



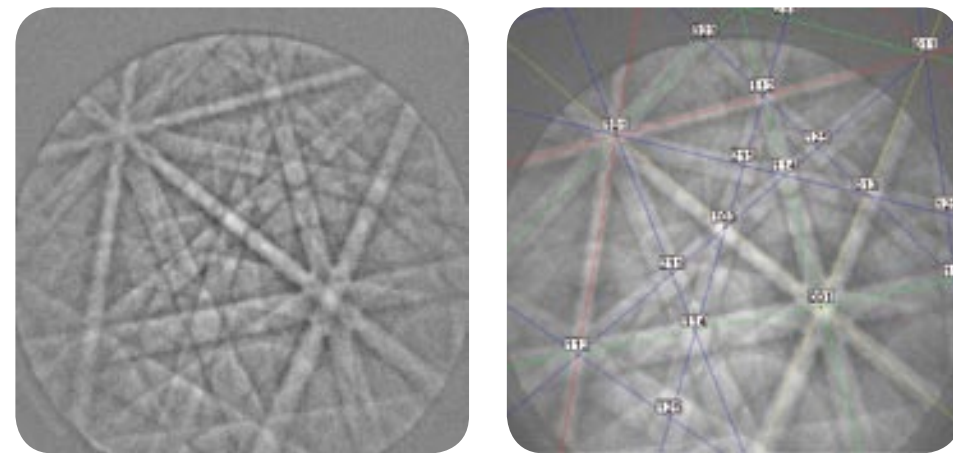
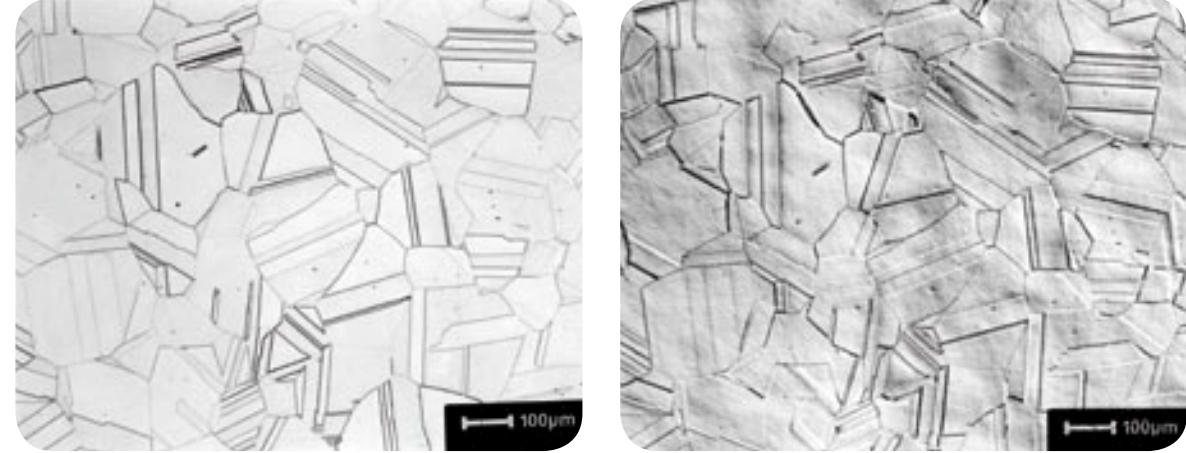
BUEHLER

Specimen Preparation for Electron Backscattered Diffraction

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Five-Step Preparation Practice for Cu and Cu Alloys

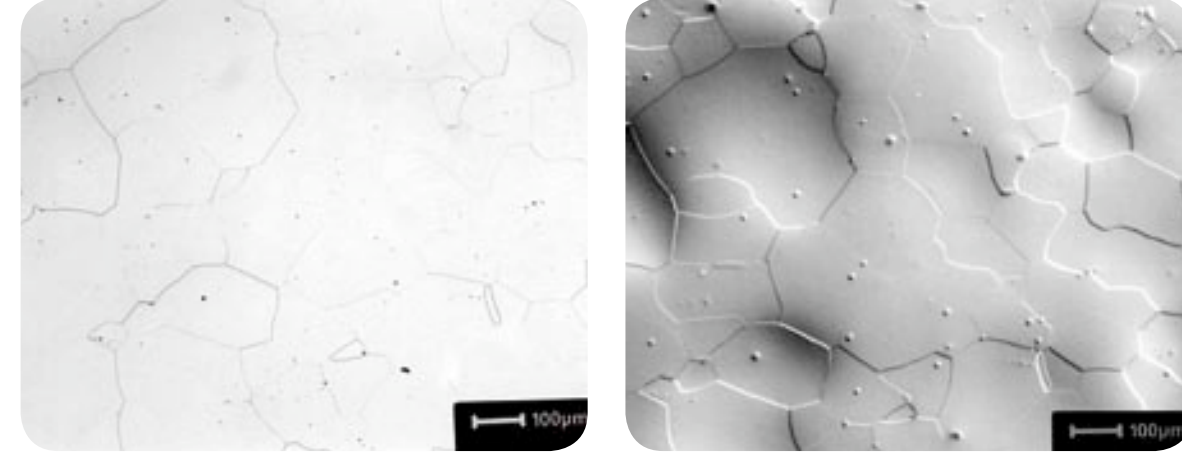
Surface	Abrasive/Size	Load Lb. (N)	Speed rpm/Direction	Time (min.)
CarbiMet waterproof paper	240 to 320 (P280 to P400) grit SiC water cooled	5-6 (22-27)	Contra	U.P.
UltraPol or TriDent cloths	9- μ m MetaDi Supreme diamond suspension	5-6 (22-27)	Contra	5
TriDent or TexMet 1500 pads	3- μ m MetaDi Supreme diamond suspension	5-6 (22-27)	Contra	4
TriDent or TexMet 1500 cloths	1- μ m MetaDi Supreme diamond suspension	5-6 (22-27)	Contra	3
MicroCloth, VelTexor ChemoMet I pads	0.05- μ m MasterMet Colloidal silica suspension	5-6 (22-27) (7 lb/31 N for ChemoMet I)	Contra	3



EBSD example: Cartridge Brass (Cu-30% Zn), cold reduced 50% and annealed (1300-F = 30 min., air cool).
 ABOVE: Alpha-Cu grain structure with annealing twins etched with equal parts ammonium hydroxide and hydrogen peroxide (3% conc.). Left - bright field illumination; right - Nomarski differential interference contrast illumination.
 LEFT: EBSD patterns, before (left) and after (right) indexing, for Cartridge Brass, Cu-30% Zn, fully annealed. Pattern quality index: 221 \pm 8.6.

Four-Step Practice for Hardened Steels and Cast Irons

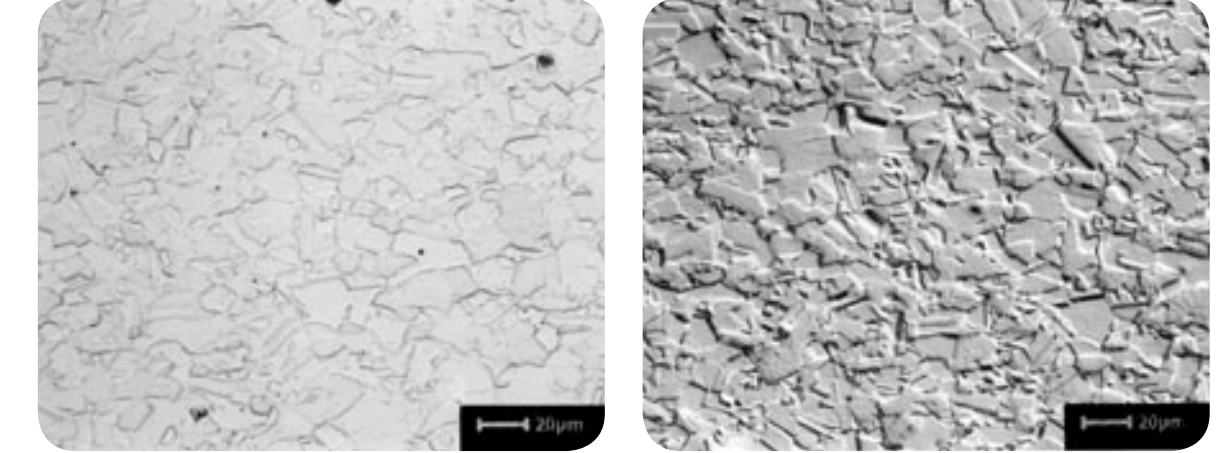
Surface	Abrasive/Size	Load Lb. (N)	Speed rpm/Direction	Time (min.)
CarbiMet waterproof discs	120 to 240 (P120 to P280) grit SiC water cooled	6 (27)	240-300 Comp.	Until Plane
UltraPol or TriDent cloths	9- μ m MetaDi Supreme diamond suspension	6 (27)	120-150 Contra	5
Texmet 1000 or Trident Cloths	3- μ m MetaDi Supreme diamond suspension	6 (27)	120-150 Contra	4
Microcloth, Nanocloth or ChemoMet I cloths	MasterPrep 0.05- μ m alumina suspension, or MasterMet colloidal silica	6 (27)	120-150 Contra	3



EBSD example: Ferrite grain structure of Silicon Core Iron B after wet hydrogen annealing.
 ABOVE: Alpha ferrite grain structure of Silicon Core Iron B (Fe-0.03% C-2.50% Si), wet hydrogen annealed (1550-F = 4 h, cooled 100-F/h), etched with nital. Left - bright field illumination; right - Nomarski differential interference contrast illumination.
 LEFT: EBSD patterns for Silicon Core Iron B before (left) and after indexing (right); pattern quality index: 199.9 \pm 7.4.

Five-Step Procedure for Ni, Ni-Cu and Ni-Fe Alloys

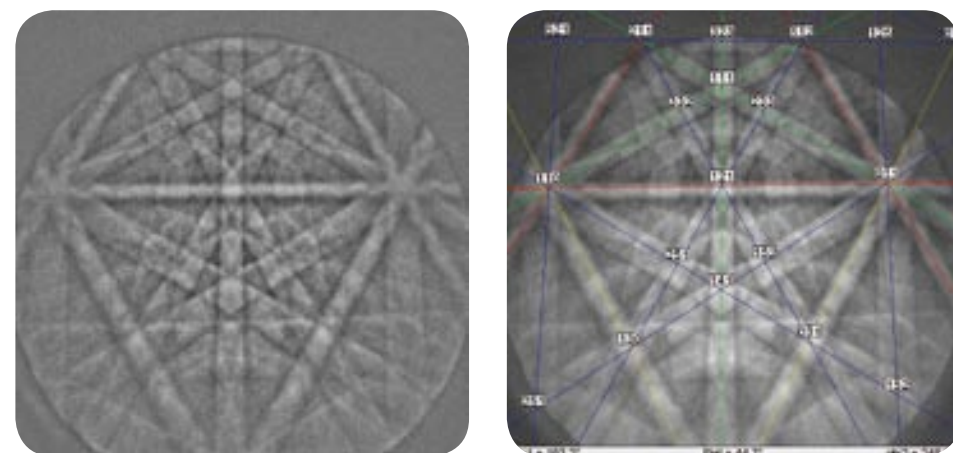
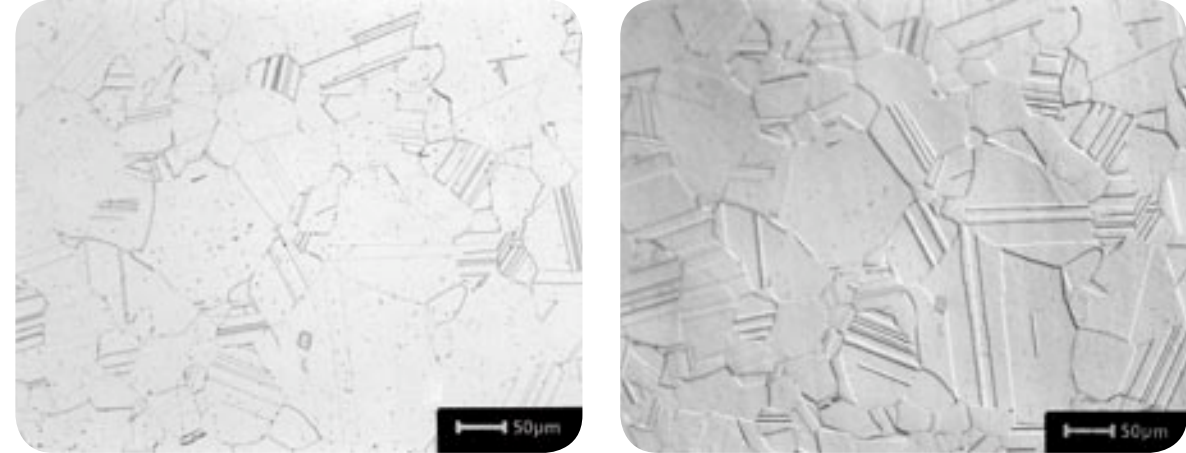
Surface	Abrasive/Size	Load Lb. (N)	Speed rpm/Direction	Time (min.)
CarbiMet abrasive discs	240/P280-grit SiC water cooled	5 (22)	200-300 Contra	Until Plane
UltraPol or TriDent cloths	9- μ m MetaDi Supreme diamond suspension	6 (27)	100-150 Contra	5
TriDent or TexMet 1500 pads	3- μ m MetaDi Supreme diamond suspension	6 (27)	100-150 Contra	4
TriDent cloth	1- μ m MetaDi Supreme diamond suspension	6 (27)	100-150 Contra	3
MicroCloth, VelTex or ChemoMet pads	0.05- μ m MasterPrep alumina suspension	6 (27) (8 lb/35 N for ChemoMet)	80-120 Contra	3



EBSD example: Wrought bar of cold drawn Ni-200 (99.5% Ni + Co).
 ABOVE: Deformed austenitic grain structure of Ni 200 etched with 15 ml HCl, 10 ml acetic acid, 10 ml HNO₃. Left - bright field illumination; right - Nomarski differential interference contrast illumination.
 LEFT: EBSD patterns before (left) and after (right) indexing of wrought Ni 200. Pattern quality index: 176.3 \pm 17.6.

Four-Step Practice for Nickel-Based Superalloys and Ni-Cr-Fe Alloys

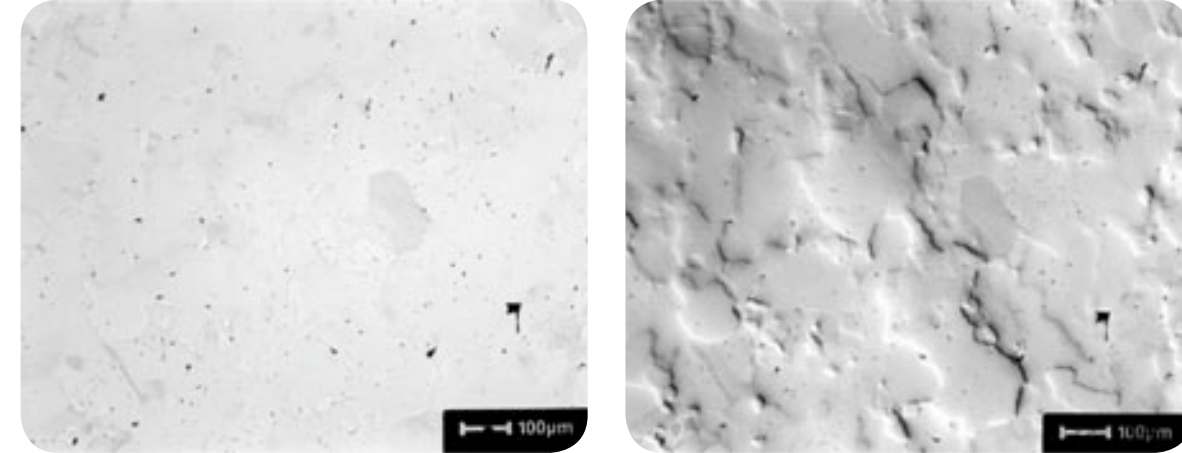
Surface	Abrasive/Size	Load Lb. (N)	Speed rpm/Direction	Time (min.)
CarbiMet waterproof paper	240/P280-grit SiC water cooled	6 (27)	240-300 Contra	Until Plane
UltraPol or TriDent cloths	9- μ m MetaDi Supreme diamond suspension	6 (27)	120-150 Contra	5
TriDent or TexMet 1500 cloths	3- μ m MetaDi Supreme diamond suspension	6 (27)	120-150 Contra	5
MicroCloth, VelTex or ChemoMet I cloths	MasterPrep 0.05- μ m alumina suspension or MasterMet colloidal silica	6 (27) (8 lb/35 N for ChemoMet)	120-150 Contra	2-5



EBSD example: Wrought solution annealed and over-aged (1475-F = 20 min., air cool) Custom Age 625 PLUS (trademark of Carpenter Technology Corp., Reading, PA) Ni-based superalloy.
 ABOVE: Austenitic, twinned grain structure of solution annealed and over-aged Custom Age 625 PLUS nickel-based superalloy etched with 15 ml HCl, 10 ml acetic acid, 10 ml HNO₃. Left - bright field illumination; right - Nomarski differential interference contrast illumination.
 LEFT: EBSD patterns for Custom Age 625 Plus before (left) and after indexing (right); pattern quality index: 200.5 \pm 6.5.

Four-Step Procedure for Refractory Metals (other than Ti, Zr and Hf)

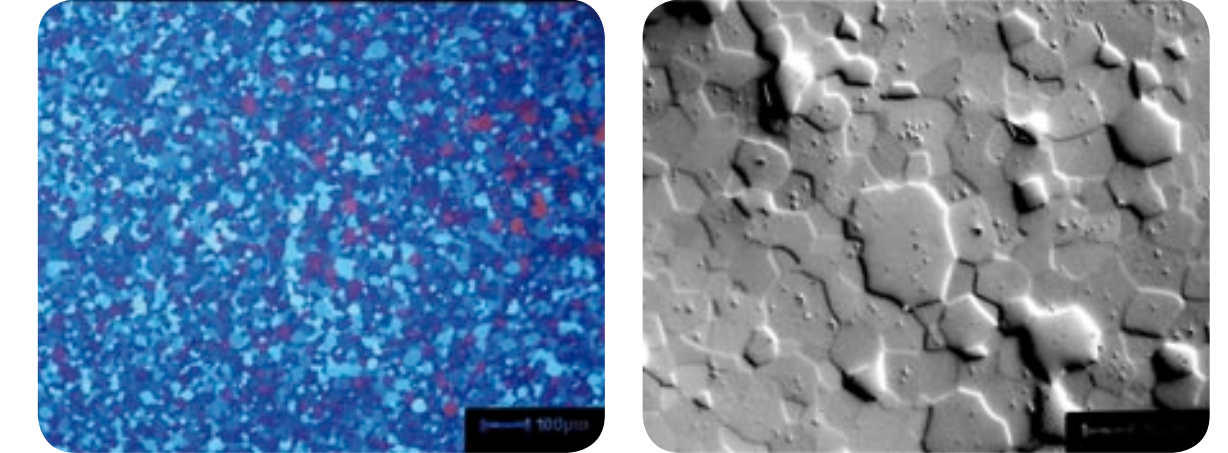
Surface	Abrasive/Size	Load Lb. (N)	Speed rpm/Direction	Time (min.)
CarbiMet waterproof paper	320/P400-grit SiC water cooled	6 (27)	200-250 Comp.	Until Plane
UltraPol or UltraPad cloths	9-mm MetaDi Supreme diamond suspension	6 (27)	150-200 Contra	10
TexMet 1500 or TriDent cloths	3-mm MetaDi Supreme diamond suspension	6 (27)	150-200 Contra	8
MicroCloth, VelTex or ChemoMet cloths	~0.05-mm MasterMet colloidal silica plus attack polish agent	6 (27)	120-150 Contra	5



EBSD example: Pure chromium.
 ABOVE: Ferrite grain structure of pure chromium (99.99%) etched with glycerol + HNO₃ + HF (30:15:10). Left - bright field illumination; right - Nomarski differential interference contrast illumination.
 LEFT: EBSD pattern (left) and after indexing (right) for 99.99% Cr - pattern quality index: 259.8 \pm 13.1.

Five-Step Automated Procedure for Precious Metals

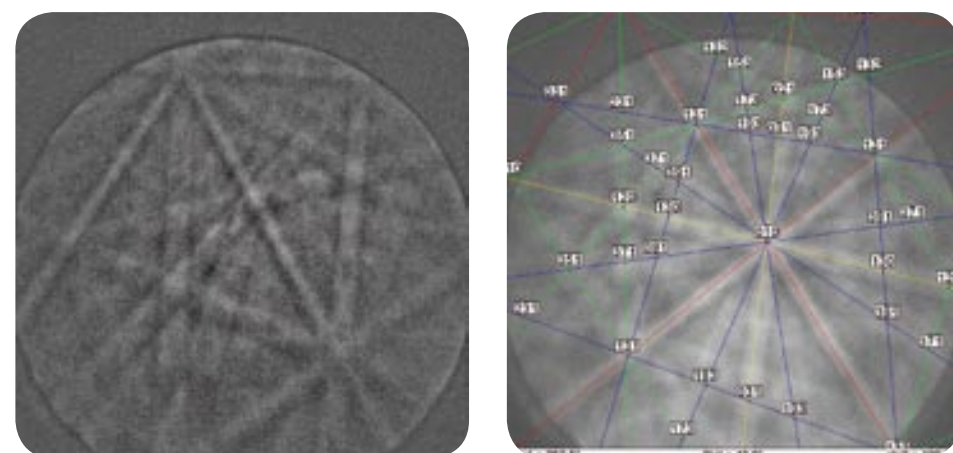
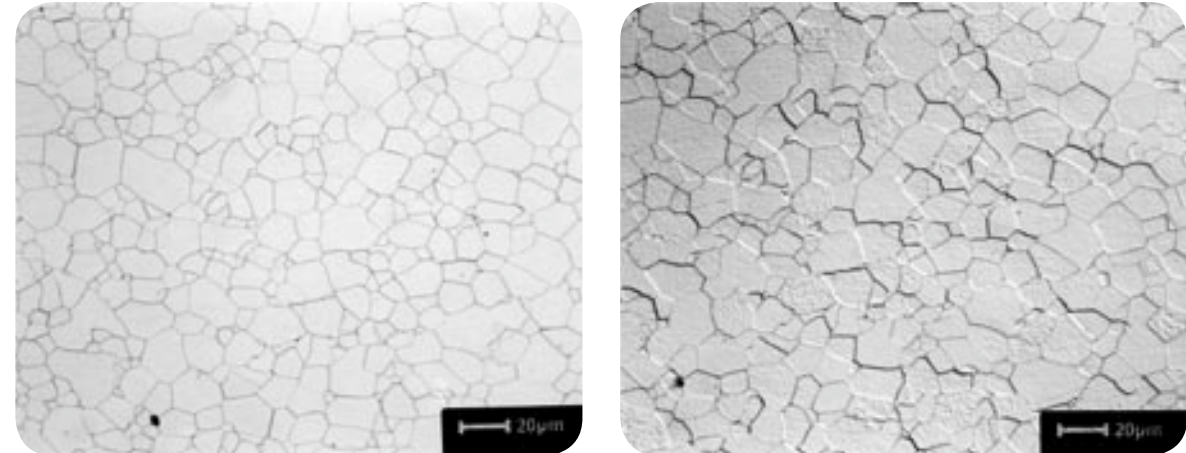
Surface	Abrasive/Size	Load Lb. (N)	Speed rpm/Direction	Time (min.)
CarbiMet waterproof paper	240/P280- or 320/P400-grit SiC water cooled	3 (13)	240 Comp.	Until Plane
TexMet 1500 pad	9- μ m MetaDi II diamond paste*	3 (13)	240 Comp.	5
TexMet 1500 pad	3- μ m MetaDi II diamond paste*	3 (13)	240 Comp.	3
TexMet 1500 pad	1- μ m MetaDi II diamond paste*	3 (13)	240 Comp.	2
ChemoMet pad	MasterPrep alumina suspension	2 (9)	100 Comp.	3



* Use water as the lubricant, but do not let it get excessively wet.
 EBSD example: Wrought, high-purity ruthenium.
 ABOVE: Pure ruthenium (hcp), as polished. Left: Polarized light illumination (100x). Right: Nomarski differential interference contrast illumination (500x).
 LEFT: EBSD patterns before (left) and after (right) indexing of hcp ruthenium. Pattern quality index: 266.2 \pm 21.8.

Four-Step Procedure for Refractory Metals (other than Ti, Zr and Hf)

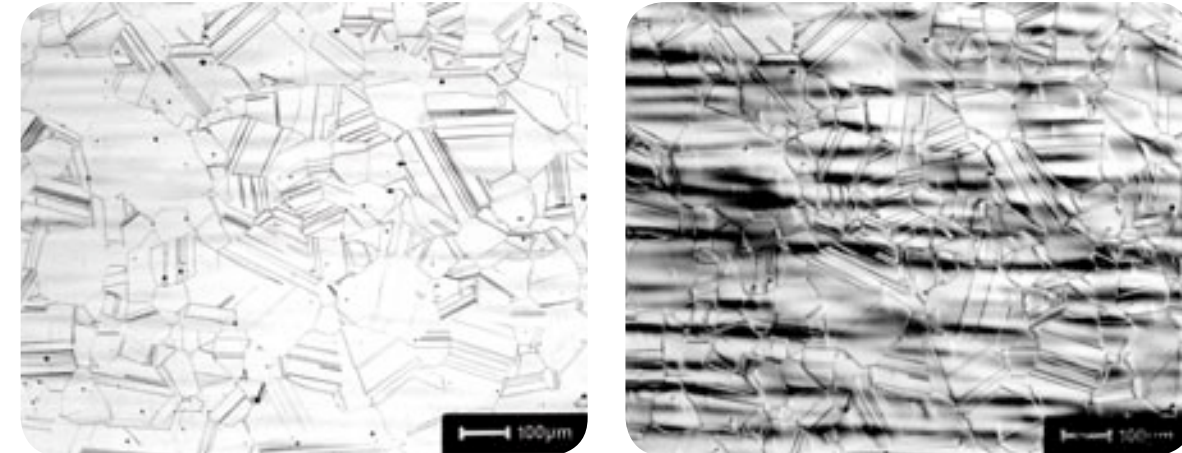
Surface	Abrasive/Size	Load Lb. (N)	Speed rpm/Direction	Time (min.)
CarbiMet waterproof paper	320/P400-grit SiC water cooled	6 (27)	200-250 Comp.	Until Plane
UltraPol or UltraPad cloths	9-mm MetaDi Supreme diamond suspension	6 (27)	150-200 Contra	10
TexMet 1500 or TriDent cloths	3-mm MetaDi Supreme diamond suspension	6 (27)	150-200 Contra	8
MicroCloth, VelTex or ChemoMet cloths	~0.05-mm MasterMet colloidal silica plus attack polish agent	6 (27)	120-150 Contra	5



EBSD example: Pure vanadium.
 ABOVE: Alpha ferrite grain structure of pure vanadium etched with equal parts of glycerol, HNO₃ and HF. Left - bright field illumination; right - Nomarski differential interference contrast illumination (which reveals some texture effects in the alpha grains).
 LEFT: EBSD patterns for pure vanadium before (left) and after indexing (right); pattern quality index: 125.9 \pm 10.3.

Five-Step Procedure for Cobalt and its Alloys

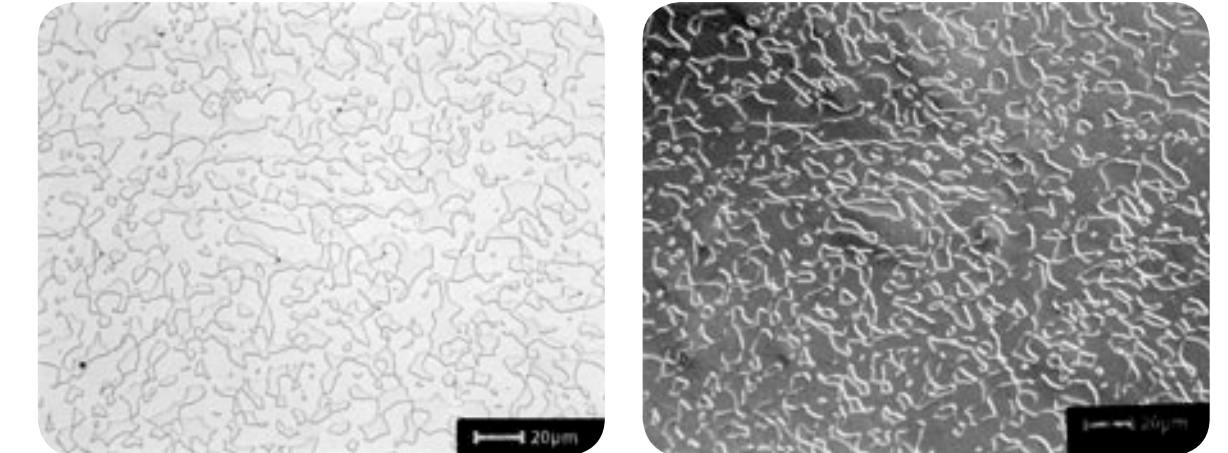
Surface	Abrasive/Size	Load Lb. (N)	Speed rpm/Direction	Time (min.)
CarbiMet abrasive waterproof disc	220 to 320 (P240 to P400) grit SiC water cooled	5 (22)	200-250 Contra	U.P.
UltraPol cloth	9- μ m MetaDi Supreme diamond suspension	6 (27)	100-150 Contra	10
TriDent or TexMet 1500 pads	3- μ m MetaDi Supreme diamond suspension	6 (27)	100-150 Contra	7
TriDent or TexMet 1500 cloths	1- μ m MetaDi Supreme diamond suspension	6 (27)	100-150 Contra	5
MicroCloth, VelTex or ChemoMet I pads	~0.05-mm MasterMet Colloidal silica or MasterPrep alumina suspensions	6 (27) (8 lb/35 N with ChemoMet I)	80-120 Contra	3



EBSD example: Eglyloy, hot rolled and solution annealed (2100-F = 2 h, water quenched) and etched with 15 ml HCl - 10 ml acetic acid - 10 ml HNO₃.
 ABOVE: Austenitic twinned grain structure of Eglyloy, hot rolled and solution annealed at 1149-C, etched with 15 ml HCl, 10 ml acetic acid, 10 ml nitric acid. Left - bright field illumination; right - Nomarski differential interference contrast illumination.
 LEFT: EBSD pattern before (left) and after indexing pattern (right) for Eglyloy (Co-20% Cr-15% Ni-15% Fe-7% Mo-2% Mn-0.15% C), hot rolled and solution annealed (2100-F = 2 h, water quench); pattern quality index: 223.4 \pm 7.4.

Four-Step Practice for Hardened Steels and Cast Irons

Surface	Abrasive/Size	Load Lb. (N)	Speed rpm/Direction	Time (min.)
CarbiMet waterproof discs	120 to 240 (P120 to P280) grit SiC water cooled	6 (27)	240-300 Comp.	Until Plane
UltraPol or TriDent cloths	9- μ m MetaDi Supreme diamond suspension	6 (27)	120-150 Contra	5
Texmet 1000 or Trident Cloths	3- μ m MetaDi Supreme diamond suspension	6 (27)	120-150 Contra	4
Microcloth, Nanocloth or ChemoMet I cloths	MasterPrep 0.05- μ m alumina suspension, or MasterMet colloidal silica	6 (27)	120-150 Contra	3



EBSD example: Austenite and ferrite in 2205 duplex stainless steel.
 ABOVE: Ferrite and austenite in 2205 duplex stainless steel etched with 15% HCl in ethanol; ferrite is the continuous phase. Left: bright field illumination; right: Nomarski differential interference contrast illumination.
 LEFT: EBSD patterns before (left) and after (right) indexing of γ -phase in 2205 duplex stainless steel. Pattern quality indexes: 248 \pm 15.4 for ferrite and 207.9 \pm 11 for austenite.