Appendix 5

VDM Metals

VDM Metals, a company of Acerinox, is the world market leader for nickel alloys and high-alloyed special stainless steels. The company offers a wide product range of welding consumables - from wire electrodes up to welding strips. Materials are suitable for joint welding and overlay welding (cladding). The product range is rounded out by consulting services and training opportunities the company offers to customers in its welding centre

Please note that process parameters for welding nickel alloys differ from those for carbon steels or stainless steels. Most of the known welding processes are suitable for nickel alloys and high-alloyed special stainless steels. However, the welding parameters need to be customized for the special requirements of these materials.

Please check out VDM Metals' material data sheets and welding consumables catalogue for further information.

Product forms

- Wire electrodes and welding wires in diameters of 0.6 to 3.2 mm.
- Welding rods in diameters from 1.6 to 4 mm.
- Core wires in diameters from 2 to 5 mm.
- Welding strips for welded cladding, mostly 0.5 mm thick.
- Welding consumables are available as well in imperial sizes from either mill production or inventory in the US and outside the US.

Packaging options

- Welding wire is available on standardized spools, as special spools or in various barrel types.
- Electrodes/rods are delivered in storage tubes.
- Welding strip is available as coil.

Quality standards

- Narrow tolerance fluctuations in the alloying elements and in the dimensions.
- Setting of optimized cast and helix values for trouble-free wire transport in automated welding processes.
- Optimum preparation of raw stocks for clean and fault-free surfaces.
- All quality-relevant processing steps are carried out by VDM Metals.

Out of stock delivery

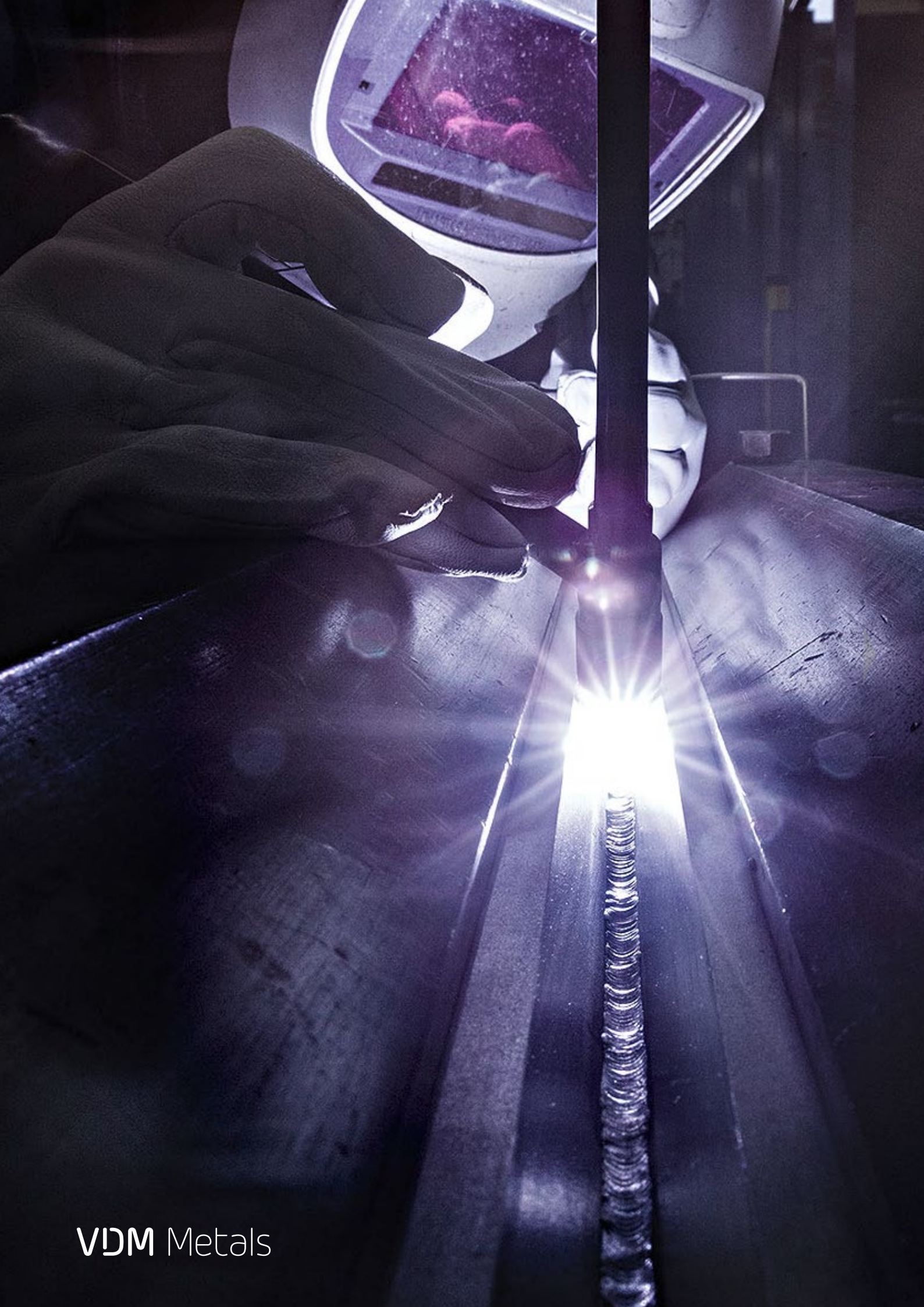
In addition to individually produced filler metals, VDM Metals' Servcie Centers hold a permanent stock of numerous materials in the form of solid wire and welding rods in order to ensure quick delivery.

We can deliver our solid wire on basket coils (15 kg/33 lbs) or in barrels (250 kg/450 kg/551lbs/992 lbs). We also supply welding rods for TIG welding in quivers (5 kg/11 lbs). Other formats are also available on demand. Please visit our webshop:

www.vdm-metals.com/shop

AWS	VDM Name	Steel No.	Description
	VDM® FM 31 Plus	2.4692	VDM® FM 31 Plus has a high chromium and moderate molybdenum content and is well suited for oxidizing media. VDM® FM 31 Plus also has a very stable austenite microstructure, even in welding-induced iron admixtures or when a PWHT is carried out. VDM® FM 31 Plus is therefore particularly suitable as a corrosion-re- sistant welding filler for deposition welding.
AWS A5.9: ER33-31	**VDM® FM 33**	1.4591	VDM® FM 33 is a nickel-chromium-iron-molybdenum filler material that has been developed especially for welding VDM® Alloy 33. It possesses outstanding corrosion resistance in oxidizing acids and hot caustic soda and is used for corrosion-resistant weld cladding in large combustion plants.
	VDM® FM 36 M		VDM® FM 36 M is an iron-nickel filler material for welding VDM® Alloy 36 with a very low thermal expansion. Thanks to its alloy additives, it exhibits good welding behavior.
	VDM® FM 36 LT		VDM® FM 36 LT is an iron-nickel filler material for welding VDM® Alloy 36. Its alloy additives make it particularly suitable for low-temperature applications in which a reduced coefficient of thermal expansion combined with increased stability of the weld metal is required.
AWS A5.14: ERNiCrFe-15	**VDM FM 52i®**		VDM FM 52i® is a nickel-chromium filler material with good workability and a low tendency to crack that is ideal for seam welding homogeneous and similar materials. In particular, this material has been developed for weld cladding and welding in Ni-Cr-Fe components in the reactor coolant systems of nuclear power plants. It is characterized by high resistance to stress corrosion cracking in this environment
AWS A5.15: ENiFe-CI	**VDM® FM 55**	2.4560	VDM® 55 is used for cast iron cold welding, e.g. for repairs and for joinging large structural elements made of grey cast iron.

AWS A5.14: ERNiCrMo-13, ABS	**VDM® FM 59**	2.4607	VDM® FM 59 is a nickel-chromium-molybdenum filler material with a low carbon content for the over-alloyed seam welding of high-performance alloys in the area of wet chemistry. It possesses exceptionally high stability in hot acid and chloride-containing media and is frequently used in the chemical industry and environmental technologies.
AWS A5.14: ERNiCu-7, ABS	**VDM® FM 60**	2.4377	VDM® FM 60 is a cupronickel filler material for seam welding VDM® Alloy 400. It possesses good corrosion resistance in brine and alkaline salt solutions and is frequently used in offshore installations, ship building and the chemical industry.
AWS A5.14: ERNi–1, ABS	**VDM® FM 61**	2.4155	VDM® FM 61 is a pure nickel filler material with a titanium additive for seam welding nickel and weld cladding on steel, frequently as a buffer layer. Due to its high corrosion resistance in saline solutions and alkalis, it is often used in the chemical industry.
AWS A5.14: ERNiFeCr-1	**VDM® FM 65 Ni**	2.4858	VDM® FM 65 Ni is a nickel-chromium-molybdenum filler material for wet corrosion- and acid gas applications. It is used primarily for the corrosion resistant weld cladding of pipes and valves for the oil and gas industry.
AWS A5.7: ERCuNi, ABS	**VDM® FM 67**	2.0837	VDM® FM 67 is a cupronickel filler material for seam welding cupronickel materials and the weld cladding of cupronickel materials on steel. It possesses good corrosion resistance in brine and is therefore frequently used in marine engineering.
AWS A5.14: ERNiCr-3	**VDM® FM 82**	2.4806	VDM® FM 82 is a versatile nickel-chromium filler material for the joint welding of high-temperature and heat-resistant chromium-nickel steels and nickel alloys. It is frequently used in industrial oven construction and for steam generators.
AWS A5.14: ERNiCrFe-12	**VDM® FM 602 CA**	2.4649	VDM® FM 602 CA is a nickel-chromium-aluminum filler material with excellent high-temperature stability and oxidation stability of more than 1,000 °C (1,832 °F) and a high resistance to carburization and metal dusting. The main areas of application are syngas applications and high temperature applications up to 1,200 °C (2,192 °F).
AWS A5.14: ERNiCrCoMo-1	**VDM® FM 617**	2.4627	VDM® FM 617 is a highly heat-resistant nickel-chromiumcobalt filler material for seam welding in high-temperature applications. It is primarily used in the power plant technology and industrial oven construction.
AWS A5.14: ERNiCrCoMo-1	**VDM® FM 617 B**	2.4627	VDM® FM 617 B was developed with the aim of providing enhanced weldability and increased creep rupture strength compared with FM 617. Its field of application is in highly stressed pipes and fittings for coal-fired power stations with extremely high steam temperatures.



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AWS A5.14: ERNiCrMo-10	**VDM® FM 622**	2.4635	VDM® FM 622 is a nickel-chromium-molybdenum filler material with a low carbon content for the seam welding of homogeneous alloys in the area of wet corrosion applications. It is also used for the corrosion-resistant weld cladding of steam generator pipes for various fuels.
AWS A5.14: ERNiCrMo-3, ABS	**VDM® FM 625**	2.4831	VDM® FM 625 is a versatile nickel-chromiummolybdenum filler material for seam welding homogeneous alloys in wet-corrosion and high-temperature applications. It is also used for corrosion-resistant weld cladding in piping and fittings in oil production and steam generator pipes.
AWS A5.14: ERNiCrMo-20	**VDM® FM 660**		VDM® FM 660 has a similar material concept to FM 625, but VDM® FM 660 uses the alloy element tungsten instead of niobium. Compared with FM 625, VDM® FM 660 offers improved weldability, higher welding material ductility and a higher thermal stability, in particular in case of post heat treatment of the substrate materials.
AWS A5.14: ERNiFeCr-2	**VDM® FM 718**	2.4667	VDM® FM 718 is a nickel-chromium-iron-molybdenum filler material for seam welding of the basic material VDM® Alloy 718 in a wide range of demanding applications. Based on its properties and good workability, VDM® FM 718 is used for seam welding and repair welding in stationary gas turbines, automotive applications, fastening elements and in pipework for the chemical processing industry.
AWS A5.14: ERNiCrMo-19	**VDM® FM 2120**	2.4700	VDM® FM 2120 is a nickel-chromium-molybdenum filler material with a low carbon content and controlled nitrogen addition for the over-alloyed seam welding of high-performance alloys in the area of wet chemistry. It offers extremely high corrosion resistance in both reducing and oxidizing conditions, in hot, acid, and chloride-containing media and excellent resistance to mineral acids such as sulfuric acid and hydrochloric acid. VDM® FM 2120 is frequently used in extremely corrosive media in the chemical industry and environmental engineering.
AWS A5.14: ERNiMo-7	**VDM® FM B-2**	2.4615	VDM® FM B-2 is a nickel-molybdenum filler material that has been developed especially for welding VDM® Alloy B-2. It possesses outstanding corrosion resistance in reducing acids.
AWS A5.14: ERNiCrMo-7	**VDM® FM C-4**	2.4611	VDM® FM C-4 is a nickel-chromium-molybdenum filler material with a low carbon content for seam welding homogeneous alloys in wet corrosion applications. It is frequently used in the chemical industry for applications involving hydrochloric acid.
	VDM® FM C-263	2.4650	VDM® FM C-263 is a nickel-chromium-cobalt filler material that has been developed especially for the homogeneous welding of superalloy VDM® Alloy C-263. The addition of titanium means that the weld metal can be hardened and thus achieves excellent creep resistance.

AWS A5.14: ERNiCrMo-4, ABS	**VDM® FM C-276**	2.4886	VDM® FM C-276 is a nickel-chromium-molybdenum filler material with a low carbon content for seam welding homogeneous alloys in wet corrosion applications. It is widely used in the chemical industry and environmental technologies.
AWS A5.15: ENiFe-CI	**VDM® CW 55**	2.4560	VDM® CW 55 is used for the production of coated nickel-iron stick electrodes. The filler material is used for so-called cast iron cold welding, e.g. for repairs and for joining large structural elements made of grey cast iron.
AWS A5.14: ERNiCu-7	**VDM® CW 60**	2.4377	VDM® CW 60 is used for the production of coated stick electrodes as per material no. 2.4377. The filler material is used for the joint welding of nickel-copper materials and for corrosion resistant weld cladding on steel. It is used for salt solutions and alkalis in the chemical industry and in marine engineering.
AWS A5.14: ERNiCr-3	**VDM® CW 182**	2.4620, 2.4648	VDM® CW 182 is used for the production of coated electrodes as per material no. 2.4648 or 2.4807. It is a widely used nickel-chromium filler material for the joint welding of hightemperature and heat-resistant chromiumnickel steels and nickel alloys, also together with carbon steels, as well as low-temperature nickel steels. It is used in cryogenic engineering as well as for industrial oven construction and steam generators.
	VDM® CW Nickel	2.4066	VDM® CW Nickel is used for the production of coated stick electrodes with a core of commercially pure nickel. Typically, these coated stick electrodes are used for joint and repair welds of cast iron especially in order to meet highest demands on ductility and machinability.
AWS A5.14: EQNiCrFe-15	**VDM® WS 52i**		VDM® WS 52i is a nickel-chromium welding filler with good workability and a low tendency to crack that is ideal for seam welding homogeneous materials. In particular, this material was developed for weld cladding and welding in Ni-Cr-Fe components in the reactor coolant systems of nuclear power plants.
AWS A5.14: EQNiCrMo-13	**VDM® WS 59**	2.4607	VDM® WS 59 is a nickel-chromium-molybdenum filler material with a low carbon content for wet corrosion-resistant weld cladding on steel. It possesses exceptionally high stability in hot acid and chloride-containing media and is frequently used in the chemical industry and environmental technologies.

AWS A5.14: EQNiCr-3	**VDM® WS 82**	2.4806	VDM® WS 82 is a chromium-nickel filler material for corrosion- and heat-resistant weld cladding. It possesses good resistance to alkaline salt solutions as well as high-temperature oxidation and chlorination. The main areas of use are in the chemical industry, oven construction and nuclear energy.
AWS A5.14: EQNiCrMo-3	**VDM® WS 625**	2.4831	VDM® WS 625 is a nickel-chromium-molybdenum filler material for wet corrosion- and heat-resistant applications. It is mainly used for corrosion-resistant weld cladding in acid gas applications, e. g. piping and valves for the oil and gas industry and for the corrosion protection of boiler tubes in waste-to-energy plants.
AWS A5.14: EQNiCrMo-3	**VDM® WS 625 HS**	2.4831	VDM® WS 625 HS is a nickel-chromium-molybdenum filler material designed as a strip for electroslag weld cladding, especially at high speeds. It is mainly used on unalloyed or low-alloyed steel to achieve higher corrosion resistance to wet corrosion or at higher temperatures. Example applications include acid gas treatment plants and acid gas lines, for slug catchers in oil production and in intake gas separators.
AWS A5.14: EQNiCr-6 (exc. C; Ti)	**VDM® WS 8020**	2.4639	VDM® WS 8020 is a chromium-nickel filler material for heat-resistant weld cladding. It has good resistance to high-temperature oxidation and chlorination. Its main areas of use are in the chemical industry and oven construction. Titanium and Carbon contents deviate from the standards due to requirements in the field of core wire.
AWS A5.14: EQNiCrMo-4	**VDM® WS C-276**	2.4886	VDM® WS C-276 is a nickel-chromium-molybdenum filler material with a low carbon content for wet corrosionresistant weld cladding on steel. It is widely used in the chemical industry and environmental technologies.