Replica Microstructures -Guidelines

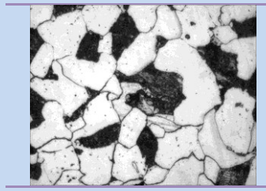
REFINERIES | CHEMICAL | FERTILIZERS | PETROCHEMICAL | OIL & GAS | POWER

Nominal composition

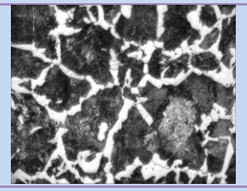
	CS	T-11	T-22	T-5	T-9	T-91
C	0.27	0.05-0.15	0.05-0.15	0.15	0.15	0.07-0.14
S	0.035	0.025	0.025	0.025	0.025	0.010
P	0.035	0.025	0.025	0.025	0.025	0.020
Mn	0.93 Max	0.30-0.60	0.30-0.60	0.30-0.61	0.30-0.60	0.30-0.60
Si	0.10	0.50-1.0	0.50-1.0	0.50	0.25-1.00	0.20-0.50
Cr		1.0-1.5	0.80-1.25	4.0-6.0	8.0-10.0	8.0-9.50
Ni				-	-	0.40
Mo		0.44-0.65	0.87-1.13	0.45-0.65	0.9-1.10	0.85-9.5
V						0.18-0.25
Nb						0.06-0.1
N						0.030-0.070
Al						0.04

	304	316	321	347	IN 800	HP-Mod	IN 625
C	0.08	0.08	0.08	0.08	0.1	0.4-0.45	<= 0.10
S	0.03	0.030	0.030	0.030	0.015	0.03 Max	<= 0.015
P	0.045	0.045	0.045	0.045			<= 0.015
Mn	2.0	2.0	2.0	2.0		1.5 Max	<= 0.5
Si	1.0	1.0	1.0	1.0	<= 1	2.0 Max	<= 0.5
Cr	18.0-20.0	16.0-18.0	17.0-19.0	17.0-20.0	19.0-23.0	24.0-28.0	20.0-23.0
Ni	8.0-10.5	10.0-14.0	9.0-12.0	9.0-13.0	30.0-35.0	34.0-37.0	>= 58.0
Mo		2.00-3.00			Cu<= 0.75	0.5 Max	8.0-10.0
Nb				10xC-1.10		0.75-1.5	Nb+Ta 3.15-4.15
Ti					Ti-0.6 max		Ti-0.4 max
Al	0.10				0.15 - 0.6		0.4 max
Else					Fe 39.5 min	Lead-0.01	Fe-5 max

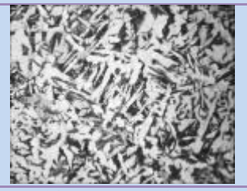
Carbon steels



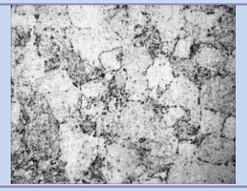
Normalized – 400X



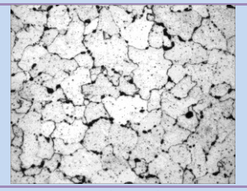
As forged or improperly heat treated–400X



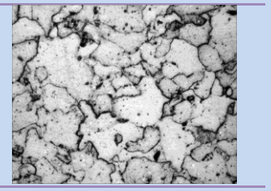
Widmanstatten ferrite and pearlite 100X



Spherodization of pearlite 400X

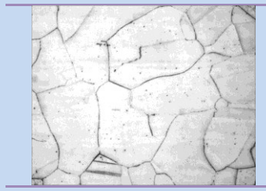


Creep voids at the grain boundaries – 400X

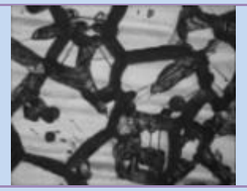


Decarburization- 400X

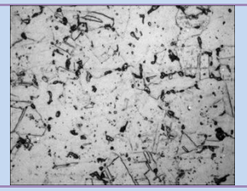
Austenitic stainless steels



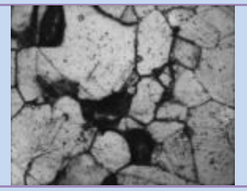
Solution annealed 400X



carbide precipitation– 400X

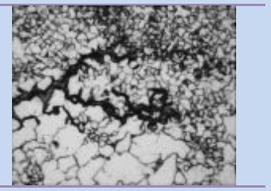


Sigma Phase 400X



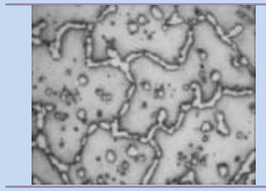
IGC 400X

TGSCC 100X

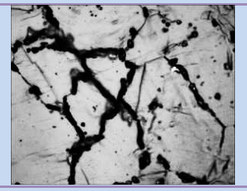


IGSCC 400X

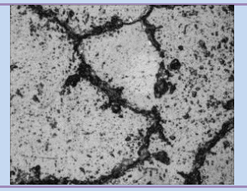
Catalytic convertors / reformer tubes / hot outlet manifolds



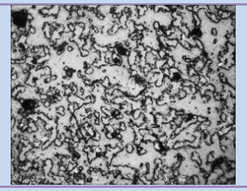
Solution annealed HK40 400X



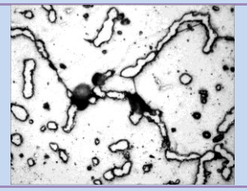
Inter-granular crack - HK40 400X



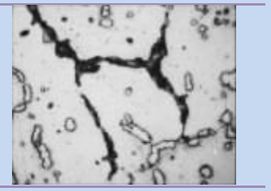
Oxidation-Incoloy 800HT 400X



Creep damage In weld HP Mod 400X

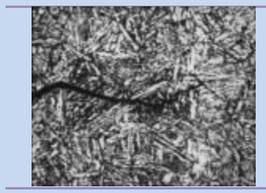


Creep damage in PM 400X

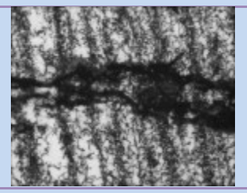


Interdendritic cracks 400X

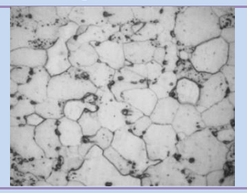
Damage mechanisms identified in the microstructure



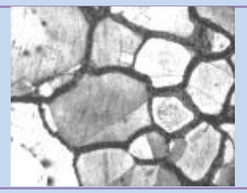
Quench cracks in alloy steel 400X



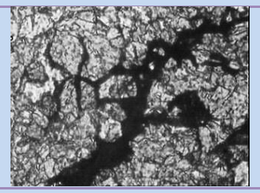
Caustic SCC carbon steel 400X



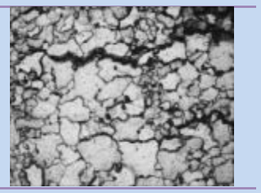
Graphitization damage low alloy steel – 400X



Grain boundary oxidation in CS - 100X



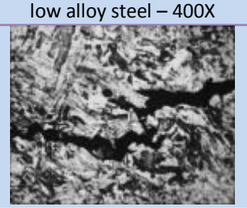
Inter-granular crack in rotor low alloy steel 400X



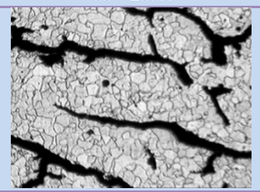
Type IV cracks P22 400X

Dissimilar metal weld SS-alloy steel 200X

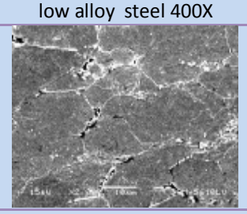
Thermal fatigue alloy steel 100X



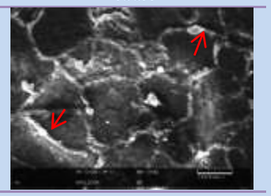
Corrosion fatigue SS 410 400X



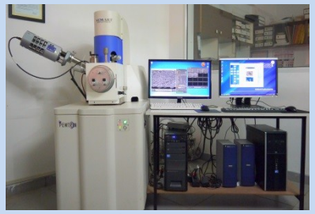
High temperature hydrogen damage C-1/2Mo. – 100X



Creep Damage in P91/T91 2000X



High temp. sulphur induced corrosion T11. – 3500X



Scanning Electron Microscopy

Optical Microscopy

Portable Microscope

In-situ Metallography by replication method.