

**Characteristics:** FL193 is an agglomerated semi-basic flux for joint welding of high quality steel pipes for oil and gas. Especially recommended for single and multi-wire (up to 5 wires) in two-run technique. Very good weld appearance and slag release providing flat welds with low reinforcement and flat weld interfaces free from undercuts. High grain hardness and resistance to abrasion and a low consumption rate with good flux feeding properties in the transport and recovery system.

As a result of low hydrogen content (<5 ml/100 g in the weld metal) and low oxygen levels as well as uniform metallurgical behavior with low silicon and manganese pick-up, constant mechanical properties are obtained even in thick-walled pipes manufacturing in the two-run technique.

**Application:** especially recommended for longitudinal and spiral welded pipes production with base material grade from L360 or X52 to L555 or X80 according to ISO 3183 / API specification 5L.

<b>Classification</b>	<b>ISO 14174: S A AB 1 66 AC H5</b>
<b>Basicity index</b>	about 1.4 (according to Boniszewski)
<b>Current</b>	Up to 1500 Amp. (DC or AC) using one wire electrode
<b>Grain size</b>	according to ISO 14174: 2-16 (0.2-1.6 mm.) Is also available different grain sizes on demand
<b>Density</b>	0.95 kg./dm <sup>3</sup> (lt)
<b>Packaging</b>	the flux is available in PE-bags of 25 kg. or in big-bags of 500 ÷ 1250 kg
<b>Storage and re-drying</b>	the flux can be stored up to 1 year after delivery in dry storage rooms. Flux that has picked up moisture has to be re-dried at 200 ± 50 °C effective flux temperature.

### Main chemical constituents

SiO <sub>2</sub> + TiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub> + MnO	CaO + MgO	CaF <sub>2</sub>
20%	35%	20%	20%

### Chemical composition of all weld metal acc. to ISO 15972-1 and AWS A5.17/A5.23 specification

In combination with wire electrode	AWS A5.17 AWS A5.23	C%	Si%	Mn%	Mo%	Ni%	Ti%	B%
<b>PITTARC S2</b>	EM12K	0.05-0.08	0.2-0.5	1.0-1.4	-	-	-	-
<b>PITTARC S2Si</b>	EH12K	0.05-0.08	0.3-0.6	1.0-1.4	-	-	-	-
<b>PITTARC S3Si</b>	EH12K	0.05-0.08	0.3-0.6	1.4-1.8	-	-	-	-
<b>PITTARC S2Mo</b>	EA2	0.05-0.08	0.2-0.5	1.1-1.4	0.4-0.6	-	-	-
<b>PITTARC S3Mo</b>	EA4	0.05-0.08	0.2-0.5	1.3-1.7	0.4-0.6	-	-	-
<b>PITTARC S4MoSi</b>	EA3K	0.05-0.08	0.4-0.8	1.4-1.9	0.4-0.6	-	-	-
<b>PITTARC S3Ni1Mo</b>	EF3	0.05-0.08	0.2-0.5	1.5-1.8	0.4-0.6	0.8-0.1	-	-
<b>PITTARC S3TiB</b>	EG	0.04-0.08	0.3-0.5	1.4-1.8	-	-	0.05	0.005
<b>PITTARC S3MoTiB</b>	EA2TiB	0.04-0.07	0.3-0.5	1.2-1.6	0.4-0.6	-	0.05	0.005

## Mechanical properties in two-run weld metal of pipes steel

In combination with wire	YS [MPa]	UTS [MPa]	Elong. [%]	RT	Impact ISO-V [Joule]				
					±0 °C +32 °F	-20 °C -4 °F	-30 °C -22 °F	-40 °C -40 °F	-51 °C -60 °F
PITTARC S2/S2Si <sup>(1)</sup>	> 400	> 500	> 22	> 80	> 50	> 27	-	-	-
PITTARC S3Si <sup>(1)</sup>	> 460	> 560	> 22	> 100	> 80	> 70	> 40	-	-
PITTARC S2Mo <sup>(2)</sup>	> 560	> 630	> 17	> 100	> 90	> 60	> 40	-	-
PITTARC S3Mo <sup>(2)</sup>	> 570	> 650	> 17	> 110	> 90	> 70	> 50	-	-
PITTARC S3Ni1Mo <sup>(2)</sup>	> 560	> 650	> 17	> 110	> 90	> 70	> 60	-	-
PITTARC S3TiB <sup>(3)</sup>	> 500	> 580	> 17	> 130	-	> 90	> 80	> 70	> 60
PITTARC S3MoTiB <sup>(3)</sup>	> 570	> 650	> 17	> 130	-	> 90	> 80	> 70	> 60

(<sup>1</sup>) = base material API 5L-X60; (<sup>2</sup>) = base material API 5L-X65 and higher; (<sup>3</sup>) = low temperature toughness.

## Mechanical properties of all weld metal acc. to ISO 15972-1 and AWS A5.17/A5.23 specification

In combination with wire	Heat Treat.	YS [MPa]	UTS [MPa]	Elong. [%]	RT	Impact ISO-V [Joule]			
						±0 °C +32 °F	-20 °C -4 °F	-30 °C -22 °F	-40 °C -40 °F
PITTARC S2/S2Si	AW	> 420	> 510	> 25	> 110	> 90	> 70	> 47	-
PITTARC S3Si	AW	> 470	> 550	> 25	> 130	> 90	> 80	-	> 47
PITTARC S2Mo	AW	> 490	> 580	> 23	> 120	> 80	> 70	> 47	-
PITTARC S3Mo	AW	> 520	> 610	> 22	> 100	> 70	> 60	> 47	-
PITTARC S4MoSi	AW	> 540	> 630	> 20	> 80	> 47	> 27	-	-
PITTARC S3Ni1Mo	AW	> 580	> 680	> 20	> 120	> 80	> 70	> 47	-
PITTARC S3Ni1Mo (*)	PWHT	> 560	> 660	> 20	> 130	> 90	> 60	> 47	-

AW = as welded conditions. PWHT = (\*) after post weld heat treatment at 620 °C/2 h

## Classification

### Two-run classification of wire flux combinations:

In combination with wire electrode	AWS A5.17 AWS A5.23	ISO 14171-A Two-run (Test ass. ISO 15792-1: type 2.5)	AWS A5.17M AWS A5.23M	AWS A5.17 AWS A5.23
PITTARC S2/S2Si	EM12K	S 3T 2 AB S2/S2Si	F43TA2-EM12K	F6TA0-EM12K
PITTARC S3Si	EH12K	S 4T 3 AB S3Si	F49TA3-EH12K	F7TA2-EH12K
PITTARC S2Mo	EA2	S 5T 3 AB S2Mo	F62TA3-EA2	F9TA2-EA2
PITTARC S3Mo	EA4	S 5T 3 AB S3Mo	F62TA3-EA4	F9TA2-EA4
PITTARC S3Ni1Mo	EF3	S 5T 3 AB S3Ni1Mo	F62TA3-EF3	F9TA2-EF3
PITTARC S3TiB	EG	S 4T 5 AB SZ	F55TA5-EG	F8TA6-EG
PITTARC S3MoTiB	EA2TiB	S 5T 5 AB S3MoTiB	F62TA5-EA2TiB	F9TA6-EA2TiB

### All weld metal multiple pass classification of wire-flux combinations:

In combination with wire electrode	AWS A5.17 WS A5.23	ISO 14171-A (Test ass. ISO 15792-1: type 1.3)	AWS A5.17M AWS A5.23M	AWS A5.17 AWS A5.23
PITTARC S2/S2Si	EM12K	S 42 3 AB S2/S2Si	F48A3-EM12K	F7A2-EM12K
PITTARC S3Si	EH12K	S 46 4 AB S3Si	F55A4/F49P4-EH12K	F8A4/F7P4-EH12K
PITTARC S2Mo	EA2	S 46 3 AB S2Mo	F55A3/P3-EA2-A2	F8A2/P2-EA2-A2
PITTARC S3Mo	EA4	S 50 3 AB S3Mo	F55A3/P3-EA4-A4	F8A2/P2-EA4-A4
PITTARC S4MoSi	EA3K	S 50 0 AB G4Mo	F62A2-EA3K-A3	F9A0-EA3K-A3
PITTARC S3Ni1Mo	EF3	S 50 3 AB S3Ni1Mo	F62A3-EF3-F3	F9A2-EF3-F3



The above-mentioned values are indicative and may change without prior notice.

Edition: July 2018