions of the operator are reduced to a minimum.

For reasons of efficiency two orbital welding machines are used for bigger pipe diameters (picture 6). For the biggest pipe diameters, e.g. 4000 mm, the welding task can be carried out with four orbital welding machines in vertical-up position in segments of 90° each (picture 7).



Picture 6



Picture 7

OSG: Orbital welding machine

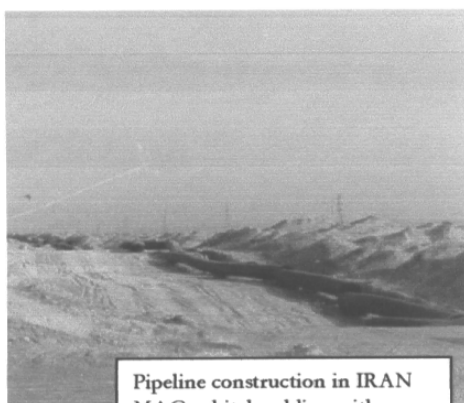
MAG orbital welding with flux-cored wires



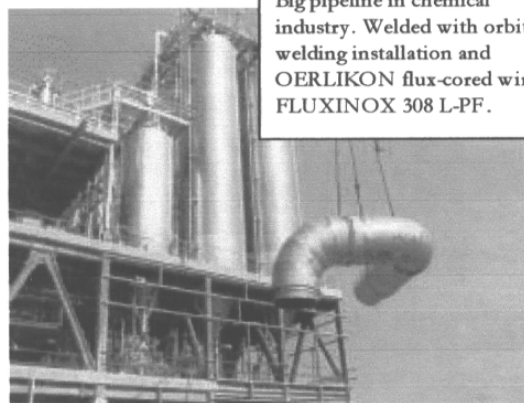
Application

Typical applications for the MAG orbital welding comprise the welding of pipelines for oil and gas or big pipelines in the chemical industry as well as the welding of long-distance heating systems or pipes in the construction with steel.

The procedure is used beginning with a diameter of 250 mm.



Pipeline construction in IRAN
MAG orbital welding with
OERLIKON installations and
consumables.



Big pipeline in chemical
industry. Welded with orbital
welding installation and
OERLIKON flux-cored wire
FLUXINOX 308 L-PF.

Welding of root passes

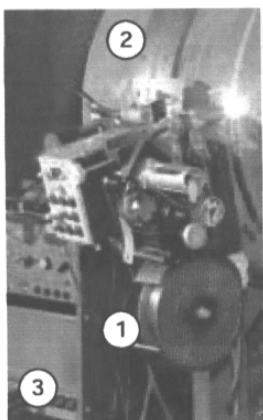
Root passes with rutile flux-cored wires suitable for MAG orbital welding can only be carried out with weld pool backing and in overhead-position they are only possible in a limited scope. Therefore root pass and hot pass are usually carried out in manual welding technique. For this purpose the following procedures are used: MAG welding with metal cored or solid wires, TIG welding or MMA welding with stick electrodes.

MAG orbital welding with flux-cored wires



MAG orbital unit

The MAG orbital unit consists of the following components:



1. Orbital welding machine with wire holder, wire feeder and control unit.
2. Guiding track made of hardened spring steel
3. MAG power source

The welding head of the orbital welding machine (OSG) carries out an oscillating movement. The following parameters can be chosen for the oscillation:

Width of oscillation	10 – 64 mm
Oscillation speed	10 – 112 mm/s
Dwelling time at the points of reverse	0 – 2 s
Rotational speed	9 – 190 cm/min

The adjustment of the parameters is simple and does not require programming experience.

The guiding track is made of hardened spring steel. For assembly on the inner surface the track is spread apart and thus pressed to the inner surface; for assembly on the outer surface the track is tightened around the pipe. Tightening and pressure unit are integrated in the track. This construction guarantees the safe fastening of the OSG during welding. Additional assembly components or supports are not necessary. For bigger pipe diameters the complete track is made of partial track parts with plug-type connectors.

MAG orbital welding with flux-cored wires

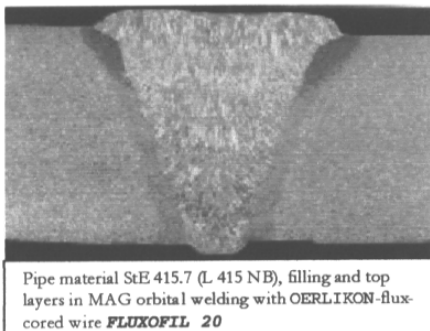
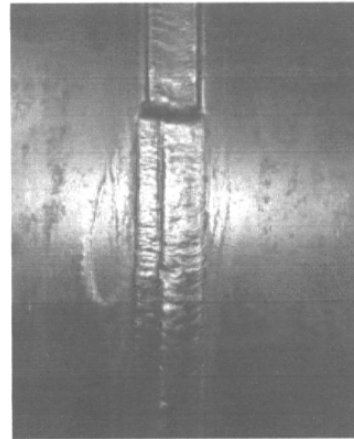


Flux-cored wires

For the MAG orbital welding according to the *OERLIKON* procedure various flux-cored wires were developed. The special rutile slag solidifies when the metal weld pool below is still liquid. Thus the weld pool is completely covered and backed by the slag. The unpleasant sagging of the weld pool - gravity effect - is efficiently avoided.

Picture right side:

MAG orbital welded pipe (material X 70, API Spec. 5L) with wall thickness 25 mm and diameter 610 mm. The picture shows the last filling layer and the two top layers in the segment around position 9 o'clock. Welded with flux cored wire FLUXOFIL 20 HD, 1,2 mm, shielding gas 82 % Ar – 18 % CO₂. V-groove, opening angle 50 °. Axis of the pipe horizontal, orbital unit mounted outside.



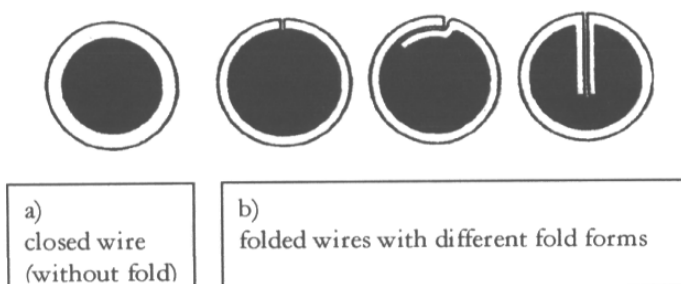
Pipe material StE 415.7 (L 415 NB), filling and top layers in MAG orbital welding with OERLIKON-flux-cored wire **FLUXOFIL 20**

The flux-cored wires are adapted to different base materials. Because of its long-term experience in welding metallurgy OERLIKON offers flux-cored wires for pipes up to the strength of the steel X 80 (API) with excellent toughness and crack resistance.

MAG orbital welding with flux-cored wires



Depending on the production technique of the producer, flux-cored wires are offered in different coating versions.



OERLIKON FLUXOFIL flux-cored wires are closed (see picture a).

After its development the production procedure for this type of wires was patented by *OERLIKON* as *FLUXOFIL* procedure. The closed form has got important advantages in comparison with the folded wire types:

- Because of the completely closed coating surface no humidity can be absorbed by the filling flux during storage and use. Humidity in welding consumables is one of the causes for the unwanted hydrogen-induced cracks. The hydrogen content of the flux-cored wires produced according to the *FLUXOFIL* procedure is very low and therefore does not cause product-related hydrogen-induced cracks. The additional re-baking of the wire spools, especially under difficult climatic conditions on site, is not necessary.
- A coppering of the flux-cored wires by galvanisation is possible - with all related advantages for current transfer and corrosion protection.
- With the symmetric cross section, torsion effects during application are nearly completely avoided - a main condition for a directionally stable wire feeding at the end of the torch.

OERLIKON flux-cored wires have got approvals from German and international approval societies (e. g. TÜV, Deutsche Bahn AG, CONTROLAS, DET NORSKE VERITAS, Germanischer Lloyd, Lloyds register of shipping) and fulfil the European standards as well as the American AWS/ASME standards.



MAG orbital welding with flux-cored wires



References

With orbital welding installation and the corresponding flux-cored wires from OERLIKON pipes for pipelines and constructions were welded successfully in the following countries: e.g. Iran, Turkey, Hungary, Thailand, Korea and Germany.

The following companies chose MAG orbital welding installations from OERLIKON:

BABCOCK, Osterode (D)
Bautec, Göttingen (D)
Bilfinger und Berger, Wiesbaden (D)
Bohlen & Doyen, Wiesmoor (D)
DUNAFERR, Donaustadt (H)
ERMO Rohrleitungsbau, Mainhausen (D)
Freytag, Olpe (D)
Kraftanlagen Heidelberg, Heidelberg (D)
Lauer, Ludwigshafen (D)
Mannesmann Rohrleitungsbau, Düsseldorf (D)
Noell, Würzburg (D)
Preussag, Düsseldorf (D)
Stahl, Mannheim (D)



MAG orbital welding with flux-cored wires

Weld build-up and welding parameters (typical settings) for MAG orbital welding with flux cored wires



Flux cored wires FLUXOFIL 14, 14 HD, 18, 19 HD, 20, 20 HD, 25
 Shielding gas 82 % Ar / 18 % CO₂ (EN 439: M 21), consumption approx. 15 l/min
 root pass welded manually (MAG with metal cored or solid wire, TIG or stick electrodes)

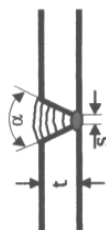
t [mm]	α [°]	s [mm]	electrode diameter [mm]	number of layers (without root pass); 1 bead per layer	amperage (1 st layer/ subsequent layers) [A]	voltage (1 st layer/ subsequent layers) [V]	welding speed [cm/min]	weld-metal deposit rate [kg/h]	welding time per meter joint (without root pass) [min/m]
6	60	2	1,0	1	160 – 180	21 – 22	10,5 – 12,0	1,9 – 2,2	9,5 – 8,3
8	60	2	1,0	1	160 – 180	21 – 22	8,1 – 9,3	1,9 – 2,2	12,3 – 10,8
10	60	3	1,0 (1,2)	2	160 – 180 200 – 210	22 23	11,0 14,0 – 15,3	2,2 2,5 – 2,8	17,0 – 16,3
12	60	3	1,2	3	160 – 180 200 – 210	22 23	12,0 14,0 – 15,3	2,2 2,5 – 2,8	22,6 – 21,0
15	60	3	1,2	4	160 – 180 220 – 240	22 23 – 24	11,0 14,6 – 16,8	2,2 3,0 – 3,4	29,6 – 27,0
18	50	3	1,2	5	160 – 180 220 – 240	22 23 – 24	11,0 13,4 – 15,4	2,2 3,0 – 3,4	39,0 – 35,1
20	50	3	1,2	5	160 – 180 220 – 240	22 23 – 24	11,0 13,0 – 15,0	2,2 3,0 – 3,4	40,5 – 39,1
22	50	3	1,2	6	160 – 180 220 – 240	22 23 – 24	11,0 12,7 – 14,6	2,2 3,0 – 3,4	48,5 – 43,3

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MAG orbital welding with flux-cored wires

Weld build-up and welding parameters (typical settings) for MAG orbital welding with flux cored wires



Flux cored wires FLUXOFIL 14, 14 HD, 18, 19 HD, 20, 20 HD, 25
Shielding gas 82 % Ar / 18 % CO₂ (EN 439: M 21), consumption approx. 15 l/min
root pass welded manually (MAG with metal cored or solid wire, TIG or stick electrodes)

t [mm]	α [°]	s [mm]	electrode diameter [mm]	number of layers (without root pass); 1 bead per layer	amperage (1 st . layer/ subsequent layers) [A]	voltage (1 st . layer/ subsequent layers) [V]	welding speed [cm/min]	weld-metal deposit rate [kg/h]	welding time per meter joint (without root pass) [min/m]
25	50	3	1,2	7	160 - 180 220 - 240	22 23 - 24	11,0 14,2 - 16,3	2,2 3,0 - 3,4	51,3 - 45,9
25	40	3	1,2	6	160 - 180 220 - 240	22 23 - 24	11,0 12,4 - 14,3	2,2 3,0 - 3,4	49,4 - 44,1
28	40	3	1,2	8	160 - 180 220 - 240	22 23 - 24	11,0 13,0 - 14,9	2,2 3,0 - 3,4	60,5 - 54,2
30	40	3	1,2	9	160 - 180 220 - 240	22 23 - 24	11,0 13,0 - 14,9	2,2 3,0 - 3,4	70,6 - 62,8

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FLUXOFIL 14



Rutile tubular cored electrode for MAG-welding, with fast-freezing slag

Standards: DIN EN 758 T 46 4 P M 1 H5
AWS/ASME SFA-5.20 E71T-1MJ H4

Applications and properties:

Rutile tubular cored electrode with fast-freezing slag. Thanks to an easily controllable weld pool, it shows outstanding welding properties in all positions. Its suitability for partly and fully mechanized welding of girth seams in pipelines should be emphasized. In MAG-orbital welding, the 6 to 12 o'clock position, using 1,2-1,4 mm electrodes, should be preferred. Low spatter loss, easy slag removal smooth, finely rippled welds without undercutting into the base metal are outstanding features.

Materials:

EN-Designation	DIN-Designation	EN-Designation	DIN-/AWS-Designation
S185	St 33	S235 to S355	St 37.0 to St 52.0
S235 to S355	St 37-2 to St 52-3	P235 to P355	St 37.4 to St 52.4
P235	St 35.8	P265	St 45.8
L210 to L415	StE 210.7 to StE 415.7	L360 to L485	StE 360.7 TM-StE 480.7 TM
L290, L320	StE 290.7TM, StE 320.7TM	P235GH, P265GH	Hi, HiI
—	X42 to X65	P295GH	17 Mn 4
—	StE 255	S(P)275 to S(P)460	StE 285to StE 460
—	A, B, D, E	—	AH 32 to EH 36
—	GS-38	GP240R	GS-45

Please observe admissible operating temperature for welding consumable and base material.

Qualification tests: TÜV, TÜV Austria, UDT

Approvals: DB, Controlas, ABS, BV, DNV, GL, LRS, RS

Indications as to approvals, see appendix.

Analysis of all-weld metal (typical values in %):

C	Si	Mn
0,05	0,55	1,2

Mechanical properties of all-weld metal (single values are typical values):

Heat treatment	Yield strength [N/mm²]	Tensile strength [N/mm²]	Elongation A ₅ [%]	Impact energy ISO-V [Joule]		
				+20 °C	-20 °C	-40 °C
AW	> 460	550–650	> 22	> 120	> 80	> 60
SR	> 460	550–650	> 22	> 120	> 60	—

AW = as-welded

SR = stress relieved (2 hrs./580 °C/furnace cooling to 300 °C)

Chemical composition and mechanical properties apply to the use of shielding gas:

DIN EN 439 - M21 (82 Vol. % Ar + 18 Vol. % CO₂)

Shielding gas as to DIN EN 439:

M21 (ARCAL 21)

Consumption:

12–15 l/min for Ø ≤ 1,6 mm, 15–20 l/min for Ø ≥ 2,0 mm

Welding parameters and deposition rate, see:

B 130

Form of delivery:

Wire cage reel K300 (16 kg)						
Wire diameters [mm]	1,0	1,2	1,4	1,6	2,0	2,4

Further forms of delivery on request.

Type of current/Polarity/Welding positions:



FLUXOFIL 14 HD



Rutile tubular cored electrode for MAG-welding, with fast-freezing slag

Standards: DIN EN 758 T 46 2 P C 1 H5 / T 46 2 P M 1 H5
 AWS/ASME SFA-5.20 E71T-1 H4 / E71T-1M H4

Applications and properties:

The higher filling degree of FLUXOFIL 14 HD results in higher current carrying capacity and deposition rate. Welding speed is thereby essentially increased which leads to a saving of time and reduction of costs. It can be used in all positions with only one setting of welding parameters (24 volts, wire feed = 9m/min, wire dia. 1,2 mm). FLUXOFIL 14 HD is employed in manual welding, as well as in fully mechanized welding by means of the orbital welding unit CITOTRACK OSG-01 or the vertical welding set CITOTRACK VSG-01. It is preferably used under mixed shielding gas and is characterized by low spatter loss, good slag removal and finely rippled, pore-free welds without undercutting into the base metal.

Materials:

EN-Designation	DIN-Designation	EN-Designation	DIN-/AWS-Designation
S185	St 33	S235 to S355	St 37.0 to St 52.0
S235 to S355	St 37-2 to St 52-3	P235 to P355	St 37.4 to St 52.4
P235	St 35.8	P265	St 45.8
L210 to L415	StE 210.7 to StE 415.7	L360 to L485	StE 360.7 TM-StE 480.7 TM
L290, L320	StE 290.7TM, StE 320.7TM	P235GH, P265GH	Hi, HiI
–	X42 to X65	P295GH	17 Mn 4
–	StE 255	S(P)275 to S(P)460	StE 285to StE 460
–	A, B, D, E	–	AH 32 to EH 36
–	GS-38	GP240R	GS-45

Please observe admissible operating temperature for welding consumable and base material.

Qualification tests: TUV

Approvals: DB, ABS, DNV, GL, LRS

Indications as to approvals, see appendix.

Analysis of all-weld metal (typical values in %):

C	Si	Mn
0,05	0,55	1,2

Mechanical properties of all-weld metal (single values are typical values):

Heat treatment	Yield strength [N/mm ²]	Tensile strength [N/mm ²]	Elongation A ₅ [%]	Impact energy ISO-V [Joule] -20 °C
AW	> 460	550–650	> 22	> 80

AW = as-welded

Chemical composition and mechanical properties apply to the use of shielding gas:

DIN EN 439 - M21 (82 Vol. % Ar + 18 Vol. % CO₂)

Shielding gas as to DIN EN 439:

M21 (ARCAL 21), C1 (carbon dioxide)

Consumption:

12–15 l/min for Ø ≤ 1,6 mm

Welding parameters and deposition rate, see:

B 131

Form of delivery:

Wire cage reel K300 (16 kg)			
Wire diameters [mm]	1,0	1,2	1,6

Further forms of delivery on request.

Type of current/Polarity/Welding positions:



B 27

FLUXOFIL 19 HD



Rutile tubular cored electrode for MAG-welding, with fast-freezing slag

Standards: DIN EN 758 T 46 2 P C 1 H5
 AWS/ASME SFA-5.20 E71T-1 H4

Applications and properties:

Rutile tubular cored electrode with enhanced filling degree. Thanks to its easily controllable weld pool, it possesses outstanding welding properties. It can be welded in all positions with only one setting of parameters (24 Volts, wire feed 9m/min, wire dia. 1,2 mm). The enhanced filling degree results in increased current carrying capacity and deposition rate, thus essentially increasing welding speed and leading to a saving of time and costs. Low spatter loss, easy slag removal, smooth and finely rippled welds without undercutting into the base metal.

Materials:

EN-Designation	DIN-Designation	EN-Designation	DIN/AWS-Designation
S185	St 33	S235 to S355	St 37.0 to St 52.0
S235 to S355	St 37-2 to St 52-3	P235 to P355	St 37.4 to St 52.4
P235	St 35.8	P265	St 45.8
L210 to L415	StE 210.7 to StE 415.7	L360 to L485	StE 360.7 TM-StE 480.7 TM
L290, L320	StE 290.7TM, StE 320.7TM	P235GH, P265GH	HI, HII
—	X42 to X70	P295GH	17 Mn 4
—	StE 255	S(P)275 to S(P)460	StE 285to StE 460
—	A, B, D, E	—	AH 32 to EH 36
—	GS-38	GP240R	GS-45

Please observe admissible operating temperature for welding consumable and base material.

Qualification tests: TUV

Approvals: DB, Controlas, ABS, BV, DNV, GL, LRS, RS, PRS, RINA

Indications as to approvals, see appendix.

Analysis of all-weld metal (typical values in %):

C	Si	Mn
0,05	0,5	1,2

Mechanical properties of all-weld metal (single values are typical values):

Heat treatment	Yield strength [N/mm ²]	Tensile strength [N/mm ²]	Elongation A ₅ [%]	Impact energy ISO-V [Joule] -20 °C
AW	> 460	550–650	> 22	> 80
SR	> 460	550–650	> 22	> 80

AW = as-welded

SR = stress relieved (2 hrs./580 °C/furnace cooling to 300 °C)

Chemical composition and mechanical properties apply to the use of shielding gas:

DIN EN 439 - C1 (100 Vol. % CO₂)

Shielding gas as to DIN EN 439:

C1 (carbon dioxide)

Consumption:

12–15 l/min for Ø ≤ 1,6 mm

Welding parameters and deposition rate, see:

B 131

Form of delivery:

Wire cage reel K300 (16 kg)

Wire diameters [mm]	1,0	1,2	1,6
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Further forms of delivery on request.

Type of current/Polarity/Welding positions:



FLUXOFIL 20



Rutile tubular cored electrode for MAG-welding, with fast-freezing slag

Standards: DIN EN 758 T 46 4 1Ni P M 1 H5
AWS/ASME SFA-5.29 E81T1-Ni1

Applications and properties:

Rutile tubular cored electrode with fast-freezing slag, producing a weld metal with excellent mechanical-technological properties and a guaranteed hydrogen content of < 5 ml per 100 grams weld metal. Easily controllable weld pool, outstanding welding properties in all positions. Partly and fully mechanized welding of girth seams in pipelines by means of the orbital welding unit CITOTRACK OSG-01 should be emphasized. In orbital MAG-welding the 6 to 12 o'clock position, using electrodes of 1,2 to 1,4 mm dia., is employed. Low spatter loss, easy slag removal, finely rippled, pore-free welds without undercutting into the base metal.

Materials:

EN-Designation	DIN-/AWS-Designation	EN-Designation	DIN-Designation
S185	St 33	S235 to S355	St 37.0 to St 52.0
S235 to S355	St 37-2 to St 52-3	P235 to P355	St 37.4 to St 52.4
P235	St 35.8	P265	St 45.8
P235GH, P265GH	HI, HII	P295GH	17 Mn 4
L210 to L415	StE 210.7 to StE 415.7	L290, L320	StE 290.7TM, StE 320.7TM
L360 to L485	StE 360.7 TM-StE 480.7 TM	—	X42 to X70
—	StE 255	S(P)275 to S(P)460	StE 285 to StE 460
—	AH 32 to EH 36	—	—

Please observe admissible operating temperature for welding consumable and base material.

Qualification tests: TÜV, TÜV Austria, UDT

Approvals: DB, Controlas, ABS, BV, DNV, GL, LRS, RS

Indications as to approvals, see appendix.

Analysis of alk-weld metal (typical values in %):

C	Si	Mn	Ni
0,05	0,5	1,2	0,9

Mechanical properties of alk-weld metal (single values are typical values):

Heat treatment	Yield strength [N/mm ²]	Tensile strength [N/mm ²]	Elongation A ₅ [%]	Impact energy ISO-V [Joule]		
				+ 20 °C	-20 °C	-40 °C
AW	> 490	570–670	> 22	> 120	> 80	> 60
SR	> 490	570–670	> 22	> 120	> 80	> 47

AW = as-welded

SR = stress relieved (2 hrs./580 °C/furnace cooling to 300 °C)

Chemical composition and mechanical properties apply to the use of shielding gas:

DIN EN 439 - M21 (82 Vol. % Ar + 18 Vol. % CO₂)

Shielding gas as to DIN EN 439:

M21 (ARCAL 21)

Consumption:

12–15 l/min for Ø ≤ 1,6 mm

Welding parameters and deposition rate, see:

B 130

Form of delivery:

Wire cage reel K300 (16 kg)			
Wire diameters [mm]	1,0	1,2	1,6

Further forms of delivery on request.

Type of current/Polarity/Welding positions:



FLUXOFIL 20 HD



Rutile tubular cored electrode for MAG-welding, with fast-freezing slag

Standards: DIN EN 758 T 46 4 1Ni P M 1 H5 / T 46 4 1Ni P C 1 H5
 AWS/ASME SFA-5.29 E81T1-Ni1

Applications and properties:

The enhanced filling degree of FLUXOFIL 20 HD, as compared to FLUXOFIL 20, results in higher current carrying capacity and deposition rate. Thus, welding speed is essentially increased which leads to a saving of time and costs. It can be welded in all positions using only one setting of parameters (24 volts, wire feed 9 m/min, wire dia. 1,2 mm). FLUXOFIL 20 HD is also well-suited for fully mechanized welding by means of vertical-welding unit CITOTRACK VSG-01. The weld metal produced features excellent mechanical-technological properties and a guaranteed hydrogen content of < 5 ml per 100 grams weld metal. Low spatter loss, easy slag removal, finely rippled, pore-free welds without undercutting into the base metal. FLUXOFIL 20 HD is preferably used with mixed shielding gas.

Materials:

EN-Designation	DIN-AWS-Designation	EN-Designation	DIN-Designation
S185	St 33	S235 to S355	St 37.0 to St 52.0
S235 to S355	St 37-2 to St 52-3	P235 to P355	St 37.4 to St 52.4
P235	St 35.8	P265	St 45.8
P235GH, P265GH	HI, HII	P295GH	17 Mn 4
L210 to L415	StE 210.7 to StE 415.7	L290, L320	StE 290.7TM, StE 320.7TM
L360 to L485	StE 360.7 TM-StE 480.7 TM	—	X42 to X70
—	StE 255	S(P)275 to S(P)460	StE 285 to StE 460
—	AH 32 to EH 36	—	—

Please observe admissible operating temperature for welding consumable and base material.

Qualification tests: TUV

Approvals: DB, ABS, BV, GL, LRS, RS

Indications as to approvals, see appendix.

Analysis of all-weld metal (typical values in %):

C	Si	Mn	Ni
0,05	0,5	1,2	0,9

Mechanical properties of all-weld metal (single values are typical values):

Heat treatment	Yield strength [N/mm ²]	Tensile strength [N/mm ²]	Elongation A ₅ [%]	Impact energy ISO-V [Joule]		
				+ 20 °C	-20 °C	-40 °C
AW	> 490	570–670	> 22	> 120	> 80	> 60
SR	> 490	570–670	> 22	> 120	> 80	> 47

AW = as-welded

SR = stress relieved (2 hrs./580 °C/furnace cooling to 300 °C)

Chemical composition and mechanical properties apply to the use of shielding gas:

DIN EN 439 - M21 (82 Vol. % Ar + 18 Vol. % CO₂)

Shielding gas as to DIN EN 439:

M21 (ARCAL 21)

Consumption:

12–15 l/min for Ø ≤ 1,6 mm

Welding parameters and deposition rate, see:

B 131

Form of delivery:

Wire cage reel K300 (16 kg)			
Wire diameters [mm]	1,0	1,2	1,6

Further forms of delivery on request.

Type of current/Polarity/Welding positions:



B 34

FLUXOFIL 18



Rutile tubular cored electrode for MAG-welding, with fast-freezing slag

Standards: **DIN EN 758** **T 42 A Z P C 1 H5 / T 42 A Z P M 1 H5**
AWS/ASME SFA-5.29 **E71T1-G**

Applications and properties:

Rutile tubular cored electrode with fast-freezing slag Thanks to its easily controllable weld pool it shows outstanding welding properties in all positions. Weld metal is resistant to weathering and therefore suited for welding similar weatherproof steels.

Materials:

EN-Designation	DIN-Designation	EN-Designation	DIN-Designation
–	WT St 37-2	S235J2W, S355J2G1W	WT St 37-3, WT St 52-3

Please observe admissible operating temperature for welding consumable and base material.

Qualification tests: TÜV, UDT

Approvals: DB

Indications as to approvals, see appendix.

Analysis of all-weld metal (typical values in %):

C	Si	Mn	Ni	Cu
0,05	0,4	1,1	1,2	0,5

Mechanical properties of all-weld metal (single values are typical values):

Heat treatment	Yield strength [N/mm ²]	Tensile strength [N/mm ²]	Elongation A ₅ [%]	Impact energy ISO-V [Joule] + 20 °C
AW	> 430	520–620	> 20	> 60

AW = as-welded

Chemical composition and mechanical properties apply to the use of shielding gas:

DIN EN 439 - C1 (100 Vol. % CO₂)

Shielding gas as to DIN EN 439:

C1 (carbon dioxide), M21 (ARCAL 21)

Consumption:

12–15 l/min for Ø ≤ 1,6 mm, 15–20 l/min for Ø ≥ 2,0 mm

Welding parameters and deposition rate, see:

B 130

Form of delivery:

Wire cage reel K300 (16 kg)						
Wire diameters [mm]	1,0	1,2	1,4	1,6	2,0	2,4

Further forms of delivery on request.

FLUXOFIL 25



Rutile tubular cored electrode with fast-freezing slag for MAG-welding

Standards: DIN EN 12071 T MoL P M 1 H5
 AWS/ASME SFA-5.29 E81T1-A1

Applications and properties:

Rutile tubular cored electrode with fast-freezing slag, suitable for welding of creep resistant boiler and pipe steels, subjected to operating temperatures up to 530 °C, as well as fine grain structural steels. Thanks to its easily controllable weld pool, it features outstanding welding properties in all positions. Low spatter loss, finely rippled welds without undercutting into the base metal.

Materials:

EN-Designation	DIN-Designation	EN-Designation	DIN-Designation
L360 to L450	StE360.7(TM)-StE445.7(TM)	S(P)355 to S(P)460	StE 355 to StE 460
P295GH, P355GH	17 Mn 4,19 Mn 5	P265	St 45.8
16Mo3	15 Mo 3	–	16 Mo 5
–	GS-20 Mn 5	–	GS- 24 Mn 5
–	GS-22 Mn V 2 2	–	GS-22 Mo 4
–	GS-C 25	–	GS-52, GS-60
–	X52 to X65	–	–

Please observe admissible operating temperature for welding consumable and base material.

Qualification tests: TÜV, UDT

Approvals: Controlas, DNV

Indications as to approvals, see appendix.

Analysis of all-weld metal (typical values in %):

C	Si	Mn	Mo
0,05	0,4	1,2	0,5

Mechanical properties of all-weld metal (single values are typical values):

Heat treatment	Yield strength [N/mm ²]	Tensile strength [N/mm ²]	Elongation A ₅ [%]	Impact energy ISO-V [Joule] + 20 °C
AW	> 490	550–650	> 20	> 70
SR	> 470	520–620	> 22	> 50
N	> 310	450–550	> 26	> 80

AW = as-welded

SR = stress relieved (2 hrs./580 °C/furnace cooling to 300 °C)

N = normalisiert (30 min / 940 °C/air cooling)

Chemical composition and mechanical properties apply to the use of shielding gas:

DIN EN 439 - M21 (82 Vol. % Ar + 18 Vol. % CO₂)

Shielding gas as to DIN EN 439:

M21 (ARCAL 21)

Consumption:

12–15 l/min for Ø ≤ 1,6 mm

Welding parameters and deposition rate, see:

B 130

Form of delivery:

Wire cage reel K300 (16 kg)		
Wire diameters [mm]	1,0	1,2

Further forms of delivery on request.

Type of current/Polarity/Welding positions:

