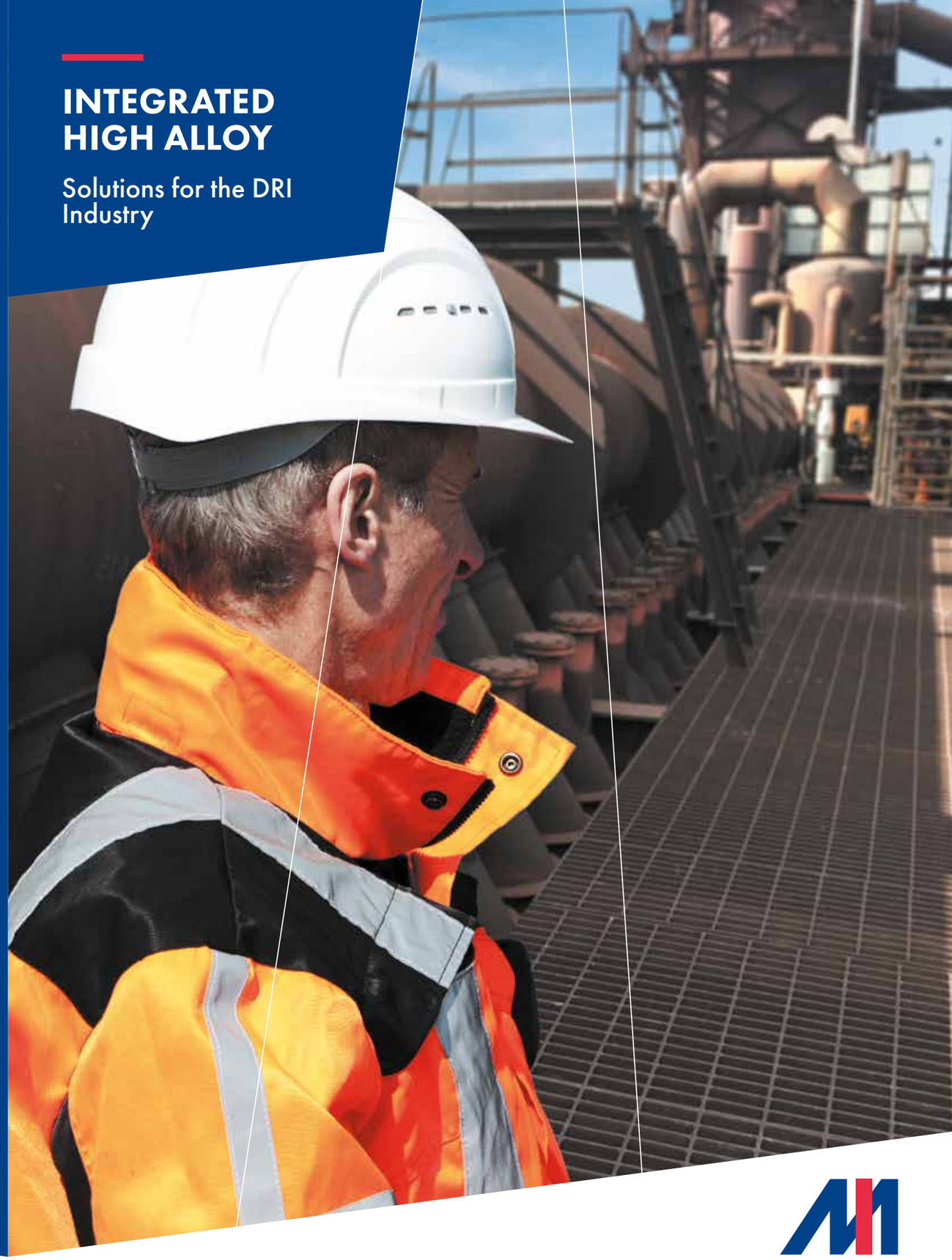
INTEGRATED HIGH ALLOY

Solutions for the DRI Industry



MANOIR INDUSTRIES

Future is our raw material.

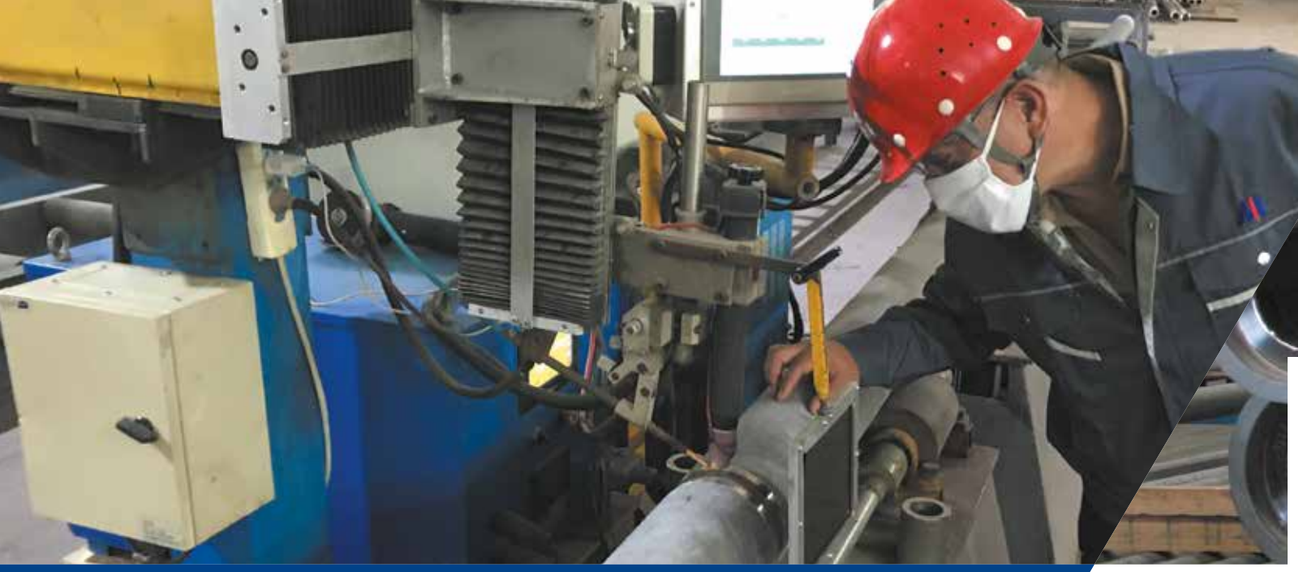
As a metal processing specialist, Manoir Industries develops alloys and operates processes for the manufacture of high-performance components. Known and recognized for several decades, its know-how is complemented by expertise in casting, forging, boilermaking, welding and assembly. Manoir's solid technical expertise continues to drive its sustainable leading position offering innovative services to its customers worldwide as true partners.

MANOIR INDUSTRIES

Contact:
support.dri@manoir.eu.com

www.manoir-industries.com

MANOIR INDUSTRIES

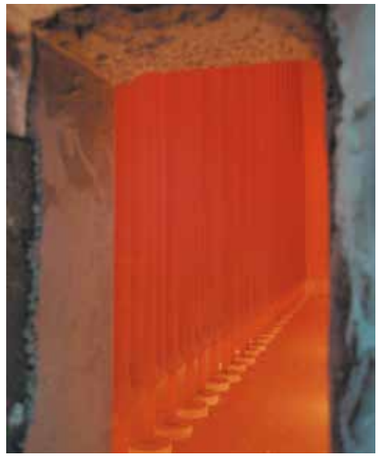


MANOIR INDUSTRIES, HISTORICAL EXPERTISE

Manoir Industries is a global company that has been involved in metal processing for nearly 100 years. Cast/forged components and assemblies are produced for extremely tough markets, such as the petrochemical, nuclear, oil and gas, civil engineering, energy, steel and defense industries.
It demonstrates historically strong and well-known technical expertise; this is driven by increasingly demanding customer requirements, which have fostered the developments of new materials and innovative solutions.

INNOVATIVE MATERIAL AND ALLOYS

In the 80's while most of the industry was operating furnace tubes with HK40 material, Manoir Industries came up with a real breakthrough by designing Manaurite® 36X (becoming HP-Nb), enhanced a few years later by micro alloying additions and then called Manaurite® XM. Today, 50 years of continuous innovation have led Manoir Industries to develop a large list of different alloys and micro alloys, servicing extremely demanding markets such as the DRI plants in the different equipment like reformers and pre-heaters on the most popular processes such as Midrex or HYL.
Manoir Industries supplies to the petrochemical and nuclear industry, where high temperature, corrosion, and high QC standards for materials are a real challenge to withstand. Manoir Industries also provides the expertise to produce centrifugally cast tubes and other fittings and accessories to be used on the actual operations required by the Direct Reduction Plants.



SHOPFLOOR WITH IN-HOUSE MANUFACTURING ACCESSORIES

Following up the international standards and audits by numerous qualification entities, **Manoir Industries** produces the different accessories used on the DRI plants:

- Reformer tubes
- Bottom canisters
- Tee pieces
- Tubes harps
- Inlet manifolds
- Outlet manifolds
- Tube sheets
- Transfer lines
- Cold and hot collectors
- Pigtails and hairpins
- Convection tubes & modules
- Process gas heater coils

SERVICES

Manoir Industries is not only a designer and manufacturer of high quality components and assemblies for petrochemical, oil & gas, nuclear, energy, steel and defense industries. It is also an assistance provider by offering DRI technical support on different areas:

- Reformer tubes performance evaluation
- Reformer tube monitoring also NDT inspection
- Process gas heaters trouble shooting
- Extended guarantees based on understanding gas composition and customizing start-up procedures
- Major shutdown and start-up technical assistance
- Plant evaluation and operation problem solving
- R&D department available to work on customer solutions
- Field welding team and welding supervision

We have in our customer services staff one DRI specialist with over **25 years of experience on DRI plant operations**, and one welding specialist with more than **25 years working on Manaurite® materials**.
Contact us at:
support.dri@manoir.eu.com

MANAURITE®				High carbon alloys							Low carbon alloys		
				DRA	XAI4	XTM	DRX	XM	50W	20	XTM LC	900B	900
Temperature Limit			°F	2192	2192	2192	2075	2015	2192	1850	2192	1976	1835
			°C	1200	1200	1200	1135	1100	1200	1010	1200	1080	1000
DRI	HyL®	Radiant Section	Tubes	■	■	■	■	■	■				
			Static castings			■	■	■	■				
		Convection section	Tubes sheets & brackets			■	■	■		■	■		■
		Transfert line					■	■			■	■	■
	Midrex®	Lower section					■	■					
		Upper section		■			■		■				

Manoir Petrochem designation	Similar grade		Composition %					Limit tube Temperature		DRI						General applications and Others
										HyL®				Midrex®		
										Radiant Section		Convection Section	Transfer line	Upper section	Lower section	
	EN 10295	ASTM	C	Ni	Cr	Al	Add	°F	°C	Tubes	Static castings	Tube sheets & brackets				
Low carbon Austenitic Alloys																
Manaurite® 900X	1,49	CT 15C	0,12	32	20		Ti	1835	1000			■	■			Pyrolysis furnace crossover
Manaurite® 900B			0,16	35	26		Nb	1976	1080							Similar to Man 900 but higher oxidation and carburization resistance
Manaurite® XTM low C	-	-	0,15	45	35		Nb, Ti, MA	2192	1200			■	■			High environmental resistance with ductility
High carbon Austenitic Alloys																
Manaurite® XM	1,49	HP+ MA	0,45	35	25		Nb, Ti, MA	2015*	1100	■	■	■	■		■	Standard for creep, creep ductility, oxidation and carburization resistance
Manaurite® DRX	-	-	0,45	35	25		Nb, Ti, MA	2075	1135	■				■	■	XM optimized for DRI, able to replace 50W at upper midrex section
Manaurite® XTM	1,49	-	0,5	45	35		Nb, Ti, MA	2192	1200	■	■	■	■			Better oxidation and carburization resistance than XM
Manaurite® 50W	2,49	-	0,4	50	30			2192	1200	■				■		Very good resistance to oxidation up to 1200°C (2192°F), Excellent creep resistance
Austenitic alloys with Aluminum																
Manaurite® XAI4	-	-	0,45	45	25	4	Nb, Ti, MA	2192	1200	■						Best performance in oxidation, carburization and coking resistance
Manaurite® DRA			■	■	■	■	■	2192	1200	■				■		Higher creep resistance than 50W at high temperature

*For specific applications, a limit of 1135°C (2080°F) can be guaranted

See complete alloy portfolio on our website manoir-industries.com