

Profile Projectors



Microscopes



PJ-H30

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MF



MF-U

PJ-A3000

SERIES 302 — Vertical Profile Projectors

FEATURES

- The PJ-A3000 Series vertical profile projectors are medium-size 11.8" (300mm) models that feature high versatility and easy operation.
- Easy-to-read digital XY counter is located near the projection screen to minimize eye movement.
- Digital readout protractor screen facilitates angle measurement.



PJ-A3010F-200



PJ-A3005D-50



PJ-A3010F-100



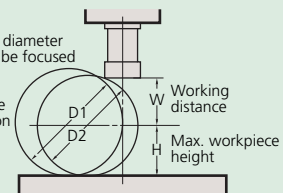
PJ-A3005F-150



PJ-A3010F-200

Projection Capacity

D1: Max. workpiece diameter whose edge line can be focused on the screen center
 D2: Max. workpiece diameter whose edge line can be focused on the screen line



	Magnification			
	10X	20X	50X	100X
View field	ø31.5	ø15.7	ø6.3	ø3.1
W	66 (20)	32.5 (2)	12.6	5
H	-50 models*	123.5	123.5	123.5
	-100 models	91	91	91
	-150 models	103.5	103.5	103.5
	200 models	92.5	92.5	92.5
D1	-50 models*	224 (198)	87 (61)	27
	-100 models	182	87 (61)	27
	-150 models	207 (198)	87 (61)	27
	200 models	185	87 (61)	27
D2		154 (120)	69 (23)	25

(): When using surface illumination

Optional Accessories

- 172-202:** 10X projection lens set (Standard accessory)
- 172-203:** 20X projection lens set
- 172-223:** 10X projection lens
- 172-224:** 20X projection lens
- 172-204:** 50X projection lens
- 172-207:** 100X projection lens
- 172-229:** Oblique illumination mirror for 10X lens
- 172-230:** Oblique illumination mirror for 20X lens
- 172-116:** Standard scale (50mm)
- 172-117:** Standard scale (2")
- 172-118:** Reading scale (200mm)
- 172-161:** Reading scale (300mm)
- 172-119:** Reading scale (8")
- 172-162:** Reading scale (12")
- 172-160-2:** Green filter (for PJ-A3000, -50 models)
- 172-160-3:** Green filter (for -100, -150, -200 models)
- 512305:** Halogen bulb (24V, 150W)

Fixture and Stage Accessories

- 176-106:** Rotary table (Effective diameter: 66mm)
- 172-196:** Rotary table (Effective diameter: 100mm)
- 172-198:** Rotary table with fine feed wheel (Effective diameter: 4" / 100mm)
- 176-105:** Swivel center support (Max. workpiece dia.: 2.7" / 70mm)
- 172-197:** Swivel center support (Max. workpiece dia.: 3.1" / 80mm)
- 176-107:** Holder with clamp
- 172-378:** V-block with clamp (Max. workpiece dia.: 1" / 25mm)
- 999678:** Fixture mount adapter

Availability	PJ-A3005D-50	PJ-A3005F-150	PJ-A3010F-100 PJ-A3010F-200
176-106	✓	✓	
172-196		✓	✓*
172-198		✓	✓*
176-105	✓		
172-197		✓	✓*
176-107	✓	✓	✓*
176-378	✓	✓	✓*

* Fixture mount adapter (999678) is required for PJ-3010F-200







QM-Data200

- 264-155A:** Stand mount type
- 264-156A:** Arm mount type
- 2-D data processing unit.
- (Refer to page I-23 for more details.)

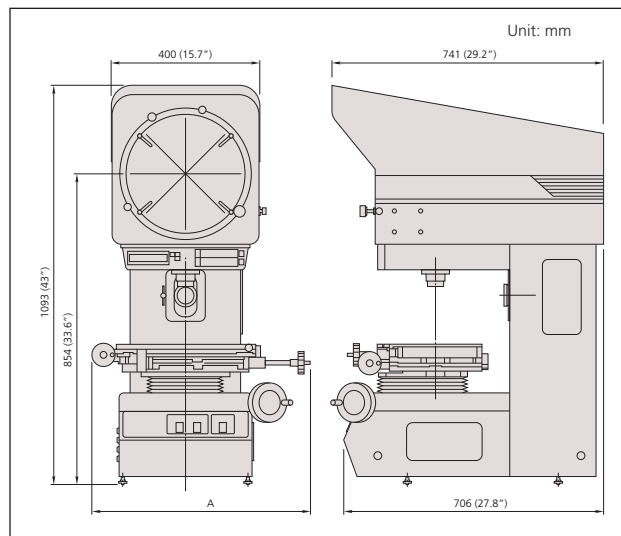


- 332-151:** Optoeye
Edge detection system for QM-Data 200
- 12AAE671:** Detector Attachment

SPECIFICATIONS

				
Model	PJ-A3010F-200	PJ-A3005F 150	PJ-A3010F-100	PJ-A3005D-50
Order No.	302-701A	302-702A	302-703A	302-704A
Projected image	Inverted image			
Protractor screen	Effective diameter	12.4" / 315mm		
	Screen material	Fine ground glass		
	Reference line	Cross hair line		
	Angle display (LED)	Resolution: 1' or 0.01° (switchable), Range: ±360° Functions: Absolute/incremental mode switching, Zero Set		
Projection lens	Standard Accessory 10X (172-202)			
Magnification accuracy	Contour illumination	±0.1% or less		
	Surface illumination	±0.15% or less		
Contour illumination	Light source	Halogen bulb (24V, 150W)		
	Optical system	Telecentric system		
	Functions	2-stage brightness switch, Heat-absorbing filter		
Surface illumination	Light source	Halogen bulb (24V, 150W)		
	Optical system	Vertical illumination with a half-reflection mirror		
XY range	8" x 4" (200 x 100mm)	6" x 2" (150 x 50mm)	4" x 4" (100x100mm)	2" x 2" (50 x 50mm)
Resolution	.0001" / 0.001mm	.0001" / 0.001mm	.0001" / 0.001mm	.0001" / 0.001mm
Measuring Unit	Built-in linear scales	Built-in linear scales	Built-in linear scales	Digimatic mic heads
Table size	14.96x9.84" (380x250mm)	11.02x5.98" (280x152mm)	9.84x9.84" (250x250mm)	5.98x5.98" (152x152mm)
Effective table area	10.47x6.69" (266x170mm)	7.24x3.23" (184x82mm)	5.6x5.6" (142x142mm)	3.23x3.23" (82x82mm)
Max. workpiece height	3.64" (92.5mm)	4.07" (103.5mm)	3.58" (91mm)	4.86" (123.5mm)
Functions	± direction switching, SPC output zero-setting	Zero-setting, ± direction switching, SPC output	Zero-setting, ± direction switching, SPC output	± direction switching, SPC output zero-setting
Power supply	120V AC, 50/60Hz			
Mass	308 lbs. (140kg)	255 lbs. (116kg)	246 lbs. (112kg)	235 lbs. (107kg)
Standard accessories	10X projection lens set, masking shield, power cord, halogen bulb, tube fuse, grounding wire, Allen key, cap			

DIMENSIONS



Model	PJ-A3005D-50	PJ-A3010F-100	PJ-A3005F-150	PJ-A3010F-200
A	17.9" / 455mm	16.8" / 427mm	17.6" / 446mm	23.3" / 593mm

PJ-H30

SERIES 303 — High Accuracy Profile Projectors

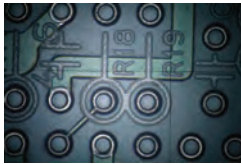
By separating axial motion, and stabilizing the XY measuring table in the vertical direction, high measuring accuracy of $(3+0.02L)\mu\text{m}$ has been achieved on the PJ-H30 Series Profile Projectors. Focusing is accomplished by moving the screen head itself up & down with the hand wheel or motorized unit. The power focusing (PJ-H30D type) provides higher performance.

FEATURES

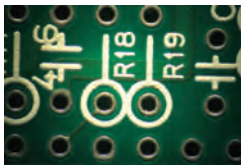
- Newly designed optical system with high NA lenses provide drastically brighter and clearer screen images during surface illumination.
- The three-lens mounting turret includes a 10X lens as standard. Four types of projection lenses (5X, 20X, 50X, 100X) are available.



Adjustable / oblique switchable surface illumination



Vertical illumination

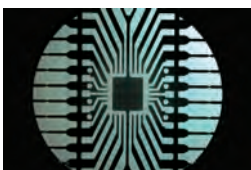
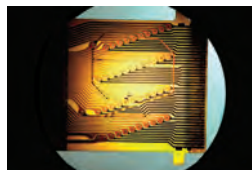
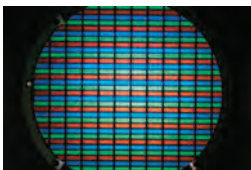


Oblique illumination

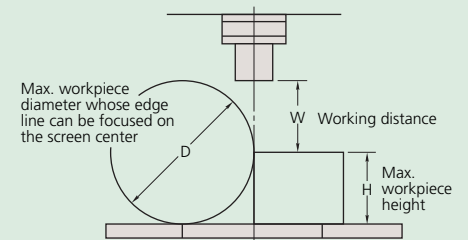


PJ-H30A3017B

XY stage travel range: 12x7" / 300x170mm



Projection Capacity



Unit: mm

	Magnification				
	5X	10X	20X	50X	100X
View field	ø61.2	ø30.6	ø15.3	ø6.12	ø3.06
H	100	100	100	100	100
W	66	70.5	56.5	50	50
D	148	197	137	114	123

Optional Accessories

172-271:	5X projection lens
172-472:	10X projection lens
172-473:	20X projection lens
172-474:	50X projection lens
172-475:	100X projection lens
172-116:	Standard scale (50mm)
172-117:	Standard scale (2")
172-118:	Reading scale (200mm)
172-161:	Reading scale (300mm)
172-119:	Reading scale (8")
172-162:	Reading scale (12")
12AAG981:	Green filter
172-269:	Machine stand
990600:	External counter zero switch
515530:	Halogen bulb (24V, 150W)

Fixture and Stage accessories

172-198:	Rotary table (Effective diameter: 4" / 100mm)
176-305:	Rotary table (Effective diameter: 7.2" / 183mm)
176-306:	Rotary table (Effective diameter: 9.4" / 240mm)
176-105:	Swivel center support (Max. workpiece dia.: 2.8" / 70mm)
172-197:	Swivel center support (Max. workpiece dia.: 3.1" / 80mm)
176-107:	Holder with clamp
172-378:	V-block with clamp (Max. workpiece dia.: 1" / 25mm)
176-317:	Fixture mount adapter C
176-304:	Fixture mount adapter A

Availability	Models	
	PJ-H30A1010B	PJ-H30A2017B
	PJ-H30B1010B	PJ-H30B2017B
	PJ-H30D1010B	PJ-H30D2017B
	PJ-H30A2010B	PJ-H30A3017B
	PJ-H30B2010B	PJ-H30B3017B
	PJ-H30D2010B	PJ-H30D3017B
172-198	✓**	✓****
176-305	✓**	
176-306		✓****
176-107 *	✓**	✓****
172-378 *	✓**	✓****
172-197 *	✓**	✓****
176-105	✓***	✓****
176-654	✓**	✓

*: Able to attach to a Rotary table(172-198 or 176-305)
 **: Fixture mount adapter C (176-317) is required.
 ***: Rotary table(172-198) is required.
 ****: Fixture mount adapter A (176-304) is required.

QM-Data200

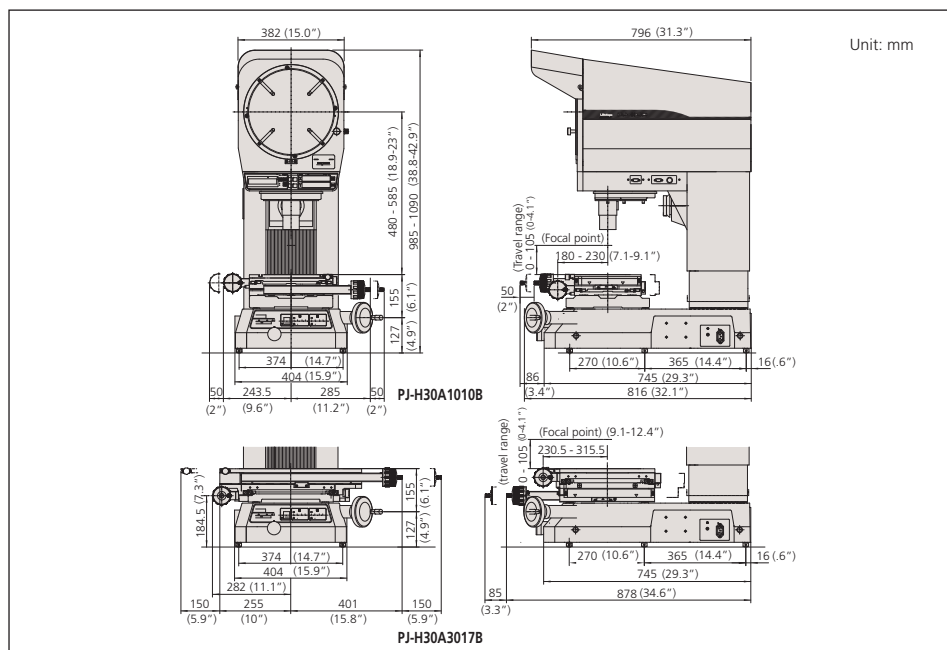
264-155A: Stand mount type
 264-156A: Arm mount type*
 *Attachment stand (12AAG982) is required
 2-D data processing unit.
 (Refer to page I-23 for more details.)



332-151: Optoeye
 Edge detection system for QM-Data 200
 12AAE671: Detector Attachment

Manual Focus type	Model No.	PJ-H30A1010B	PJ-H30A2010B	PJ-H30A2017B	PJ-H30A3017B
	Order No.	303-712A	303-713A	303-714A	303-715A
Power Focus, built-in OPTOEYE type	Model No.	PJ-H30D1010B	PJ-H30D2010B	PJ-H30D2017B	PJ-H30D3017B
	Order No.	303-732A	303-733A	303-734A	303-735A
Projected Image		Erect image			
Protractor screen	Effective diameter	12" / 306mm			
	Screen material	Fine ground glass			
	Reference line	Cross hair line			
	Screen rotation	±360°, fine feed and clamp			
	Angle display(LED)	Resolution: 1' or 0.01°(switchable), Range: ±370°, Functions: Absolute/incremental mode switching, Zero set			
Projection lens	Standard accessory: 10x(172-472), Optional accessories: 2X, 20X, 50X, 100X				
Lens mount	3-lenses mounting turret				
Magnification accuracy	Contour illumination	±0.1% or less			
	Surface illumination	±0.15% or less			
Contour illumination	light source	Halogen bulb(24V 150W)			
	Optical system	Zoom telecentric system			
	Functions	Brightness adjustment, Heat-absorbing filter, Cooling fan			
Surface illumination	light source	Halogen bulb(24V 150W)			
	Optical system	Vertical / Oblique illumination with an adjustable condenser lens			
	Functions	Non-stepped brightness adjustment, Heat-absorbing filter, Cooling fan			
	XY Range	4 x 4" 100 x 100mm	8 x 4" 200 x 100mm	8 x 6.7" 200 x 170mm	12 x 6.7" 300 x 170mm
	Resolution	.0001" / 0.001mm			
Measuring Unit	Built in Linear scale				
Table size		11.8 x 9.4" 300 x 240mm	13.8 x 11" 350 x 280mm	16.1 x 13.5" 410 x 342mm	20 x 13.5" 510 x 342mm
	Effective table area	7.1 x 5.9" 180 x 150mm	9.8 x 5.9" 250 x 150mm	10.6 x 9.4" 270 x 240mm	14.6 x 9.4" 370 x 240mm
Max. workpiece ht.	4.1" / 105mm				
Max. workpiece load	22lbs / 10kg	22lbs / 10kg	44 lbs / 20kg	44 lbs / 20kg	
Power supply	120V AC, 50/60Hz				
Mass	391lbs / 176kg	396lbs / 178kg	556lbs / 205kg	471lbs / 212kg	
Standard accessories	10x projection lens set, masking shield, power cord, halogen bulb, tube fuse, grounding wire, allen key, cap				

DIMENSIONS



PV-5110

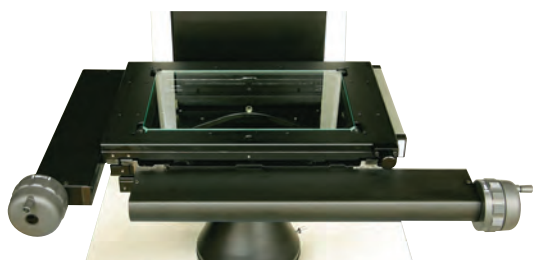
SERIES 304 — Profile Projectors

FEATURES

- Large 500mm screen
- Floor model that uses a downward illumination system.
- Digital readout protractor screen (including zero-setting, ABS/INC coordinate switching functions) for easy and error-free angle measurement.
- Angled screen allows projected images to be easily traced or compared with a template.
- The oblique surface illumination system provides clear and bright images, allowing easy inspection of non-reflective workpieces such as plastic parts or printed materials.

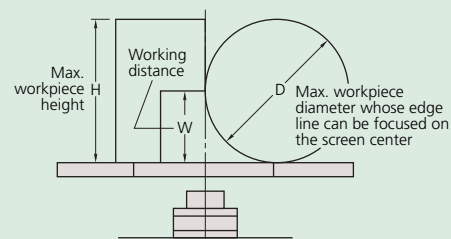


PV-5110
with optional KA counter



PV-5110

Projection Capacity



Unit: mm

	Magnification				
	5X	10X	20X	50X	100X
View field	ø101.6	ø50.8	ø25.4	ø10.16	ø5.08
H	125	181	206	87	87
W	60 (27)	60	60	32.4	22.5
D	120	120	120	64.8	45

(): When using surface illumination

Optional Accessories

172-401:	5X projection lens set
172-406:	5X projection lens
172-402:	10X projection lens set (standard accessory)
172-409:	10X projection lens
172-403:	20X projection lens set
172-411:	20X projection lens
172-404:	50X projection lens set
172-413:	50X projection lens
172-405:	100X projection lens set
172-415:	100X projection lens
172-419:	Surface illumination unit (standard accessory)
172-116:	Standard scale (50mm)
172-117:	Standard scale (2")
172-118:	Standard scale (200mm)
172-119:	Standard scale (8")
172-161:	Reading scale (300mm)
172-329:	Reading scale (600mm)
172-162:	Reading scale (12")
172-160-2:	Green filter
172-319:	Canopy
512305:	Halogen bulb (24V, 150W)
510189:	Vinyl cover

Fixture and Stage accessories

172-196:	Rotary table* (Effective diameter: 4" / 100mm)
172-198:	Rotary table with fine feed wheel* (Effective diameter: 4" / 100mm)
172-197:	Swivel center support* (Max. workpiece dia.: 3.1" / 80mm)
176-107:	Holder with clamp*
172-378:	V-block with clamp* (Max. workpiece dia.: 1" / 25mm)

*Fixture mount adapter (999678) is required.



KA Counter

(Refer to the page H-18 for more details.)



QM-Data200

264-155A:	Stand mount type
264-156A:	Arm mount type

2-D data processing unit.
(Refer to page I-23 for more details.)



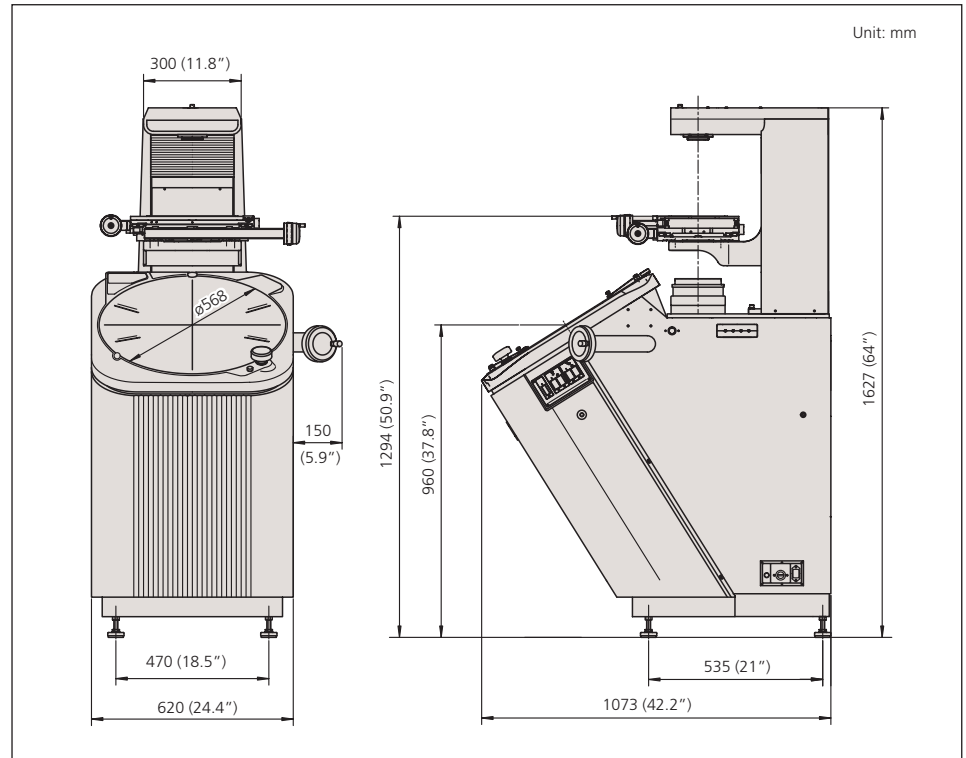
332-151:	Optoeye Edge detection system for QM-Data 200
12AAE672:	Detector Attachment (B)

SPECIFICATIONS

Model No.	PV-5110	
Order No.	304-909A	
Projected Image	Invert image	
Protractor screen	Effective diameter	20" / 508mm
	Screen material	Fine ground glass
	Reference line	Cross hair line
	Screen rotation	±360°, fine feed and clamp
	Angle display (LED)	Resolution: 1" or 0.01"(switchable), Range: ±370°, Functions: Absolute/incremental mode switching, Zero set
Projection lens	Standard accessory: 10x(172-472), Optional accessories: 5X, 20X, 50X, 100X	
Magnification accuracy	Contour illumination	±0.1% or less
	Surface illumination	±0.15% or less
Contour illumination	light source	Halogen bulb(24V 150W)
	Optical system	Zoom telecentric system
	Functions	2-step brightness switch, Heat-absorbing filter, Cooling fan
Surface illumination	light source	Halogen bulb(24V 150W)
	Optical system	Vertical illumination
	Functions	Adjustable condenser lens. Oblique illumination (for 5X, 10X, and 20X), 2-step brightness switch, Heat-absorbing filter, Cooling fan
	XY Range	8 x 4" / 200 x 100mm
Resolution	.0001" / 0.001mm*	
Measuring Unit	Built in Linear scale	
Table size	15 x 9.8" / 380 x 250mm	
Effective table area	10.5 x 6.7" / 266 x 170mm	
Max. workpiece height	See (H) on page I-6	
Max. workpiece load	11lbs / 5kg	
Power supply	120V AC, 50/60Hz	
Mass	467lbs / 210kg	
Standard accessories	200x100mm (8" x 4") stage, 10x projection lens set, Surface illumination unit. Counter stand for KA counter, power cord, halogen bulb, tube fuse, grounding wire, allen key, cap	

* Counter not included

DIMENSIONS



PH-A14

SERIES 172 — Profile Projector

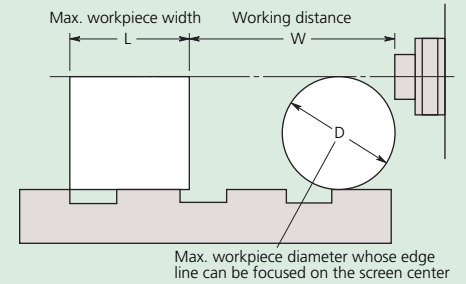
FEATURES

- Bench-top model that uses horizontal optical system.
- Suitable for thread pitch measurements—blurred or distorted images will not be produced when workpiece is angled.
- Inverted image on the day-bright screen.
- 14" (356mm) diameter protractor screen with cross-hairs and staggered lines for easy alignment.
- Heavy-duty workpiece table incorporates linear scales for fast, accurate measurement.



PH-A14

Projection Capacity



PH-A14

Unit: mm

	Magnification			
	10X	20X	50X	100X
View field	70.6	17.3	7.12	3.56
L	235	235	80	109
W	93	40	14.6	11
D	105	105	30.4	19

Optional Accessories

172-011:	10X projection lens
172-012:	20X projection lens
172-013:	50X projection lens set
172-014:	100X projection lens set
172-116:	Standard scale (50mm)
172-117:	Standard scale (2")
172-118:	Reading scale (200mm)
172-161:	Reading scale (300mm)
172-119:	Reading scale (8")
172-162:	Reading scale (12")
172-286:	Green filter
512305:	Halogen bulb (24V, 150W)

Fixture and Stage accessories

172-142:	Center support
172-143:	Center support riser
172-144:	Rotary vise (Max. workpiece dia.: 2.4" / 60mm)
172-234:	V-block with clamp (Max. workpiece dia.: 2" / 50mm)
172-132:	Vertical holder
64AAA129B:	Machine stand



KA Counter

(Refer to page H-18 for more details.)

64AAB149: Counter stand



QM-Data200

2-D data processing unit.

264-155A: Stand mount type

264-156A: Arm mount type

(Refer to page I-23 for more details.)



332-151: Optoeye

Edge detection system for QM-Data 200

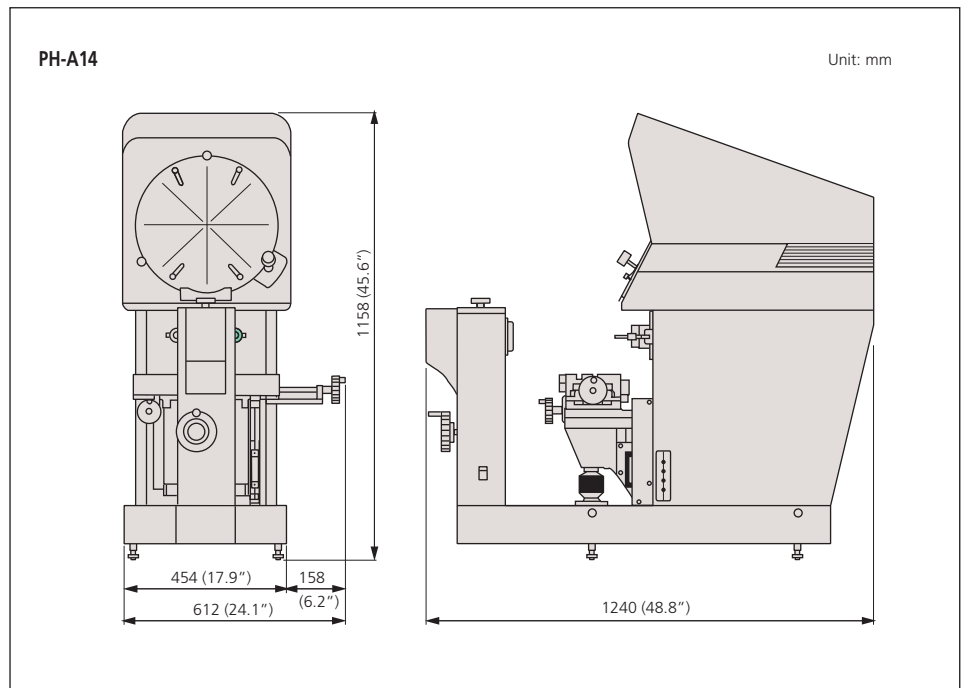
12AAE671: Detector attachment (A)

SPECIFICATIONS

Model No.	PH-A14	
Order No.	172-810-10A	
Projected image	Inverted image	
Protractor screen	Effective diameter	14" / 356mm
	Screen material	Fine ground glass
	Reference line	Cross hair line
	Screen rotation	±360°, fine feed and clamp
	Angle display	Vernier reading, Resolution: 2'
Projection lens	Standard accessory: 10x(172-011), Optional accessories: 20X, 50X, 100X	
Magnification accuracy	Contour illumination	±0.1% or less
	Surface illumination	±0.15% or less
Contour illumination	light source	Halogen bulb(24V 150W)
	Optical system	Telecentric system
	Functions	Heat-absorbing filter, Cooling fan
Surface illumination	light source	Halogen bulb(24V 150W)
	Optical system	Twin fiber optic illumination
XY Stage	Table travel (X-axis)	8" / 203.2mm
	Table size(X, Z)	16 x 6" / 407 x 153mm
	Vertical travel (Y-axis)	4" / 101.6mm
	Resolution	.00005" / 0.001mm*
	Measuring Unit	Built in Linear scale
	Max. workpiece width	See (L) on page I-12
Max. workpiece load	100lbs / 45kg	
Power supply	120V AC, 50/60Hz	
Mass	308lbs / 140kg	
Standard accessories	10x projection lens set, work stage, power cord, halogen bulb, tube fuse, grounding wire, allen key, cap	

*Counter not included

DIMENSIONS



PH-3515F

SERIES 172 — Profile Projector

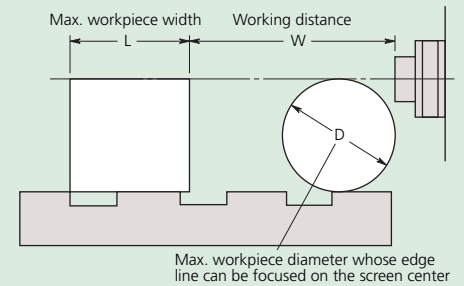
FEATURES

- Bench-top model that uses horizontal optical system.
- Suitable for thread pitch measurements—blurred or distorted images will not be produced when workpiece is angled.
- Erect image on the day-bright screen.
- Twin fiber optic illumination comes standard.
- 14" (353mm) diameter protractor screen with cross-hairs and staggered lines for easy alignment.
- Digital angle measurement to 1' or 0.01°.
- Heavy-duty workpiece table incorporates linear scales for fast, accurate measurement.
- Built-in linear scales for use with optional display counters.



PH-3515F

Projection Capacity



PH-3515F

Unit: mm

	Magnification				
	5X	10X	20X	50X	100X
View field	70.6	35.3	17.65	7.06	3.5
L	175	235	235	80	109
W	160 (64)	93 (35)	40	14.6	9.5
D	152.4	152.4	116	30.4	19

() : When using surface illumination

Optional Accessories

- 172-145: 5X projection lens set
- 172-175: 5X projection lens
- 172-184: 10X projection lens set (standard accessory)
- 172-011: 10X projection lens
- 172-173: 20X projection lens set
- 172-165: 50X projection lens set
- 172-174: 50X projection lens
- 172-166: 100X projection lens set
- 172-116: Standard scale (50mm)
- 172-117: Standard scale (2")
- 172-118: Reading scale (200mm)
- 172-161: Reading scale (300mm)
- 172-119: Reading scale (8")
- 172-162: Reading scale (12")
- 172-286: Green filter
- 512305: Halogen bulb (24V, 150W)
- 172-133: Surface illumination
- 64AAB004: Fiber optical illumination cable
- 64PPP277: Halogen lamp (for 64AAB004)
- 58ZZA097: Machine stand

Fixture and Stage accessories*

- 172-142: Center support
- 172-143: Center support riser
- 172-144: Rotary vise (Max. workpiece dia.: 2.3" / 60mm)
- 172-234: V-block with clamp (Max. workpiece dia.: 2" / 50mm)
- 172-132: Vertical holder
- 172-001: Tipped-saw support stand
- 172-002: Cutter support stand

* See page I-17 for details



174-173A KA Counter
64AAB003: Counter tray
(Refer to page H-18 for more details.)



QM-Data200
2-D data processing unit.
264-155A: Stand mount type
264-156A: Arm mount type
(Refer to page I-23 for more details.)



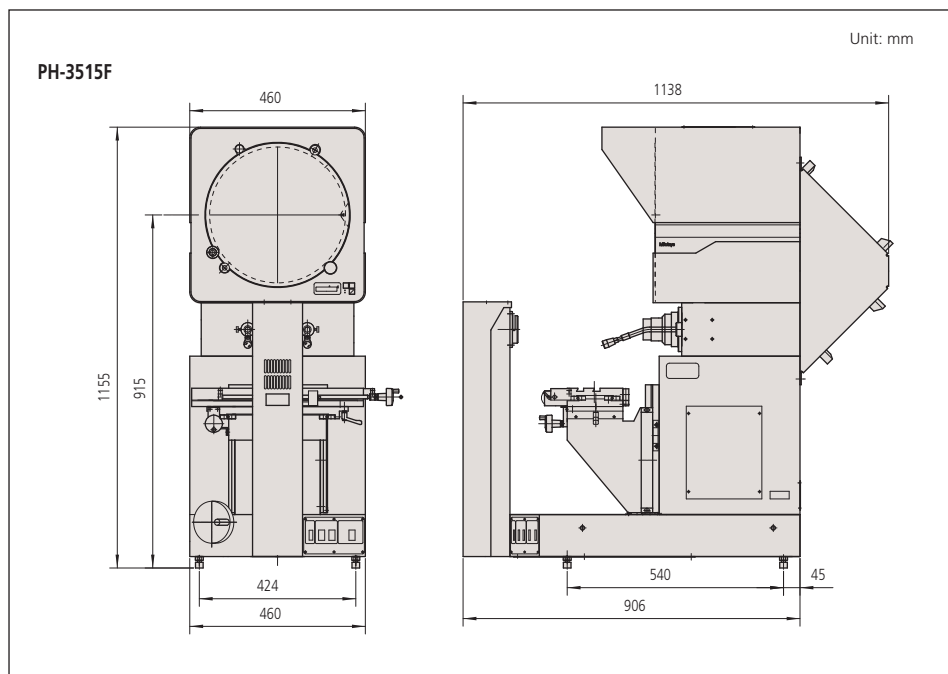
332-151: Optoeye
Edge detection system for QM-Data 200
12AAE671: Detector attachment (A)

SPECIFICATIONS

Model No.	PH-3515F	
Order No.	172-858-A	
Projected Image	Erect image	
Protractor screen	Effective diameter	14" / 353mm
	Screen material	Fine ground glass
	Reference line	Cross hair line
	Screen rotation	±360°, fine feed and clamp
	Angle display(LED)	Resolution: 1' or 0.01°(switchable), Range: ±370°, Functions: Absolute/incremental mode switching, Zero set
Projection lens	Standard accessory: 10x(172-184), Optional accessories: 5X, 20X, 50X, 100X	
Magnification accuracy	Contour illumination	±0.1% or less
	Surface illumination	±0.15% or less
Contour illumination	light source	Halogen bulb (24V 150W)
	Optical system	Telecentric system
	Functions	2-step brightness switch, Heat-absorbing filter, Cooling fan
Surface illumination (Optional accessories)	light source	Halogen bulb(24V 150W)
	Functions	Adjustable condenser lens. Heat-absorbing filter, Cooling fan
XY Stage	Table travel (X-axis)	10" / 254mm
	Table size (X, Z)	17.7"x5.7" / 450x146mm
	Vertical travel (Y-axis)	6" / 152mm
	Resolution	0.001mm/.0001"*
	Measuring Unit	Built in Linear scale
	Max. workpiece width	See (L) on page I-10
	Max. workpiece load	100lbs / 45kg
Power supply	120V AC, 50/60Hz	
Mass	333lbs / 150kg	
Standard accessories	10x projection lens set, work stage, power cord, halogen bulb, tube fuse, grounding wire, allen key, cap, Vinyl cover	

* Counter not included

DIMENSIONS



Accessories for Profile Projectors

SERIES 172 — Profile Projector

Standard Scales



172-116

- Used for checking magnification accuracy.

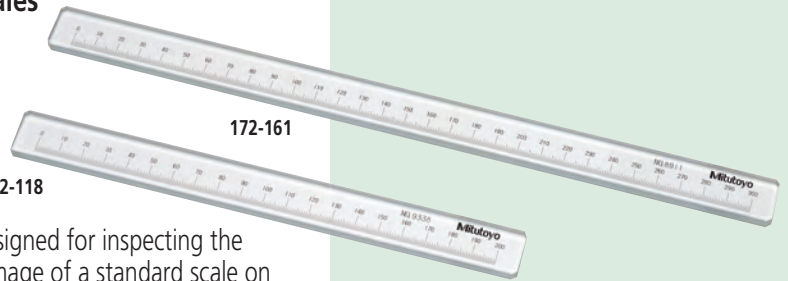
SPECIFICATIONS

Metric				
Graduation	Range	Order No.	Accuracy (20°C)*	
0.1mm	50mm	172-116	(3+5L/1000)μm	
0.1mm	80mm	172-330	(3+5L/1000)μm	

*L = Measured length (mm)

Inch				
Graduation	Range	Order No.	Accuracy (20C)	
.01"	2"	172-117	.00013"	

Reading Scales



172-118

172-161

- Specially designed for inspecting the magnified image of a standard scale on the projection screen.

SPECIFICATIONS

Metric				
Graduation	Range	Order No.	Accuracy	
0.5mm	200mm	172-118	18μm (15+15L/1000)μm	
0.5mm	300mm	172-161	19.5μm (15+15L/1000)μm	
0.5mm	600mm	172-329	24μm (15+15L/1000)μm	

Inch				
Graduation	Range	Order No.	Accuracy	
.02"	8"	172-119	.00071"	
.02"	12"	172-162	.00077"	

Micrometer Heads

for Profile Projectors and Toolmaker's Microscopes

Micrometer Heads for XY Stage

FEATURES

- Non-rotating device is provided.
- The thimble reading can be zero-set at any spindle position.
- Black and red figures of the bi-directional graduation allow easy reading in both directions.
- Clamping stem diameter: 18mm

SPECIFICATIONS

Metric					
Graduation	Range	Order No.	Accuracy	Remarks	
0.005mm	25mm	152-390	±2μm	for X-axis	
0.005mm	25mm	152-389	±2μm	for Y-axis	

Inch					
Graduation	Range	Order No.	Accuracy	Remarks	
.0001"	1"	152-391	±.0001"	for X-axis	
.0001"	1"	152-392	±.0001"	for Y-axis	

Digimatic Micrometer Heads

FEATURES

- Large LCD digits for error-free reading.
- The display rotates 330° for easy viewing.
- The spindle does not rotate.
- With SPC data output.

Adjustable Micrometer Heads for XY Stages

FEATURES

- The adjustable spindle can be fed under the thimble clamped at any reading, allowing easy reference point setting.
- The spherical measuring face is carbide-tipped.
- Clamping stem diameter: 18mm

SPECIFICATIONS

Metric					
Graduation	Range	Order No.	Accuracy	Remarks	
0.001mm*	25mm	152-402	±2μm	for X-axis	
0.001mm*	25mm	152-401	±2μm	for Y-axis	

*Obtained by using vernier.



164-164



152-390

SPECIFICATIONS

Inch/Metric			
Resolution	Range	Order No.	Accuracy
.00005"/0.001mm	2" (50mm)	164-164	±.00015"

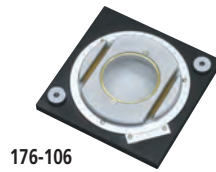
Optional Accessories

- 937387: SPC cable for series 164 (1m)
- 965013: SPC cable for series 164 (2m)

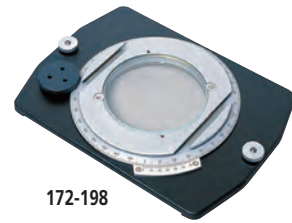
Workpiece Fixtures

for Profile Projectors and Measuring Microscopes

Rotary Tables



176-106



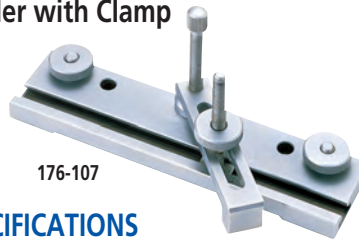
172-198

SPECIFICATIONS

Order No.	176-106	172-198
Effective glass dia.	66mm	100mm
Angle reading	6'	2' (w/ fine adjustment)
Mass	1.7kg	2.5kg

Note: Holder with clamp (176-107) can be mounted.

Holder with Clamp



176-107

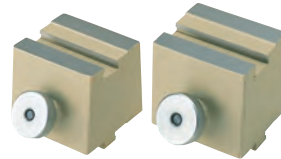
SPECIFICATIONS

Order No.	176-107
Max. workpiece height	35mm
Mass	0.42kg

Center Support



172-142



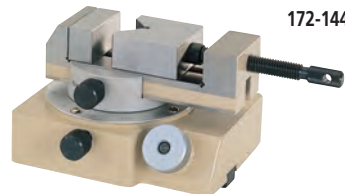
172-143

SPECIFICATIONS

Order No.	172-142
Max. workpiece height	120mm (240mm)*
Mass	3.3kg

*When using a center support riser (172-143)

Rotary Vise



172-144

SPECIFICATIONS

Order No.	172-144
Max. workpiece height	60mm
Width of jaw	40mm
Angle reading	5°
Mass	2.5kg

Swivel Center Supports



176-105



172-197

SPECIFICATIONS

Order No.	176-105	172-197
Max. workpiece dia.	70mm (45mm)*	80mm (65mm)*
Max. workpiece length	140mm	140mm
Swivel range	±10°	±10°
Mass	2.4kg	2.5kg

*When swiveled 10°

V-Block with Clamp



172-234

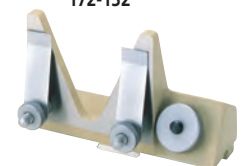


172-378

SPECIFICATIONS

Order No.	172-234	172-378
Max. workpiece dia.	50mm	25mm
Width of block	60mm	41mm
Mass	1.24kg	0.8kg

Vertical Holder



172-132

SPECIFICATIONS

Order No.	172-132
Mass	1.3kg

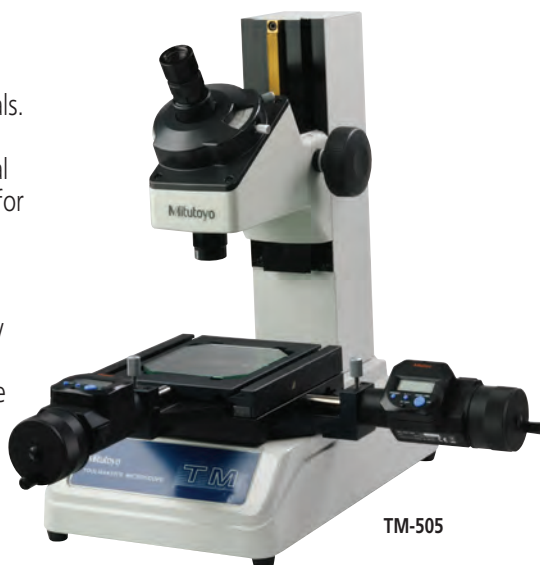
TM-505/510

SERIES 176 — Toolmaker's Microscopes

The Mitutoyo TM Series is a toolmaker's microscope well suited for measuring dimensions and angles of machined metals. It can also be used to check the shape of screws and gears by attaching an optional reticle. The compact body makes it ideal for use on shop-floors with limited space.

FEATURES

- Angle measurement is performed easily by turning the angle scale disc to align the cross-hair reticle with the workpiece image.
- Illumination intensity can be adjusted.

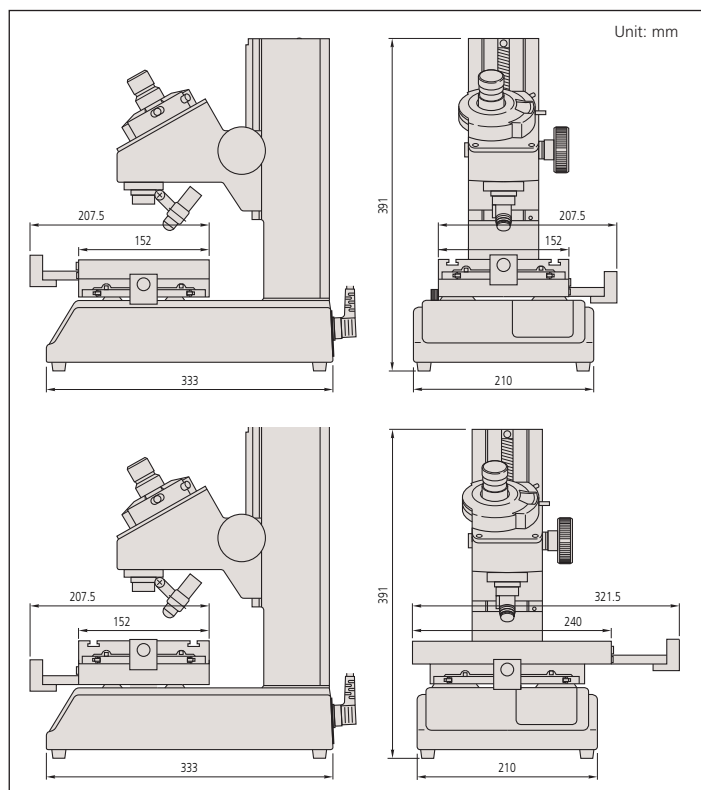


SPECIFICATIONS

Model No.	TM-505		TM-510	
Order No.	176-808A	176-811A	176-809A	176-812A
XY stage travel range	2 x 2" / 50 x 50mm		4 x 2" / 100 x 50mm	
Measurement method	Digimatic Micrometer Head IN/MM (164-164 2pc)	Optional*	Digimatic Micrometer Head IN/MM (164-164 2pc)	Optional*
XY stage table top size	6 x 6" / 152 x 152mm		9.4 x 6" / 240 x 152mm	
Effective area of table	3.8 x 3.8" / 96 x 96mm		6 x 3.8" / 154 x 96mm	
Max. workpiece height	4.5" / 115mm		4.2" / 107mm	
Max. stage loading	11lbs			

* See page I-12

DIMENSIONS



Angle reading



Technical Data

- Observation image: Erect image
 Optical tube: Monocular (diopter adjustable)
 Depression angle: 30°
 Reticle: 90° broken cross-hair (176-126)
 Range: 360°
 Angle reading: Minimum reading: 6' (by vernier)
 Eyepiece: 15X (176-116), View field dia.: 0.5" / 13mm
 Objective: 2X (176-138), Working distance: 2.6" / 67mm
 Optional: 5X, 10X
 Total magnification: 30X
 Contour illumination:
 • Light source: Tungsten bulb (24V, 2W)
 • Functions: With green filter, Light intensity adjustable
 Surface illumination:
 • Light source: Tungsten bulb (24V, 2W)
 • Functions: Light intensity adjustable
 Power supply: 120V AC, 50/60Hz
 Mass: 30lbs / 13.5kg (32lbs / 14.5kg: TM-510)

Optional Accessories

- 176-115: 10X eyepiece (view field dia.: 13mm)
 176-116: 15X projection lens set*
 176-117: 20X eyepiece (view field dia.: 10mm)
 176-139: Objective, 5X (W.D.: 33mm, N.A.: 0.10)
 176-137: Objective, 10X (W.D.: 14mm, N.A.: 0.14)
 164-161: Digimatic micrometer head (range: 50mm, reading: 0.001mm)
 164-164: Digimatic micrometer head (range: 2"/50mm, reading: .00005"/0.001mm)
 152-390: Micrometer head for X-axis (range: 25mm, reading: 0.005mm)
 152-389: Micrometer head for Y-axis (range: 25mm, reading: 0.005mm)
 152-391: Micrometer head for X-axis (range: 1", reading: .0001")
 152-392: Micrometer head for Y-axis (range: 1", reading: .0001")
 611201-531: Rectangular gauge block (1")
 611202-531: Rectangular gauge block (2")
 383038: Halogen bulb (24V, 2W)
 176-204: Dial indicator attachment for Z-axis measurement
 965013: SPC cable (2m) for Digimatic micrometer head

Fixture and Stage accessories

- 990561: Workpiece clip (2pcs/set)
 176-106: Rotary table for TM-505 (effective dia.: 66mm)
 172-196: Rotary table for TM-510 (effective dia.: 100mm)
 176-105: Swivel center support for TM-505 (max. workpiece dia.: 2.7" / 70mm)
 172-197: Swivel center support for TM-510 (max. workpiece dia.: 3.1" / 80mm)
 172-378: V-block with clamp (max. workpiece dia.: 1" / 25mm)
 176-107: Holder with clamp

Illumination units

- 176-366: Fiber-optic ring light
 176-203: Twin-bulb reflected illumination unit
 176-344: Bifurcated fiber illuminator

Reticles

- 176-111: Concentric circles (up to ø4mm, 0.05mm increment)
 176-135: Concentric circle (up to ø.2", .01" increment)
 176-113: 55° angle
 176-114: 60° angle
 176-109: Metric screw threads (pitch = 0.25 - 1mm)
 176-110: Metric screw threads (pitch = 1.25 - 2mm)
 176-140: ISO metric screw threads (pitch = 0.075 - 0.7mm)
 176-141: ISO metric screw threads (pitch = 0.75 - 2mm)
 176-142: ISO unified screw threads (80 - 28TPI)
 176-143: ISO unified screw threads (24 - 14TPI)
 176-144: ISO unified screw threads (13 - 10TPI)
 176-123: Unified screw threads (80 - 28TPI)
 176-124: Unified screw threads (24 - 14TPI)
 176-125: Unified screw threads (13 - 10TPI)
 176-120: Whitworth screw threads (60 - 26TPI)
 176-121: Whitworth screw threads (24 - 18TPI)
 176-122: Whitworth screw threads (16 - 11TPI)
 176-127: NF screw threads (80 - 28TPI)
 176-128: NF screw threads (24 - 14TPI)
 176-129: NF screw threads (13 - 10TPI)
 176-130: 14.5° involute gear teeth (normal rack type)
 176-112: 20° involute gear teeth (normal rack type)

MF

SERIES 176 — Measuring Microscopes

Technical Data

Observation image:	Erect image
Optical tube (optional):	Monocular or binocular tube (depression: 25°), Reticle projection method, with TV mount, Optical path ratio (eyepiece/TV mount: 50/50)
Eyepiece lens (optional):	10X, 15X, 20X
Objective:	3X (375-037), W.D.: 72.5mm Optional: 1X, 5X 10X, 20X, 50X, 100X
Transmitted illumination	
• Light source:	Halogen bulb or LED (12V, 50W)
• Optical system:	Telecentric illumination with adjustable aperture diaphragms
• Functions:	Light intensity adjustable, Non-stepped brightness adjustment
Surface illumination	
• Light source:	Halogen bulb or LED (12V, 50W)
• Optical system:	Koehler illumination with adjustable aperture diaphragms
• Functions:	Light intensity adjustable, Non-stepped brightness adjustment
Display unit:	
• No. of axis:	2 axes (MF-A type) or 3 axes (MF-B type)
• Resolution:	.0001" / .00005" / .00001" / 0.001mm / 0.0005mm / 0.0001mm
• Functions:	Zero-setting, Direction switching, Data output (via RS-232C interface)
Power supply:	120V AC, 50/60Hz
Mass:	145lbs / 65.5kg (505C, 1010C) / 153lbs / 69.5kg (2010C) / 287lbs / 130kg (2017C) / 304lbs / 138kg (3017C) / 317lbs / 144kg (4020C)

Optional Reticles for 3X Eyepiece

- 12AAG838 (12AAG878):** Cross-hair (7μm width)
 - 12AAG836 (12AAG877):** Cross-hair (5μm width)
 - 12AAG873 (12AAG876):** Cross-hair (3μm width)
 - 12AAG839 (12AAG879):** Cross-hair and 45° angle
 - 12AAG840 (12AAG880):** Broken cross-hair and 60° angle
 - 12AAG841 (12AAG881):** Zeiss type chart
 - 12AAG842*:** 20mm scale (0.1mm reading)
 - 12AAG843*:** Concentric circle (ø1.2 - ø18mm)
 - 12AAG844*:** 10mm scale (0.1mm reading)
 - 12AAG845*:** 5mm scale (0.05mm reading)
 - 12AAG846*:** 10x10mm section (1mm min.)
 - 12AAG847*:** Metric screw thread (P = 0.25-1.0)
 - 12AAG848*:** Metric screw thread (P = 1.25-2.0)
 - 12AAG849*:** Involute gear tooth (14.5°), module = 0.1 - 1.0
 - 12AAG850*:** Involute gear tooth (20°), module = 0.1 - 1.0
 - 12AAG851*:** Unified screw thread (80 - 28TPI)
 - 12AAG852*:** Unified screw thread (24 - 14TPI)
 - 12AAG853*:** Unified screw thread (13 - 10TPI)
 - 12AAG854*:** Concentric circle (ø.01" - ø.2")
- () : for MF-U models, * : MF/MF-U compatible

Reticle mount
(standard accessory)



for MF models

for MF-U models

Cross-hair and 45° angle
(standard accessory)



12AAG839

The MF measuring microscopes' expandability, such as when used in combination with Mitutoyo's vision unit to boost its performance or data management on a PC, promises further improved measuring efficiency.

FEATURES

- Observation with a clear and flare-less erect image and a wide field of view
- Measuring accuracy that is the highest in its class (and conforms to JIS B 7153)
- ML series, high-NA objectives that are specially designed for the MF series (long working distance type)

- Illumination unit (reflected/transmitted) selectable from a high-intensity LED or halogen bulb (required)
- Variable aperture diaphragm (reflected/transmitted) allows observation measurement while suppressing light diffraction
- Variety of standardized stages in sizes up to 400x200mm
- Quick-release mechanism useful for moving the stage quickly when measuring workpieces that are large in size or quantity
- Coarse/fine feed handles equipped as standard on both sides allow precise focus and observation measurement regardless of handedness
- High-magnification eyepiece observation up to 2000x
- Standard measuring microscope that has a wide variety of optional accessories including a Vision Unit and various digital CCD cameras



MF-B2017C

XY stage travel range: 8 x 6.6" / 200 x 170mm (with optional binocular tube)



Using optional slide type nosepiece with 2-lens mount (factory set option)

Selection of XY stage by travel range

1010C: 4 x 4" / 100 x 100mm



2010C: 8 x 4" / 200 x 100mm



3017C: 12 x 6.6" / 300 x 170mm



4020C: 16 x 8" / 400 x 200mm



MF

SERIES 176 — Measuring Microscopes

SPECIFICATIONS

Model No. (XY stage size)	1010C	2010C	2017C	3017C	4020C	
Order No.	MF-A	176-662-10	176-663-10	176-664-10	176-665-10	176-666-10
	MF-B	176-682-10	176-683-10	176-684-10	176-685-10	176-686-10
XY stage travel range	4 x 4" 100 x 100mm	8 x 4" 200 x 100mm	8 x 6.7" 200 x 170mm	6 x 6.7" 300 x 170mm	16 x 8" 400 x 200mm	
Z-axis travel range	6" / 150mm	6" / 150mm	8.7" / 220mm	8.7" / 220mm	8.7" / 220mm	
Focusing method	Manual focusing (coarse focusing: 30mm/rev., fine focusing: 0.2mm/rev.)					
Measurement method	Linear encoder (2-axis model: X / Y-axis, 3-axis model: X / Y / Z-axis)					
Resolution (switchable)	.0001" / .00005" / .00001" / 0.001mm / 0.0005mm / 0.0001mm					
Measuring accuracy (at 20°C)	XY-axis: (2.2+0.02L) μ m, L = Measuring length (mm) when not loaded, JIS B 7153					
Indication accuracy (at 20°C)	Z-axis: (5+0.04L) μ m, L = Measuring length (mm) (MF-B type)					
Floating function	X and Y axes with Quick-release mechanism					
XY stage top size	11 x 11" 280 x 280mm	14 x 11" 350 x 280mm	16.1 x 13.4" 410 x 342mm	20.07 x 13.4" 510 x 342mm	24" x 13.4" 610 x 342mm	
Effective glass size	7 x 7" 180 x 180mm	10 x 6" 250 x 150mm	10.6 x 9.4" 270 x 240mm	14.5 x 9.4" 370 x 240mm	17.3 x 9.4" 440 x 240mm	
Swiveling function	—	—	$\pm 5^\circ$ (left)	$\pm 5^\circ$ (left)	$\pm 3^\circ$ (left)	
Max. stage loading	22lbs / 10kg	22lbs / 10kg	44lbs / 20kg	44lbs / 20kg	33lbs / 15kg	
Max. workpiece height	6" / 150mm	6" / 150mm	8.7" / 220mm	8.7" / 220mm	8.7" / 220mm	

Selection of machine type

Machine type	MF-A	MF-B
Measurement system	X and Y-axis (2-axis type)	X, Y and Z-axis (3-axis type)

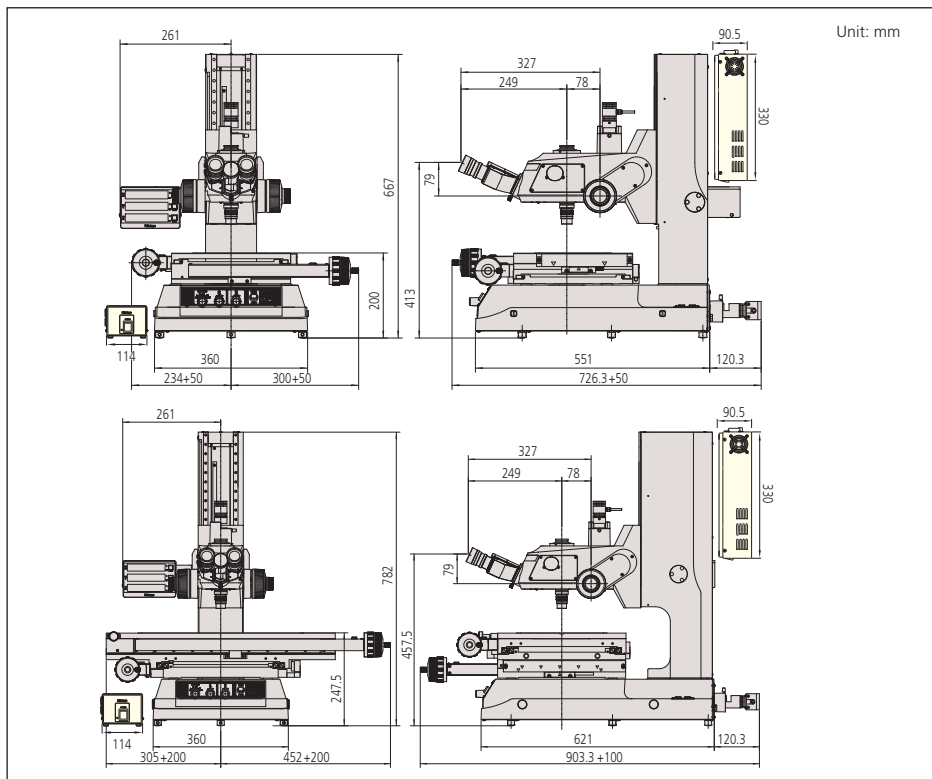
Illumination Unit (must select)

Applicable Illumination Unit	LED	Halogen
Order No.	176-345A	176-347A

Eye Tube Selection (must select)

Monocular with 10X eyepiece	172-392
Binocular with 10X eyepiece	172-393

DIMENSIONS



Optional Accessories

- 176-392:** Monocular tube with 10X eyepiece
- 176-393:** Binocular tube with 10X eyepiece set
- 378-866:** 10X eyepiece set (view field dia.: 24mm)
- 378-857:** 15X eyepiece set (view field dia.: 16mm)
- 378-858:** 20X eyepiece set (view field dia.: 12mm)
- 375-043:** Protractor eyepiece (10X)
- 176-313:** Digital protractor eyepiece (10X)
- 375-036-2:** 1X objective (W.D.: 61mm, N.A.: 0.03)
- 375-037-1:** 3X objective (W.D.: 77mm, N.A.: 0.09)
- 375-034-1:** 5X objective (W.D.: 61mm, N.A.: 0.13)
- 375-039:** 10X objective (W.D.: 51mm, N.A.: 0.21)
- 375-051:** 20X objective (W.D.: 20mm, N.A.: 0.42)
- 375-052:** 50X objective (W.D.: 13mm, N.A.: 0.55)
- 375-053:** 100X objective (W.D.: 6mm, N.A.: 0.7)
- 176-314-1:** Slide type nosepiece (2-mount, parfocal)
- 176-314-2:** Slide type nosepiece (2-mount, mag. adjusted)
- 12AAA643:** ND2 color filter (transmitted / surface)
- 12AAA644:** ND8 color filter (transmitted / surface)
- 12AAA645:** GIF filter (transmitted / surface)
- 12AAA646:** LB80 color filter (transmitted / surface)
- 375-054:** 0.5X camera adapter (with C-mount adapter)
- 970441:** C-mount adapter
- 513667:** Halogen bulb (24V, 50W)
- 12BAB345:** Halogen bulb (long life type, 24V, 50W)
- 176-308:** Vibration damping stand
- 176-309:** Mounting stand
- 375-056:** Stage micrometer
- 12AAA165:** Lens cleaning kit
- 12AAA846:** Foot switch

Illumination units

- 176-351-6A:** Oblique surface illumination unit
- 176-367-2A:** LED ring illuminator
- 176-343A:** Twin fiber-optics illuminator
- 176-366A:** Ring fiber-optics illuminator
- 12AAG806:** GIF color filter (for fiber-optics illuminator)
- 12AAG807:** LB80 color filter (for fiber-optics illuminator)

Fixture and Stage accessories

- 176-107:** Holder with clamp*
- 172-378:** V-block with clamp*
(max. workpiece dia.: 1" / 25mm)
- 172-197:** Swivel center support*
(max. workpiece dia.: 3.1" / 80mm)
- 176-305:** Rotary stage with fine feed knob for 505C/1010C/2010C models
- 176-306:** Rotary stage with fine feed knob for 2017C/3017C/4020C models

*Fixture mount adapter (**176-310**) is required for 2010C models.
Fixture mount adapter (**176-304**) is required for 2017C/3017C/4020C models.



QM-Data200
2-D data processing unit
264-155A: Stand mount type
12AAA807: Connecting cable set

Focus pilot FP-05
Focus assisting system



Vision Unit
PC-based vision measuring system



Technical Data

Observation image:	Erect image
Optical tube:	Siedentoph type (pupil distance adjustment: 51 - 76mm), 1X tube lens, Binocular tube (depression: 30°), Reticle projection method, with TV mount, Optical path ratio (eyepiece/TV mount: 50/50)
Eyepiece lens:	10X (field No.: 24mm), Optional: 15X, 20X
Turret (optional):	Manual or power
Objective (optional):	M / BD Plan Apo objective from 1X to 100X
Transmitted illumination	
• Light source:	Halogen bulb (12V, 50W) or LED
• Optical system:	Telecentric illumination with adjustable aperture diaphragms
• Functions:	Light intensity adjustable, Non-stepped brightness adjustment
Surface illumination	
• Light source:	Optional halogen illumination unit (fiber-optic cold light illumination) or LED
• Optical system:	Koehler illumination with adjustable aperture diaphragms
• Functions:	Light intensity adjustable, Non-stepped brightness adjustment
Display unit:	
• No. of axis:	2 axes or 3 axes
• Resolution:	.0001" / .00005" / .00001" / 0.001mm / 0.0005mm / 0.0001mm
• Functions:	Zero-setting, Direction switching, Data output (via RS-232C interface)
Power supply:	120V AC, 50/60Hz
Mass:	145lbs/65.5kg (505C, 1010C) / 153lbs/69.5kg (2010C) / 287lbs/130kg (2017C) / 304lbs/138kg (3017C) / 317lbs/144kg (4020C)

Selection of XY stage by travel range



MF-U

SERIES 176 — High-power Multi-function Measuring Microscopes

FEATURES

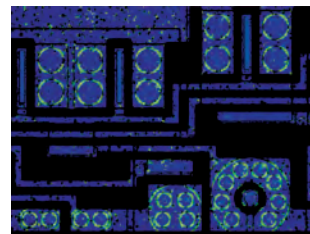
- Observation with a clear and flare-less erect image and a wide field of view
- Measuring accuracy that is the highest in its class (and conforms to JIS B 7153)
- Proven high-NA objectives from the FS optical system (long working distance type)



- Integration of metallurgical and measurement microscope functions provides high-resolution observation and high-accuracy measurement solution
- Illumination unit (reflected/transmitted) selectable from a high-intensity LED or halogen bulb (required)
- Variable aperture diaphragm (reflected/transmitted) allows observation measurement while suppressing light diffraction
- Variety of standardized stages in sizes up to 400 x 200 mm
- Quick-release mechanism useful for moving the stage quickly when measuring workpieces that are large in size or quantity
- High-magnification eyepiece observation up to 4000X
- Low-noise design

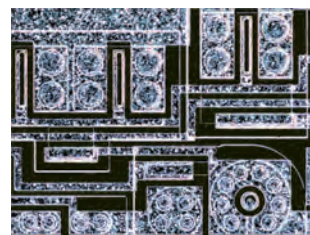
MF-UB3017C

XY stage travel range: 12 x 6.7" / 300 x 170mm (with optional turret, objective and fiber illumination)



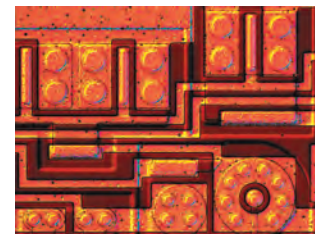
Polarized light observation:

Observing only the filtered light that vibrates in one direction. Used for observing materials with special optical characteristics, such as mineral and liquid crystal.



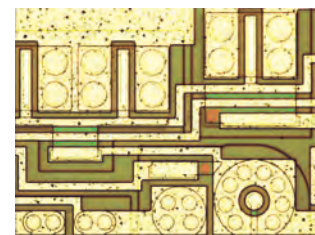
Dark field (DF) observation:

Observing only the scattered light by shutting down the direct light to the objectives. The scratches and dust that cannot be viewed in the bright view field can be observed by this method in high-contrast.



Differential interference contrast (DIC) observation:

Effective in detecting fine scratches and steps on the surface of metal, liquid crystal, and semiconductors.



Bright field (BF) observation:

Most common method of observation. Observing directly the light reflected from the surface of the workpiece.

MF-U

SERIES 176 — High-power Multi-function Measuring Microscopes

SPECIFICATIONS

Model No. (XY stage size)	1010C	2010C	2017C	3017C	4020C
Order No.	MF-UA 176-668-10	176-669-10	176-670-10	176-671-10	176-672-10
	MF-UB 176-688-10	176-689-10	176-690-10	176-691-10	176-692-10
	MF-UC 176-674-10	176-675-10	176-676-10	176-677-10	176-678-10
	MF-UD 176-694-10	176-695-10	176-696-10	176-697-10	176-698-10
XY stage travel range	4 x 4" 100 x 100mm	8 x 4" 200 x 100mm	8 x 6.7" 200 x 170mm	12 x 6.7" 300 x 170mm	16 x 8" 400 x 200mm
Z-axis travel range	6" / 150mm		8.7" / 220mm		
Focusing method	Manual focusing (coarse focusing: 10mm/rev., fine focusing: 0.1mm/rev.)				
Measurement method	Linear encoder (2-axis model: X / Y-axis, 3-axis model: X / Y / Z-axis)				
Resolution (switchable)	.0001" / .00005" / .00001" (0.001mm / 0.0005mm / 0.0001mm)				
Measuring accuracy (at 20°C)	XY-axes: (2.2+0.02L)µm, L = Measuring length (mm) when not loaded, JIS B 7153				
Indication accuracy (at 20°C)	Z-axis: (5+0.04L)µm, L = Measuring length (mm)				
Floating function	X and Y axes with Quick-release mechanism				
XY stage top size	11 x 11" 280 x 280mm	14 x 11" 350 x 280mm	16 x 13.6" 410 x 342mm	20 x 13.6" 510 x 342mm	24 x 13.6" 610 x 342mm
Effective glass size	7.1 x 7.1" 180 x 180mm	10 x 6" 250 x 150mm	10.6 x 9.6" 270 x 240mm	14.6 x 9.6" 370 x 240mm	17.3 x 9.6" 440 x 240mm
Swiveling function	—	—	±5° (left)	±5° (left)	±3° (left)
Max. stage loading	22lbs / 10kg		44lbs / 20kg	44lbs / 20kg	33lbs / 15kg
Max. workpiece height	6" / 150mm		8.7" / 220mm		

Selection of machine type

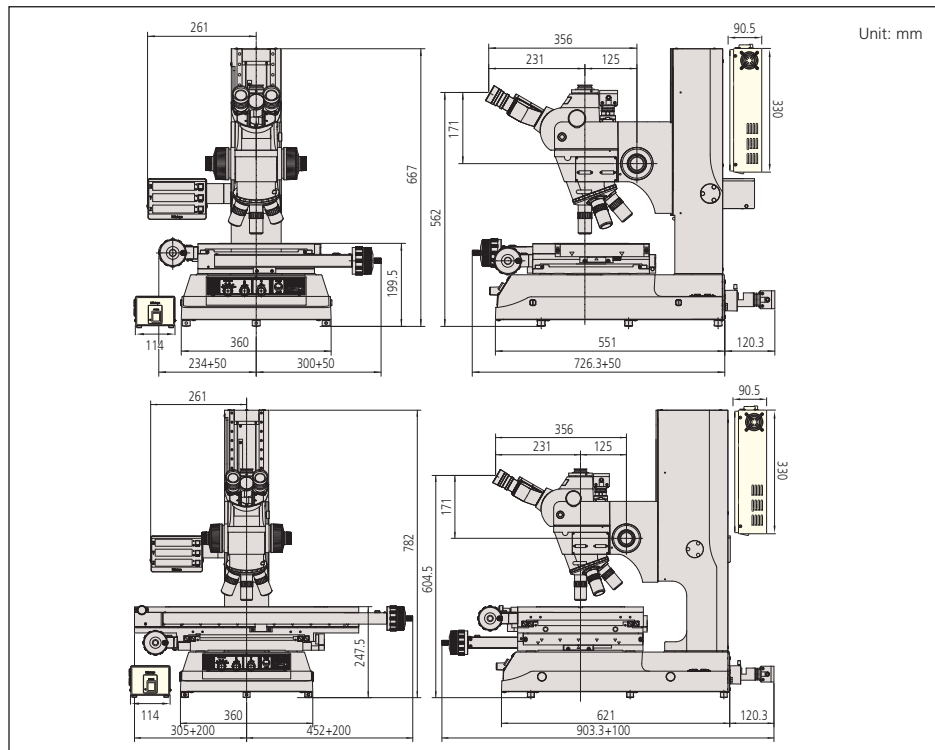
Machine type	MF-UA	MF-UB	MF-UC	MF-UD
Observation type	Bright field (BF)	Bright field (BF)	Bright / Dark field (BF/DF)	Bright / Dark field (BF/DF)
Measurement system	X and Y-axis (2 axes)	X, Y and Z-axis (3 axes)	X and Y-axis (2 axes)	X, Y and Z-axis (3 axes)

Illumination Unit (must select illumination unit)

Applicable Illumination Unit	LED	Halogen
Order No.	176-346A	176-348A

Note: *Generation C type* does not include the illumination unit, it is necessary to select the either LED illumination unit or Halogen illumination unit.

DIMENSIONS



Optional Accessories

- 378-857:** 15X eyepiece set (view field dia.: 16mm)
378-858: 20X eyepiece set (view field dia.: 12mm)
- Objective**
378-018: Adjustable manual BF turret
378-116A: Adjustable power BF turret
176-211: Adjustable manual BF/DF turret
176-210A: Adjustable power BF/DF turret

- Reticles**
378-092: Polarization unit
378-076: DIC unit for 100X, SL80X, SL50X objective
378-078: DIC unit for 50X, SL20X objective
378-079: DIC unit for 20X objective
378-080: DIC unit for 10X, 5X objective
12AAA643: ND2 color filter
12AAA644: ND8 color filter
12AAA645: GIF filter
12AAA646: LB80 color filter
375-054: 0.5X camera adapter (with C-mount adapter)
- 970441:** C-mount adapter
513667: Halogen bulb (24V, 50W)
12BAB345: Halogen bulb (long life type, 24V, 50W)
517181: Halogen bulb (24V, 100W)
12BAD602: High intensity halogen bulb (24V, 100W)
176-308: Vibration damping stand
176-309: Mounting stand
375-056: Stage micrometer
12AAA165: Lens cleaning kit
12AAA846: Foot switch

Illumination units

- 176-315A:** Halogen illumination unit (12V, 100W)
176-316A: Halogen illumination unit (12V, 150W)
176-343A: Twin fiber-optics illuminator
12AAG806: GIF color filter (for 176-315)
12AAG807: LB80 color filter (for 176-315)
 See page I-28 for lens selection

Fixture and Stage accessories

- 176-107:** Holder with clamp*
172-378: V-block with clamp* (max. workpiece dia.: 1" / 25mm)
172-197: Swivel center support* (max. workpiece dia.: 3.1" / 80mm)
176-305: Rotary stage with fine feed knob for 505C/1010C/2010C models
176-306: Rotary stage with fine feed knob for 2017C/3017C models

*Fixture mount adapter (176-310) is required for 2010C models. Fixture mount adapter (176-304) is required for 2017C/3017C models.

Manual and Power Turrets



Hyper MF/MF-U

SERIES 176 — High-Accuracy Measuring Microscopes

Technical Data: Hyper MF

Observation image:	Erect image
Optical tube:	Monocular or binocular tube (optional, depression: 25°), Reticle projection method, with TV mount, Optical path ratio (eyepiece/TV mount: 50/50)
Eyepiece lens (optional):	10X, 15X, 20X
Objective:	3X (375-037-1), W.D.: 77.0mm Optional: 1X, 5X 10X, 20X, 50X, 100X
Transmitted illumination	
• Light source:	Halogen bulb (12V, 50W) (fiber-optic cold light illumination)
• Optical system:	Telecentric illumination with adjustable aperture diaphragms
• Functions:	Light intensity adjustable, 100 steps brightness adjustment
Surface illumination	
• Light source:	Halogen bulb (12V, 100W)
• Optical system:	Koehler illumination with adjustable aperture diaphragms
• Functions:	Light intensity adjustable, 100 steps brightness adjustment
Data output:	Via RS-232C interface
Power supply:	120V AC, 50/60Hz
Dimensions:	35x36x30" / 880x913x770mm (main unit) 6.3x19x15" / 160x476x381 (power unit)
Mass:	562lbs / 254kg (main unit), 33lbs / 14kg (power unit)

Technical Data: Hyper MF-U

Observation image:	Erect image
Optical tube:	Siedentoph type (pupil distance adjustment: 51 - 76mm), 1X tube lens, Binocular tube (depression: 25°), Reticle projection method, with TV mount, Optical path ratio (eyepiece/TV mount: 50/50)
Eyepiece lens:	10X (field No.: 24mm), Optional: 15X, 20X
Turret (optional):	Power Objective (optional): M / BD Plan Apo objective from 1X to 100X
Transmitted illumination	
• Light source:	Halogen bulb (12V, 50W)
• Optical system:	Telecentric illumination with adjustable aperture diaphragms
• Functions:	Light intensity adjustable, 100 steps brightness adjustment
Surface illumination	
• Light source:	Halogen bulb (12V, 100W)
• Optical system:	Koehler illumination with adjustable aperture diaphragms
• Functions:	Light intensity adjustable, 100 steps brightness adjustment
Data output:	Via RS-232C interface
Power supply:	120V AC, 50/60Hz
Dimensions:	35x36x30" / 880x913x770mm (main unit) 6.3x19x15" / 160x476x381 (power unit)
Mass:	562lbs / 255kg (main unit), 33lbs / 14kg (power unit)

FEATURES

- The world highest accuracy XY measuring accuracy of $(0.9+3L/1000)\mu\text{m}$
- Selectable LAF (Laser Auto Focus) function
- High operability and repeatability
- Three-axis motorized control
- Power-drive auto focus unit is a standard feature.

Hyper MF-U
with optional optical tube,
turret and objectives



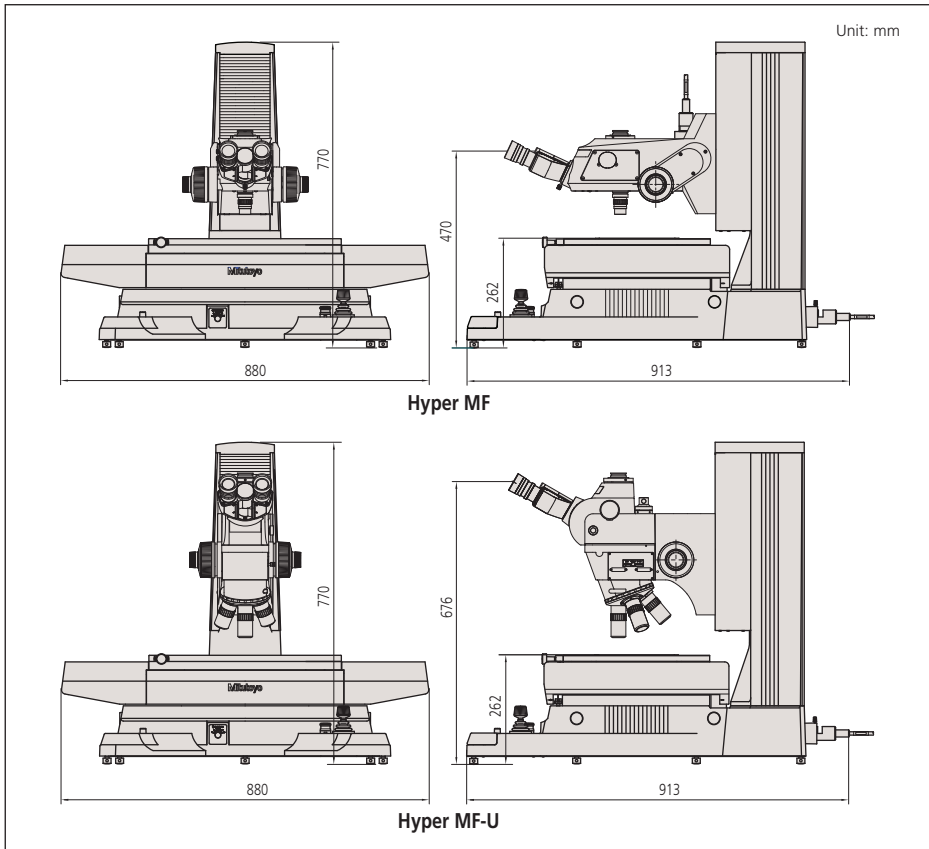
SPECIFICATIONS

Model No.	Hyper MF-B2515B	Hyper MF-UB2515B	Hyper MF-UD2515B	Hyper MF-UE2515B	Hyper MF-UF2515B
Order No. (mm)	176-430A	176-431A	176-432A	176-433A	176-434A
Observation type	BF	BF	BF or BF/BD	BF	BF or BF/BD
Digital counter	—	—	—	—	—
Laser auto focus function	—	—	—	Available	Available
XY stage travel range	10 x 6" 250 x 150mm	10 x 6" 250 x 150mm	10 x 6" 250 x 150mm	10 x 6" 250 x 150mm	10 x 6" 250 x 150mm
Measuring unit	Linear encoder	Linear encoder	Linear encoder	Linear encoder	Linear encoder
Resolution	0.01 μm	0.01 μm	0.01 μm	0.01 μm	0.01 μm
Measuring accuracy (at 20°C)	$(0.9+3L/1000)\mu\text{m}$, L = XY axis measuring length (mm) when not loaded				
Drive system (X, Y, Z-axis)	Motor-driver control with the joystick				
XY stage top size	18 x 14" 460 x 350mm	18 x 14" 460 x 350mm	18 x 14" 460 x 350mm	18 x 14" 460 x 350mm	18 x 14" 460 x 350mm
Effective glass size	12 x 8" 300 x 200mm	12 x 8" 300 x 200mm	12 x 8" 300 x 200mm	12 x 8" 300 x 200mm	12 x 8" 300 x 200mm
Swiveling function	$\pm 3^\circ$	$\pm 3^\circ$	$\pm 3^\circ$	$\pm 3^\circ$	$\pm 3^\circ$
Max. stage loading	66 lbs / 30kg	66 lbs / 30kg	66 lbs / 30kg	66 lbs / 30kg	66 lbs / 30kg
Max. workpiece height	6" / 150mm	6" / 150mm	6" / 150mm	6" / 150mm	6" / 150mm

Hyper MF/MF-U

SERIES 176 — High-Accuracy Measuring Microscopes

DIMENSIONS

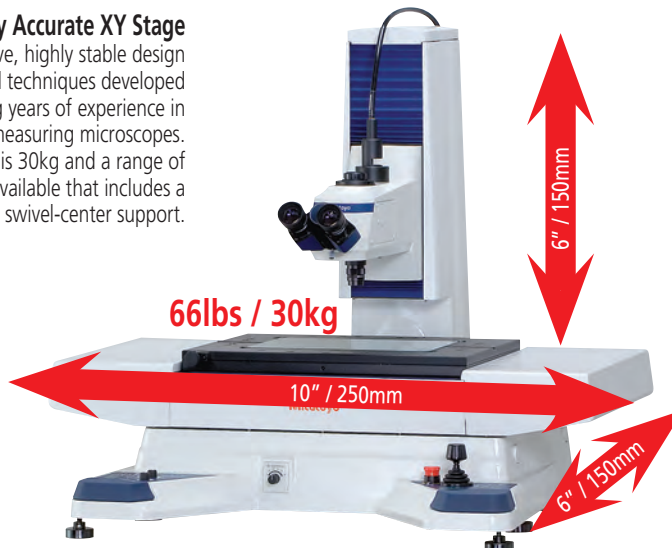


Three-axis Motor-driven Joystick

The X, Y, and Z axes are driven and controlled with one joystick that serves as the nerve center of operation. Speed control is possible from high-speed traverse of the stage to ultra low-speed, precise positioning of a workpiece.

Large, Highly Accurate XY Stage

The XY stage is a massive, highly stable design created using mechanical techniques developed over Mitutoyo's long years of experience in manufacturing precision measuring microscopes. Maximum stage loading is 30kg and a range of useful fixtures is available that includes a wafer holder and swivel-center support.



Optional Accessories



QM-Data200
2-D data processing unit



Vision Unit
PC-based vision measuring system

Highly Accurate Digital Scales

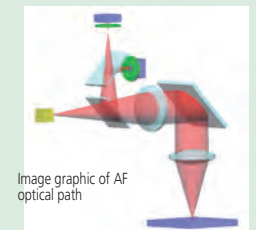
These microscopes are equipped with highly accurate digital glass scales on all three axes. Mitutoyo produces glass scales in an underground laboratory where the temperature and humidity are constant throughout the year. The XY (stage) and Z (optical tube) displacements are displayed digitally.

LAF Optical Tube

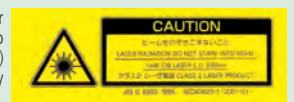
The LAF (Laser Auto Focus) optical tube can be selected. The LAF system achieves high repeatability when measuring minute steps, etc., enabling difficult measurements with minimum fatigue.



*Available for model MF-U only

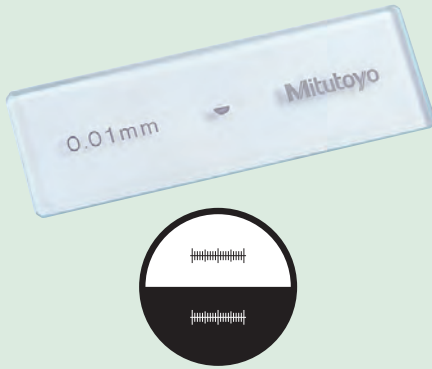


The LAF uses a low-power laser that corresponds to Class 2 (visible radiation) of JIS C6802/1997, Safety of Laser Products.



Accessories for Measuring Microscope

Stage Micrometer



SPECIFICATIONS

Order No.	375-056
Range	1mm
Graduations	0.01mm
Accuracy (at 20°C)	(1+L)μm, L = Measuring length (mm)
Dimensions (WxD)	3" x 1" / 76 x 26mm
Mass	16g

Focus Pilot FP-05

FEATURES

- By installing this system on the camera mount of an MF series measuring microscope and projecting the focusing chart onto the workpiece surface, the focal point can be detected with high-accuracy and high-repeatability.
- The brightness of the chart can be adjusted.
- A wide view field observation on the monitor is made possible with the use of a CCD camera (C-mount adapter is included.)

- Four types of chart patterns are available. The pattern should be selected in accordance with the type of workpiece surface texture.



Concentric circle



Slit

SPECIFICATIONS

Order No.	375-057A	375-058A	375-067A	375-068A
Applicable microscopes	MF C models		MF-U C models	
Light source	Green LED	Red LED	Green LED	Red LED
Magnification	0.5X, Accuracy: 0.1% **			
Camera adapter	C-mount (provided)			
Applicable CCD camera	Up to 2/3-inch			
Mass	4lbs / 1.8kg		4lbs / 1.8kg	

** Within 2/3 area from the center of view field



Power Focus Unit



SPECIFICATIONS

Order No.	Please contact us
Applicable microscopes	MF-C models, MF-UC models
Resolution	0.4μm
Drive speed	3.2mm/s
Power supply	100 - 240V AC, 50/60Hz
Dimensions (WxDxH)	Control box: 4.1 x 3 x 7.6" 108 x 72 x 193mm

Manual and Power Turrets

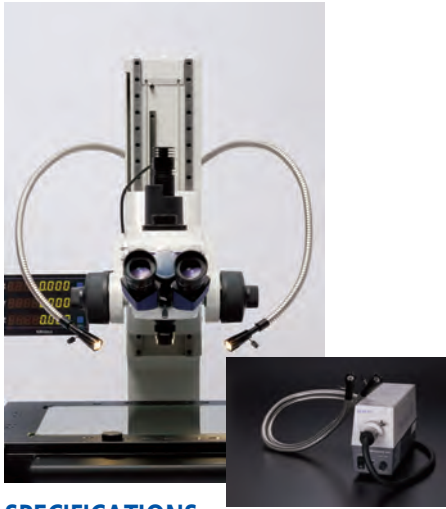


SPECIFICATIONS

Order No.	176-211	378-018	176-210A	378-016A	378-116A
Observation type	BD	BF	BD	BF	BF
No. of objective mounts	4-mount	4-mount	4-mount	4-mount	5-mount
Driving method	Manual		Motor		
Dimensions (W x D x H)	—		Turret: 6.5 x 2.6 x 5.4" 164 x 65 x 137 Control Box: 4.1 x 3 x 7.6" 108 x 72 x 193		

Accessories for Measuring Microscope

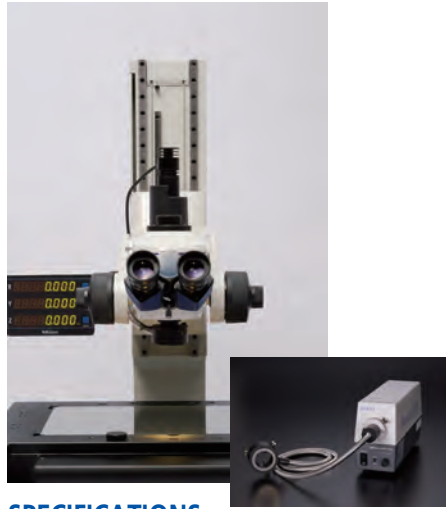
Twin fiber-optics illuminator



SPECIFICATIONS

Order No.	176-343A
Applicable microscopes	MF, MF-U models
Length of fiber cable	28" / 700mm
Light source	Halogen bulb (12V, 100W) (517181: halogen bulb)
Dimensions (W x D x H)	Light unit: 9.3 x 3 x 4.7" 235 x 76 x 120mm

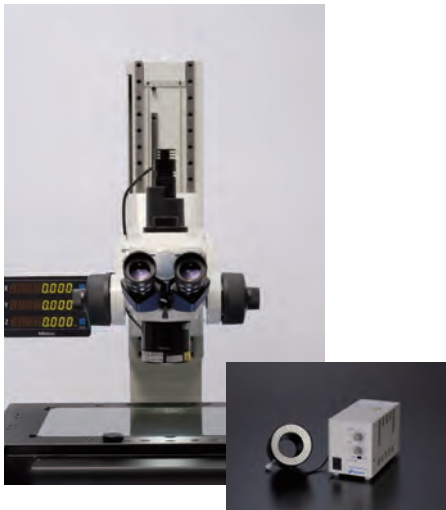
Ring fiber-optics illuminator



SPECIFICATIONS

Order No.	176-366A
Applicable microscopes	MF models
Length of fiber cable	40" x 1000mm
Light source	Halogen bulb (12V, 100W) (517181: halogen bulb)
Dimensions (W x D x H)	Light unit: 9.3 x 3 x 4.7" 235 x 76 x 120mm

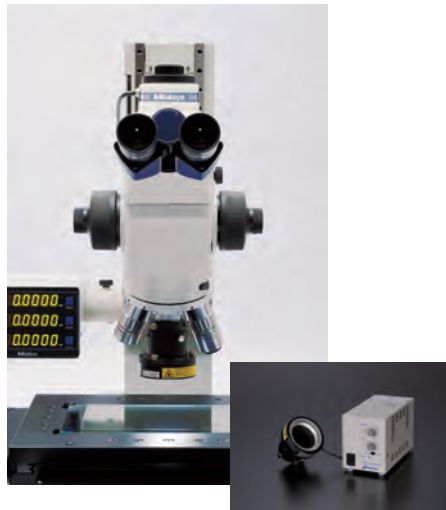
LED Ring Illuminator



SPECIFICATIONS

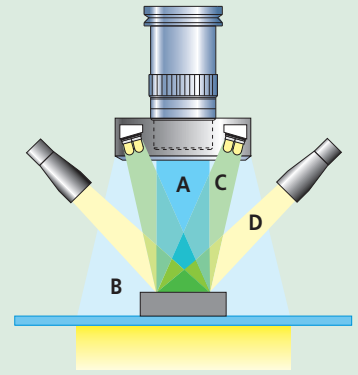
Order No.	176-367-2A
Applicable microscopes	MF models with 1X/3X/5X/10X objective
Light source	White LED
Length of LED cable	59" / 1500mm

LED Ring Light (for FS Objectives)

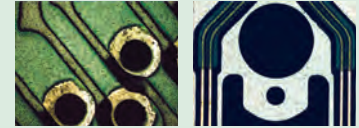


SPECIFICATIONS

Order No.	Please contact us
Applicable microscopes	MF models with 1X/3X/5X objective
Light source	Supplied from microscope (surface illumination)

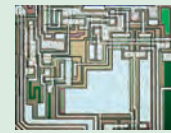


A: Vertical surface illumination (Halogen)



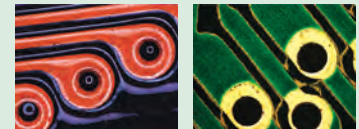
PCB

HDD suspension



IC circuit

B: Ring fiber optics illumination



Flexible PCB

PCB



Electric parts

C: LED ring illumination



HDD suspension

PCB



Black resin molded parts

D: Twin fiber optics illumination



IC package

Garnet



PCB

QM-Data200

SERIES 264 — 2-D Data Processing Unit

Technical Data

Resolution:	0.0001mm
Program functions:	Part program creation, execution, editing
Statistical processing:	Number of data, maximum value, minimum value, mean value, standard deviation, range, histogram
Element memory:	Maximum of 1000 elements
Element recall:	Point, line, circle, distance, ellipse, rectangular hole, slotted hole, intersection and intersecting angle
Element key-in:	Point, line, circle
Display system:	Monographic LCD (320 x 240 dots, with back light)
Measurement result file output:	RS-232C/USB output (CSV format, MUX-10F format)
Display language:	Japanese/English/German/French/Italian/Spanish/Portuguese/Swedish/Polish/Dutch/Hungarian
Data input:	RS-232C/USB, X/Y/Z-axis signal, Footswitch
Data output:	RS-232C/USB
Power supply:	120V AC, 50/60Hz
Mass:	2.2kg (stand-mount type) 2.1kg (arm-mount type)

QM-Data200

Order No.: 264-155A (stand-mount type)
Order No.: 264-156A (arm-mount type)
Order No.: 264-159A (for Hyper MF/MF-U)

The QM-Data200 is a geometric readout/analysis unit for optical instruments like a profile projectors. This features powerful 2-D coordinate measurement capabilities with unmatched simple key operation. The QM-Data200 improves operator productivity, minimizes errors and save a total measurement time and production cost.

FEATURES

- Various graphic displays on the large colored LCD screen for easy measurement operations.
- One-key operation for combined measurements that are often used (circle-circle distance, etc.)



QM-Data 200
Stand-mount type

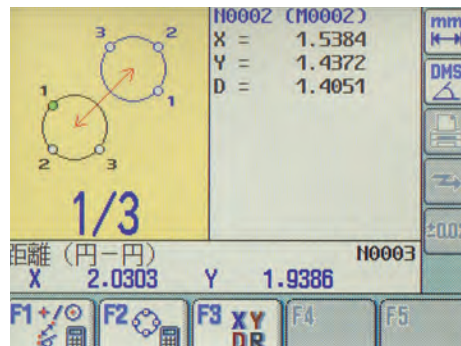
- The AI measurement function (automatic identification of measuring item) eliminates switching between the measurement command keys.
- Equipped with the measurement procedure teaching function and the measuring position navigation in Repeat mode.
- The user menu function allows user to register measurement commands or part programs to create his/her own menu.
- Tolerance zone measurement of data processing result and various statistical processing for each item are available.
- Measurement result output to "MS-Excel" in spreadsheet (CSV) format.
- The measurement procedure and measurement result can be saved, using a USB drive.
- Two models are available: a stand-alone type with tilt system and a flexible arm type that can be mounted on a Profile Projector.

Intuitive panel design

The QM-Data200 employs the "Geometry Keys" to accelerate the measurement process. The probing routine of standard geometric features and combinations are designed with Geometry Keys on the front panel. Click of a key that you need and capture features you can complete the measurement quickly and accurately. This improves operator productivity, reduce errors and save operation time and cost.

Graphic display

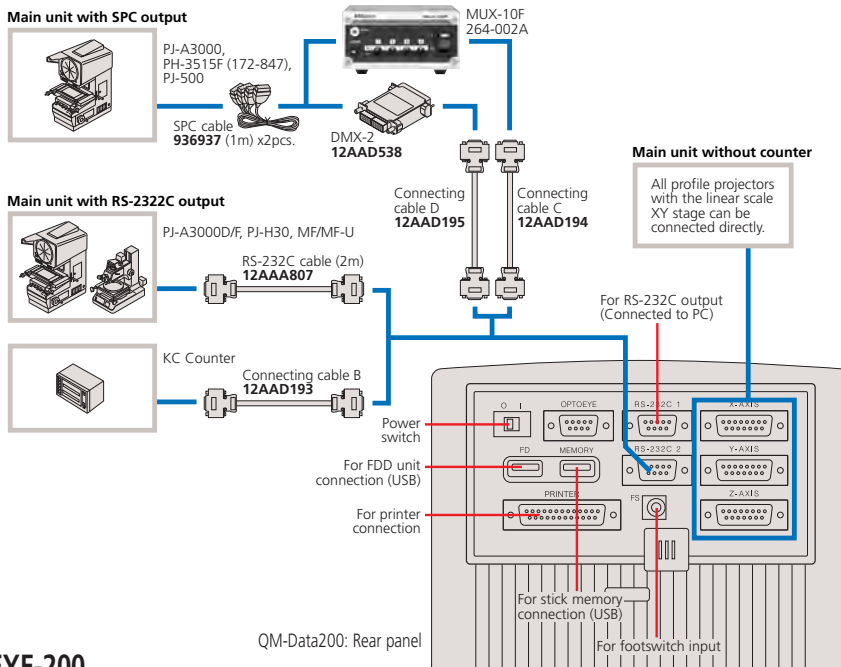
Measurement information and data are visualized on the back-lit colored LCD display with graphical interfaces. The geometric feature that you selected is displayed with the probing navigator. The measurements map and blink indication show you the probing points and sequences. Simply probe points and click by following the blink indicator the measurement can be easily completed even a beginner. This improves operation accuracy and reduces errors and time.



QM-Data200

SERIES 264 — 2-D Data Processing Unit

SYSTEM DIAGRAM



OPTOEYE-200

The OPTOEYE-200 Image Edge Sensor eliminates human errors which may be involved in visual alignment, ensuring speedy, accurate, and consistent measurements, regardless of operator's skill.

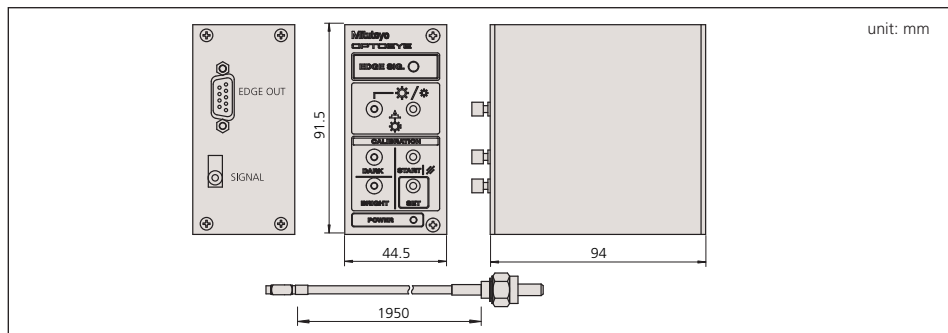
FEATURES

• OPTOEYE-200 adopts a thin fiber-optic cable for detector connection to offer easy set-up and smart operation without obstructing your view.

- Bright and dark buttons allow easy calibration.
- OPTOEYE can be powered by QM-Data200 via the connecting cable. It means that no AC adapter is required.
- The brightness of the chart can be adjusted.



DIMENSIONS



Optional Accessories

- 12AAH035: Floppy disk drive unit (USB type)
- 12AAD034: Receipt printer (for 120V)
- 908353: Printer paper for receipt printer
- 12AAA804: Printer cable (2m)
- 937179T: Foot switch
- 12AAD193: Connection cable B
- 12AAD194: Connection cable C
- 12AAD195: Connection cable D
- 12AAA807: RS-232C cable (2m)
- 12AAA920: RS-232C cable (3m)

Technical Data

Image detection

- Directivity: Non-direction
- Min. diameter: $\varnothing 2\text{mm}$ on the screen
- Min. width: 1mm on the screen
- Max. moving speed: 1000mm/s

Applicable illumination

- Type: Surface / Contour illumination
- Range: 30Lx to 1500Lx on the screen

Repeatability:

Function:

1 μm in contour illumination
Error in detection of illumination change
Supporting a contour illumination brightness selector switch of projector

Optional Accessories

12AAE671:

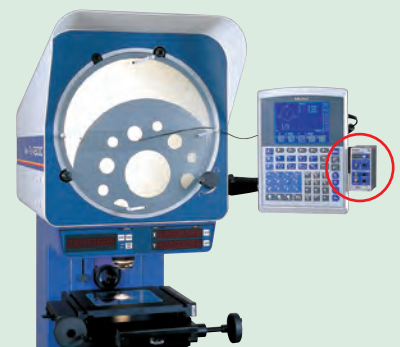
Detector attachment (A)

PJ-A3000, PJ-H30, PH-3515, PH-A14 series
(Adaptation diameter of a screen:
10" / $\varnothing 250$ to 14" / $\varnothing 350\text{mm}$)

12AAE672:

Detector attachment (B)

PJ-500, PV-5110, PV-600A series
(Adaptation diameter of a screen:
20" / $\varnothing 500$ to 24" / $\varnothing 600\text{mm}$)



Vision Unit

SERIES 359 — Vision System Retrofit for Microscopes

Technical Data

Projected image:	Inverted image
Camera unit	
• Image sensor:	Color CMOS camera
• Resolution:	0.0001mm
• Dimensions:	4x2.3x3.5" / 100x58x89mm (WxDx H)
• Mass:	1lbs / 0.4kg
Adapter unit	
• Operating software:	QSPAK VUE (optional)
• Dimensions:	1.8 x 5" / 45 x 123mm
• Magnification:	0.5X
• Mass:	0.8lbs / 0.3kg
Magnifications:	21X - 210X on 19" monitor
Standard accessory:	Foot switch (12AAJ088)

QSPAK, optional software

For observation/comparison of form

- Template matching function
- Manual pattern matching function

For simple measurement

- One-click edge detection tool function
- Smart tool function
- User macro function

For repeated measurement/auto-measurement

- Quick navigation function
- Playback function
- Graphic function
- External data output function
- Statistical calculation function

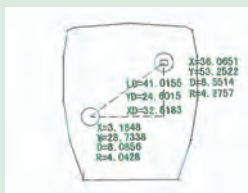
One-click Edge Detection

Just by clicking the mouse near the edge of a workpiece, QSPAK automatically scans the edge and detects it, showing its coordinates. This function also works with the point tool, box tool, circle tool and auto-focus tool.



Graphic Window

The measurement results and measured elements are plotted in the graphic window in real-time. By using this function the user can check the current measuring position at a glance. The graphic window can be used for geometrical calculation.

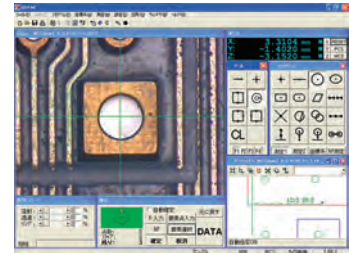


FEATURES

- The automatic edge-detection tools and various macro icons allow measurement in one easy step.
- The graphics and measurement navigation functions facilitate operation.
- Image data input/storage function.
- Measurement results are output to MS-Excel®. This lets the user generate an inspection table on the same computer.
- Allows the tolerance zone measurement of measurement results and various types of statistical processing for each item.
- Combined use with the focus pilot provides high-accuracy in height measurements. (Patent pending)

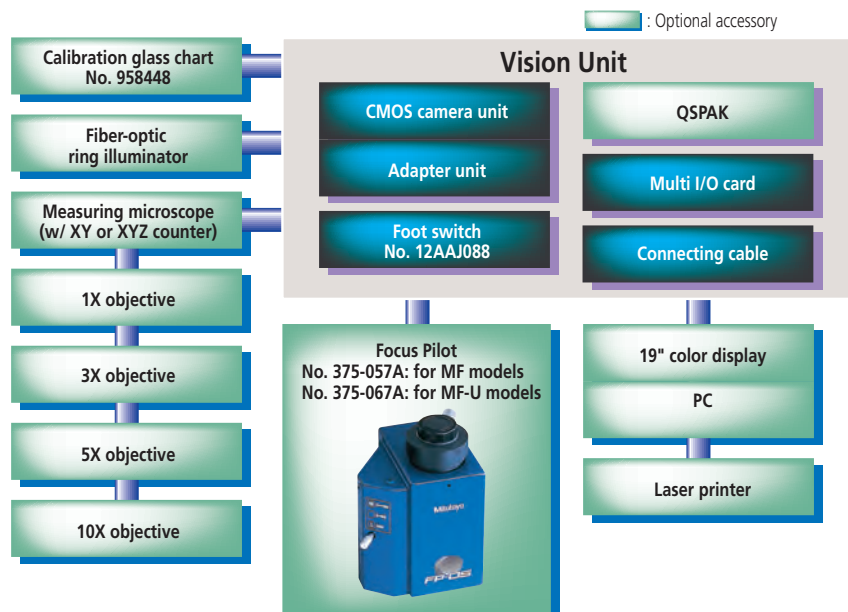
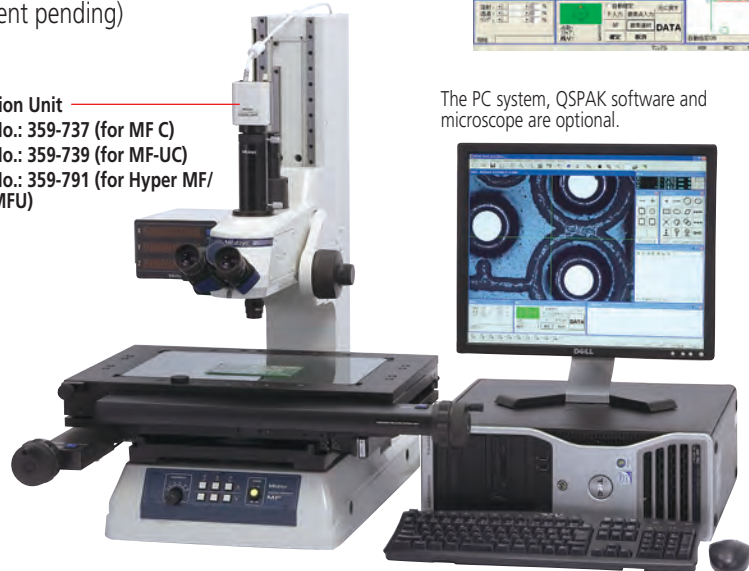
- A series of measuring operations can be performed using just one screen display.
- The auto-brightness control function faithfully reproduces the type and degree of illumination used. (This function is limited to the MF/MF-U series.)

QSPAK Measurement Window



The PC system, QSPAK software and microscope are optional.

Vision Unit
 No.: 359-737 (for MF C)
 No.: 359-739 (for MF-UC)
 No.: 359-791 (for Hyper MF/MFU)



FS-70

SERIES 378 — Microscope Unit for Semiconductor Inspection

FEATURES

- The optical system that has originally developed for the best seller FS 60 models was further enhanced for the FS70 models. It is ideal as a microscope unit of a prober station for semiconductors. (All models CE marked.)
- The FS70L supports three types of YAG laser wavelength ranges (1064nm, 532nm and 355nm), while the FS70L4 supports two types of wavelength ranges (532nm and 266nm), thus expanding a scope of laser applications, allowing laser-cutting of thin-films used in semiconductors and liquid crystal substrates. However, Mitutoyo assumes no responsibility whatsoever for the performance and/or safety of the laser system used with Mitutoyo microscopes. a careful examination is recommended in selecting a laser-emission unit.
- Bright field, Differential Interference Contrast (DIC) and polarized observations are standard with the FS70Z. The FS70L and FS70L4 do not support the DIC method.
- By employing an inward revolver, the long working distance objectives provide excellent operability.
- An ergonomic design with superb operability: the FS70 employs the erect-image optical system (the image in the field of view has the same orientation as the specimen) and enlarged fine focus adjustment wheel with rubber grip coarse adjustment knob.

Technical Data

Focus adjustment	
• Method:	With concentric coarse and fine focusing wheels (right and left) 50mm travel range
• Range:	0.1mm/rev. for fine adjustment, 3.8mm/rev. for coarse adjustment
Trinocular tube Image:	Erect image
Pupil distance:	Siedentopf type, adjustment range: 2-3" / 51-76mm
Field number:	24
Tilt angle:	0° - 20° (only -TH, -THS models)
Illumination system:	Reflective illumination for bright field (Koehler illumination, with aperture diaphragm)
Light source:	12V/100W fiber optics, non-stepped adjustment), light guide length 1.5m, power consumption 150W
Objectives (optional):	M Plan Apo-4, M Plan Apo SL, G Plan Apo



SPECIFICATIONS

Model No. Order No.	FS70 378-184-1	FS70-TH 378-184-3	FS70Z 378-185-1	FS70Z-TH 378-185-3	FS70L 378-186-1	FS70L-TH 378-186-3	FS70L4 378-187-1	FS70L4-TH 378-187-3
Short base model No. Order No.	FS70-S 378-184-2	FS70-THS 378-184-4	FS70Z-S 378-185-2	FS70Z-THS 378-185-4	FS70L-S 378-186-2	FS70L-THS 378-186-4	FS70L4-S 378-187-2	FS70L4-THS 378-187-4
Focus adjustment	50mm travel range with concentric coarse (3.8mm/rev) and fine (0.1mm/rev) focusing wheels (right / left)							
Image	Erect image							
Pupil distance	Siedentopf type, adjustment range: 2 - 3" / 51 - 76mm							
Field number	24							
Tilt angle	—	0° - 20°	—	0° - 20°	—	0° - 20°	—	0° - 20°
Optical pass ratio	50/50	100/0 or 0/100	50/50	100/0 or 0/100	100/0 or 0/100	100/0 or 0/100	100/0 or 0/100	100/0 or 0/100
Protective filter	—		—		Built-in laser beam filter		Built-in laser beam filter	
Tube lens	1X		1X - 2X zoom		1X		1X	
Applicable laser	—		—		1064/532/355nm		532/266nm	
Camera mount	C-mount (using optional adapter B)				Use a laser with TV port.		C-mount receptacle (with green filter switch)	
Illumination system, optional	Reflective illumination for bright field (Koehler illumination, with aperture diaphragm) 12V 100W fiber optics, non-stepped adjustment, light guide length: 1.5m, power consumption 150W							
Objective, optional (for observation)	M Plan Apo, M Plan Apo SL, G Plan Apo							
Objective, optional (for laser-cutting)	—				M/LCD Plan NIR, M/LCD Plan NUV		M Plan UV	
Loading weight*	32lbs/14.5kg	30lbs/13.6kg	31lbs/14.1kg	29lbs/13.2kg	31lbs/14.2kg	30lbs/13.5kg	31lbs/13.9kg	29lbs/13.1kg
Mass (main unit)	13lbs/6.1kg	15.5lbs/7.1kg	14.5lbs/6.6kg	16.5lbs/7.5kg	14lbs/6.4kg	15.5lbs/7.2kg	14.5lbs/6.7kg	16.5lbs/7.5kg

*Loading weight on optical tube excluding weight of objective lenses and eyepieces

VMU

SERIES 378 — Video Microscope Unit

The VMU is a compact, light-weight, and easy-to-install microscope unit for CCD camera monitoring in semiconductor fabrications.

FEATURES

- The optical system features ultra-long working distance objectives and correction for the wide range of radiation.
- The fiber-optic reflected illumination keeps the workpiece free from thermal expansion caused by heat. The fiber-optic illuminator is required for the light source.
- Also available with a laser mount or revolving nosepiece (objective mount).



SPECIFICATIONS

Maginification of tube	1X
Applicable wavelength	378-505, 378-506 378-507, 378-513 378-508 378-514
	Near-infrared and visible radiation Near-infrared—visible—near-ultraviolet radiation Visible and ultraviolet radiation Near-infrared to ultraviolet
Objective	(Optional)
Reflected illumination	• Telecentric system with aperture stop system • Fiber-optic illuminator (optional) is required.
Light source	Halogen bulb (21V, 150W) (optional)
Mass	378-505: 570g 378-506: 590g 378-507: 980g 378-508: 1010g 378-513: 1300g 378-514: 1300g

Selection Guide of System Configuration

Order No. (Depends on each system configuration)	378-505	378-506	378-507	378-508	378-513	378-514
Vertical CCD camera mount	●	●	●	●	●	●
Horizontal CCD camera mount		●				
YAG laser mount			●	●	●	●
Fiber-optic illumination unit			●	●	●	●
M Plan Apo, M Plan Apo SL, G Plan Apo objectives for bright field observation	▲	▲	▲	▲	▲	▲
M Plan Apo NIR, LCD Plan Apo NIR, M Plan Apo NUV and LCD Plan Apo NUV objectives for laser cutting			▲		▲	▲
M Plan UV objectives for laser machining				▲		▲

●: Provided, ▲: Available as optional accessory

Eyepieces

SERIES 378

FEATURES

- The field of view is extra wide.
- Optional reticles are available.



378-866



378-857



378-858

SPECIFICATIONS

Order No. (2pcs. set)	Magnification	Field number	Mass	Individual order No.
378-866	10X	24	85g	378-866-5
378-857	15X	16	40g	378-857-5
378-858	20X	12	55g	378-858-8

Reticles (optional)

- 516848:** Cross-hair
- 516576:** Broken cross hair (90° and 60°)
- 516578:** Concentric circle
(Diametric increment: 1.2mm)
- 516577:** 20mm scale
(Minimum reading: 0.1mm) with cross hair
- 516849:** 10mm scale (Minimum reading: 0.1mm)
- 516850:** 5mm scale (Minimum reading: 0.05mm)
- 516851:** 10x10mm section
(Minimum section: 1x1mm)

Objectives

SERIES 378

The Mitutoyo 378 Series objectives have the world's longest working distance and an infinity correction optical system. These objectives provide flexible observation at high magnifications and independent correction of chromatic aberration.

FEATURES

- The long working distance type objectives provide excellent clearance between the lens surface and the workpiece surface in focus, making it possible to observe workpieces which are usually hard-to-focus because of awkward projections.
- The metallurgical plan apochromatic (M Plan Apo) objective is an excellent optical system. This objective provides a flat, chromatic aberration-free image throughout the field of view, making it is suitable for any type of microscope.
- Specially designed objectives are also available with correction for near-infrared radiation, near-ultraviolet radiation, and ultraviolet radiation, or various thicknesses of LCD screen glasses.
- The mounting screw threads of objectives are designed to conform to JIS B-7141-1988.



M Plan Apo and M Plan Apo SL objectives for bright field observation



BD Plan Apo and BD Plan Apo SL objectives for bright/dark field observation



Near-infrared radiation corrected M Plan Apo NIR objectives



Near-ultraviolet radiation corrected M Plan Apo NUV objectives



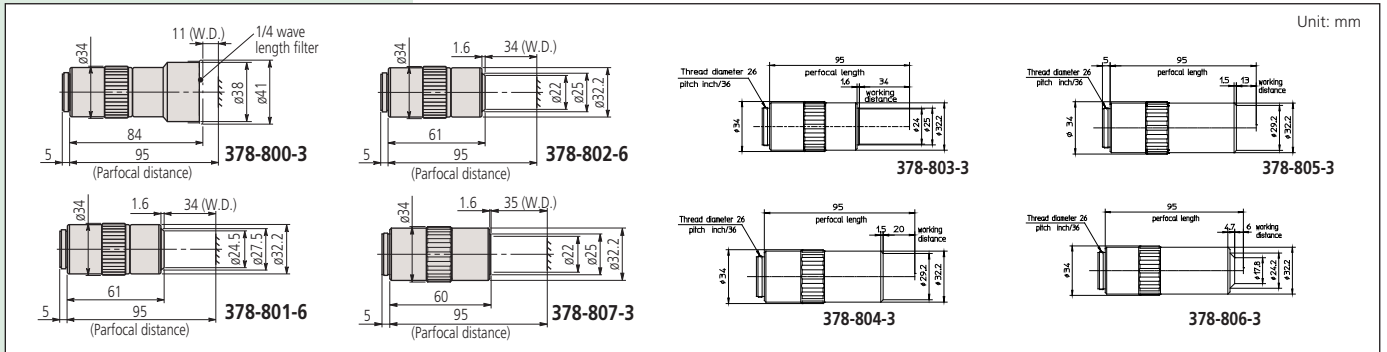
Ultraviolet radiation corrected M Plan UV objectives

Note:
Polarizing unit (**378-074**) is required when using 1X objective.

M Plan Apo for Bright Field Observation

Order No.	Mag.	N.A.	W.D.	f	R	D.F.	View field 1	View field 2	Mass
378-800-3	1X	0.025	11.0mm	200mm	11.0μm	440μm	ø24mm	4.8x6.4mm	300g
378-801-6	2X	0.055	34.0mm	100mm	5.0μm	91μm	ø12mm	2.4x3.2mm	220g
378-802-6	5X	0.14	34.0mm	40mm	2.0μm	14.0μm	ø4.8mm	0.96x1.28mm	230g
378-807-3	7.5X	0.21	35.0mm	26.67mm	1.3μm	6.2μm	ø3.6mm	0.64x0.85mm	240g
378-803-3	10X	0.28	34.0mm	20mm	1.0μm	3.5μm	ø2.4mm	0.48x0.64mm	240g
378-804-3	20X	0.42	20.0mm	10mm	0.7μm	1.6μm	ø1.2mm	0.24x0.32mm	270g
378-805-3	50X	0.55	13.0mm	4mm	0.5μm	0.9μm	ø0.48mm	0.10x0.13mm	290g
378-806-3	100X	0.70	6.0mm	2mm	0.4μm	0.6μm	ø0.24mm	0.05x0.06mm	320g

DIMENSIONS

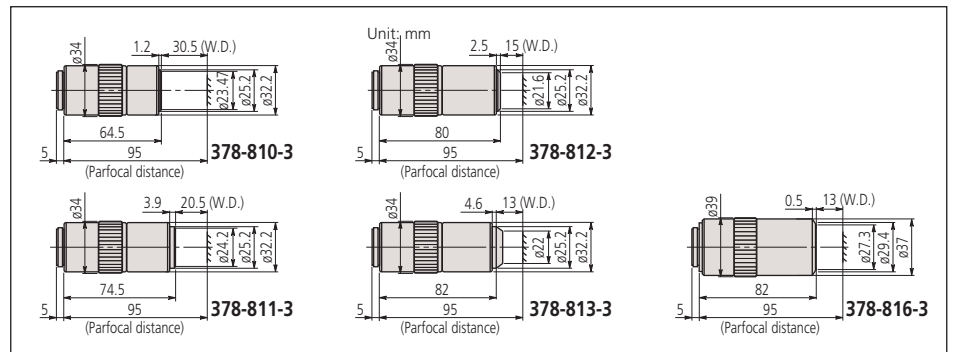


Note:
These objectives offer extra-long working distance.

M Plan Apo SL for Bright Field Observation

Order No.	Mag.	N.A.	W.D.	f	R	D.F.	View field 1	View field 2	Mass
378-810-3	20X	0.28	30.5mm	10mm	1.0μm	3.5μm	ø1.2mm	0.24x0.32mm	240g
378-811-3	50X	0.42	20.5mm	4mm	0.7μm	1.6μm	ø0.48mm	0.10x0.13mm	280g
378-812-3	80X	0.50	15.0mm	2.5mm	0.6μm	1.1μm	ø0.3mm	0.06x0.08mm	280g
378-813-3	100X	0.55	13.0mm	2mm	0.5μm	0.9μm	ø0.24mm	0.05x0.06mm	290g
378-816-3	200X	0.62	13.0mm	1mm	0.4μm	0.7μm	ø0.12mm	0.025x0.03mm	490g

DIMENSIONS

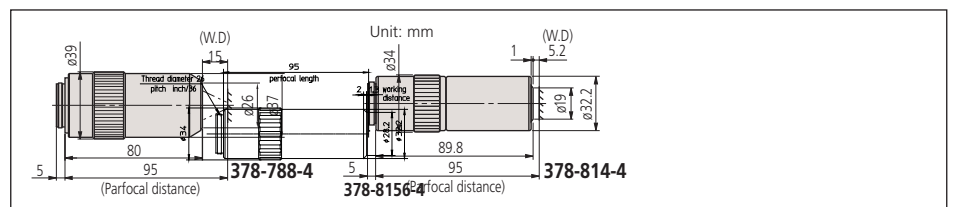


Note:
These objectives offer extra-high resolving power.

M Plan Apo HR for Bright Field Observation

Order No.	Mag.	N.A.	W.D.	f	R	D.F.	View field 1	View field 2	Mass
378-788-4	10X	0.42	15mm	20mm	0.7μm	1.6μm	ø2.4mm	0.48x0.64mm	460g
378-814-4	50X	0.75	5.2mm	4mm	0.4μm	0.49μm	ø0.48mm	0.10x0.13mm	400g
378-815-4	100X	0.90	1.3mm	2mm	0.3μm	0.34μm	ø0.24mm	0.05x0.06mm	410g

DIMENSIONS



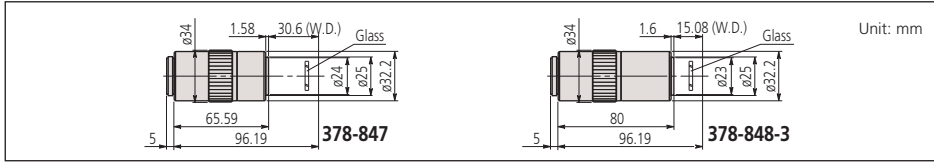
Mag.: Magnification
N.A.: Numerical aperture
W.D.: Working distance
f: Focal distance
R: Resolving power
D.F.: Focal depth
View field 1:
Field of view when using ø24mm eyepiece
View field 2:
Field of view when using 1/2" CCD camera

Glass Thickness (t = 3.5mm) Corrected G Plan Apo for Bright Field Observation

Order No.	Mag.	N.A.	W.D.	f	R	D.F.	View field 1	View field 2	Mass
378-847	20X	0.28	29.42mm*	10mm	1.0 μ m	3.5 μ m	ϕ 1.2mm	0.24x0.32mm	270g
378-848-3	50X	0.50	13.89mm*	4mm	0.6 μ m	1.1 μ m	ϕ 0.48mm	0.10x0.13mm	320g

*In air

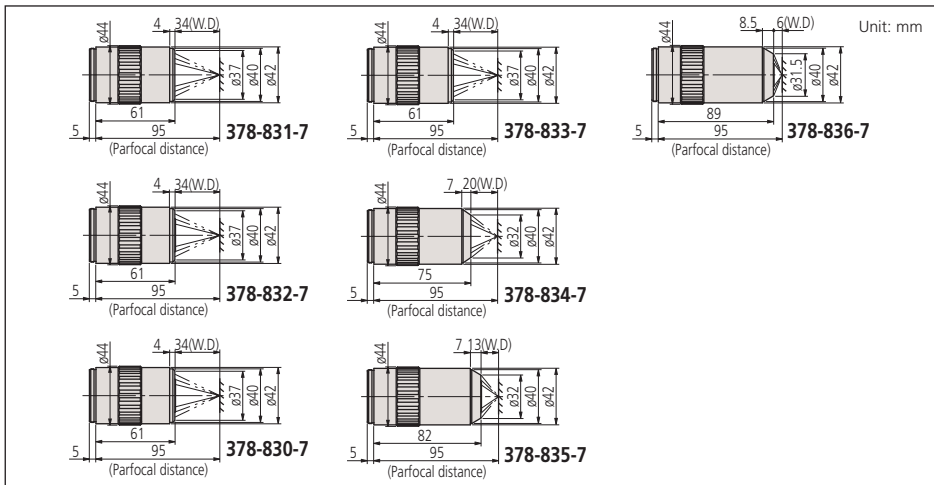
DIMENSIONS



BD Plan Apo for Bright/Dark Field Observation

Order No.	Mag.	N.A.	W.D.	f	R	D.F.	View field 1	View field 2	Mass
378-831-7	2X	0.055	34.0mm	100mm	5.0 μ m	91 μ m	ϕ 12mm	2.4x3.2mm	340g
378-832-7	5X	0.14	34.0mm	40mm	2.0 μ m	14.0 μ m	ϕ 4.8mm	0.96x1.28mm	350g
378-830-7	7.5X	0.21	34.0mm	26.67mm	1.3 μ m	6.2 μ m	ϕ 3.6mm	0.64x0.85mm	350g
378-833-7	10X	0.28	34.0mm	20mm	1.0 μ m	3.5 μ m	ϕ 2.4mm	0.48x0.64mm	350g
378-834-7	20X	0.42	20.0mm	10mm	0.7 μ m	1.6 μ m	ϕ 1.2mm	0.24x0.32mm	400g
378-835-7	50X	0.55	13.0mm	4mm	0.5 μ m	0.9 μ m	ϕ 0.48mm	0.10x0.13mm	440g
378-836-7	100X	0.70	6.0mm	2mm	0.4 μ m	0.6 μ m	ϕ 0.24mm	0.05x0.06mm	460g

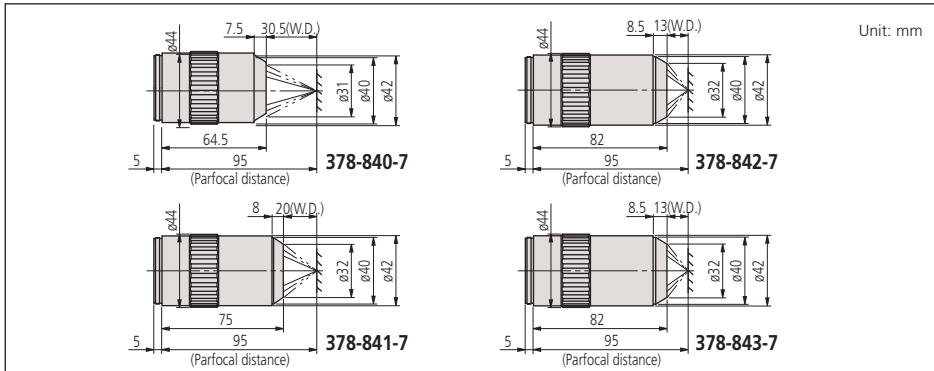
DIMENSIONS



BD Plan Apo SL for Bright/Dark Field Observation

Order No.	Mag.	N.A.	W.D.	f	R	D.F.	View field 1	View field 2	Mass
378-840-7	20X	0.28	30.5mm	10mm	1.0 μ m	3.5 μ m	ϕ 1.2mm	0.24x0.32mm	350g
378-841-7	50X	0.42	20.0mm	4mm	0.7 μ m	1.6 μ m	ϕ 0.48mm	0.10x0.13mm	410g
378-842-7	80X	0.50	13.0mm	2.5mm	0.6 μ m	1.1 μ m	ϕ 0.3mm	0.06x0.08mm	430g
378-843-7	100X	0.55	13.0mm	2mm	0.5 μ m	0.9 μ m	ϕ 0.24mm	0.05x0.06mm	440g

DIMENSIONS



Note:

The G Plan Apo Series are designed for observing a workpiece through glass (thickness = 3.5mm).

Note:

These objectives offer extra-long working distance.

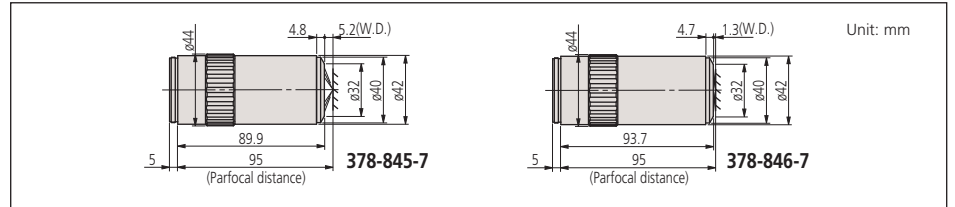
Mag.: Magnification
 N.A.: Numerical aperture
 W.D.: Working distance
 f: Focal distance
 R: Resolving power
 D.F.: Focal depth
 View field 1:
 Field of view when using ϕ 24mm eyepiece
 View field 2:
 Field of view when using 1/2" CCD camera

Note:
These objectives offer extra-high resolving power.

BD Plan Apo HR for Bright/Dark Field Observation

Order No.	Mag.	N.A.	W.D.	f	R	D.F.	View field 1	View field 2	Mass
378-845-7	50X	0.75	5.2mm	4mm	0.4μm	0.49μm	ø0.48mm	0.10x0.13mm	530g
378-846-7	100X	0.90	1.3mm	2mm	0.3μm	0.34μm	ø0.24mm	0.05x0.06mm	545g

DIMENSIONS

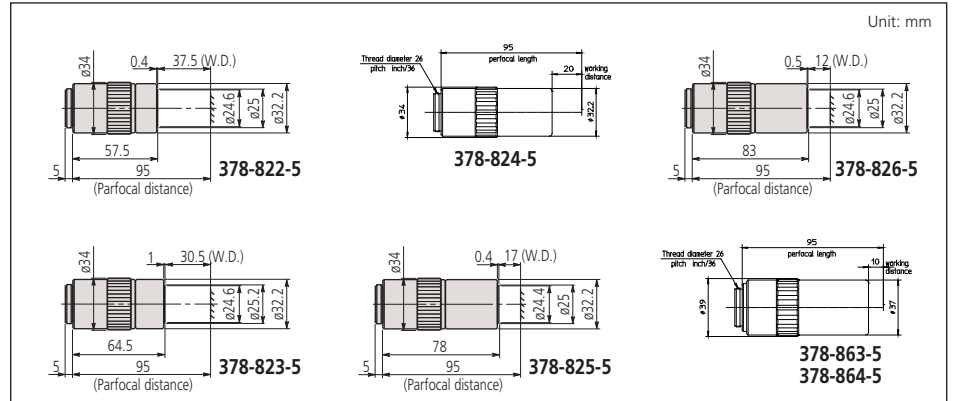


Note:
These objectives are designed so that a workpiece's image can be focused within the focal depth even when the wavelength used is changed anywhere from the visible range ($\lambda = 480\text{nm}$) up to near-infrared range ($\lambda = 1800\text{nm}$). Therefore the M Plan NIR Series are suitable for laser repair. However, when the wavelength used exceeds 1100nm, the focussing position may slightly deviate from that in the visible range due to changes in glass dispersion and refractive index.

Near-infrared Radiation Corrected M Plan Apo NIR for Bright Field Observation

Order No.	Mag.	N.A.	W.D.	f	R	D.F.	View field 1	View field 2	Mass
378-822-5	5X	0.14	37.5mm	40mm	2.0μm	14.0μm	ø4.8mm	0.96x1.28mm	220g
378-823-5	10X	0.26	30.5mm	20mm	1.1μm	4.1μm	ø2.4mm	0.48x0.64mm	250g
378-824-5	20X	0.40	20.0mm	10mm	0.7μm	1.7μm	ø1.2mm	0.24x0.32mm	300g
378-825-5	50X	0.42	17.0mm	4mm	0.7μm	1.6μm	ø0.48mm	0.10x0.13mm	315g
378-826-5	100X	0.50	12.0mm	2mm	0.6μm	1.1μm	ø0.24mm	0.05x0.06mm	335g
378-863-5	50X	0.65	10mm	4mm	0.4μm	0.7μm	ø0.48mm	0.10x0.13mm	450g
378-864-5	100X	0.70	10mm	2mm	0.4μm	0.6μm	ø0.24mm	0.05x0.06mm	450g

DIMENSIONS

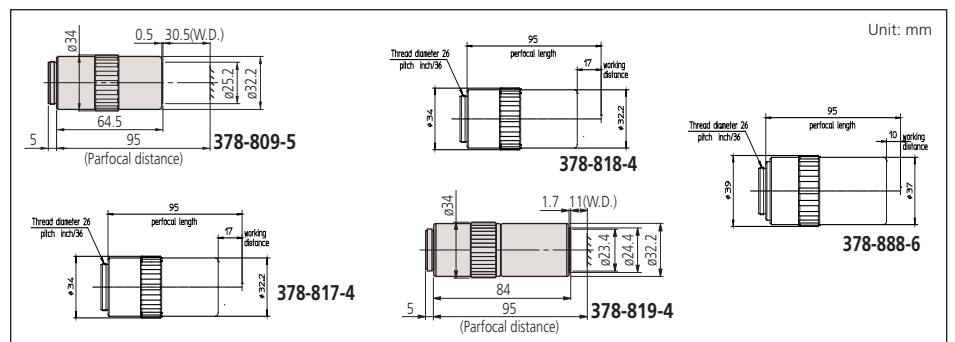


Note:
These objectives are designed so that a workpiece's image can be focused within the focal depth even when the wavelength used is changed anywhere from the visible range ($\lambda = 620\text{nm}$) to the near-ultraviolet range ($\lambda = 355\text{nm}$). Therefore The M Plan NUV Series are suitable for laser repair using a high frequency laser beam.

Near-ultraviolet Radiation Corrected M Plan Apo NUV for Bright Field Observation

Order No.	Mag.	N.A.	W.D.	f	R	D.F.	View field 1	View field 2	-
378-809-5	10X	0.28	30.5mm	20mm	1μm	3.5μm	ø2.4mm	0.48x0.64mm	255g
378-817-4	20X	0.40	17.0mm	10mm	0.7μm	1.7μm	ø1.2mm	0.24x0.32mm	340g
378-818-4	50X	0.42	15.0mm	4mm	0.7μm	1.6μm	ø0.48mm	0.10x0.13mm	350g
378-819-4	100X	0.50	11.0mm	2mm	0.6μm	1.1μm	ø0.24mm	0.05x0.06mm	380g
378-888-6	50X	0.65	10.00mm	4mm	0.42μm	0.65μm	ø0.48mm	0.10x0.13mm	500g

DIMENSIONS



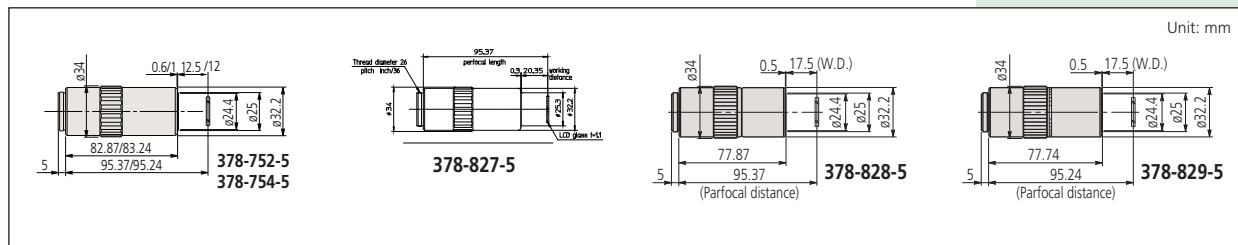
Mag.: Magnification
N.A.: Numerical aperture
W.D.: Working distance
f: Focal distance
R: Resolving power
D.F.: Focal depth
View field 1: Field of view when using ø24mm eyepiece
View field 2: Field of view when using 1/2" CCD camera

Near-Infrared Radiation and LCD Glass Thickness (t = 1.1mm or 0.7mm) Corrected LCD Plan Apo NIR for Bright Field Observation

Order No.	Mag.	N.A.	W.D.	f	R	D.F.	View field 1	View field 2	Mass
378-827-5	20X (t1.1)	0.40	19.98mm*	10mm	0.7 μ m	1.7 μ m	\varnothing 1.2mm	0.24x0.32mm	305g
378-828-5	50X (t1.1)	0.42	17.13mm*	3.9mm	0.7 μ m	1.6 μ m	\varnothing 0.48mm	0.10x0.13mm	320g
378-829-5	50X (t0.7)	0.42	17.26mm*	3.9mm	0.7 μ m	1.6 μ m	\varnothing 0.48mm	0.10x0.13mm	320g
378-752-5	100X (t1.1)	0.50	12.13mm*	2mm	0.6 μ m	1.1 μ m	\varnothing 0.24mm	0.05x0.06mm	335g
378-754-5	100X (t0.7)	0.50	11.76mm*	2mm	0.6 μ m	1.1 μ m	\varnothing 0.24mm	0.05x0.06mm	335g

*In air

DIMENSIONS

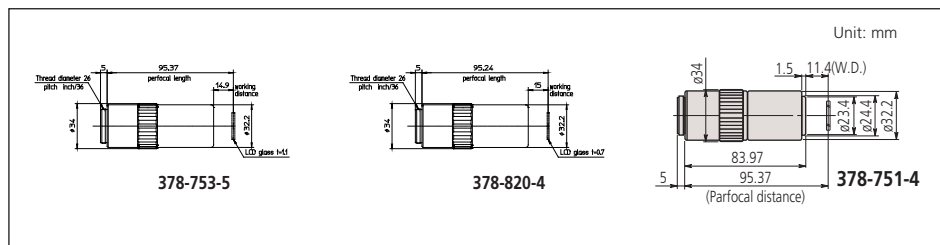


Near-ultraviolet Radiation and LCD Glass Thickness (t = 0.7mm) Corrected LCD Plan Apo NUV for Bright Field Observation

Order No.	Mag.	N.A.	W.D.	f	R	D.F.	View field 1	View field 2	Mass
378-820-4	50X (t0.7)	0.42	14.76mm*	4mm	0.7 μ m	1.6 μ m	\varnothing 0.48mm	0.10x0.13mm	310g
378-753-4	50X (t1.1)	0.42	14.53mm	4mm	0.7 μ m	1.6 μ m	\varnothing 0.48mm	0.10x0.13mm	310g
378-751-4	100X (t1.1)	0.50	11.03mm	2mm	0.6 μ m	1.1 μ m	\varnothing 0.24mm	0.05x0.06mm	380g

*In air

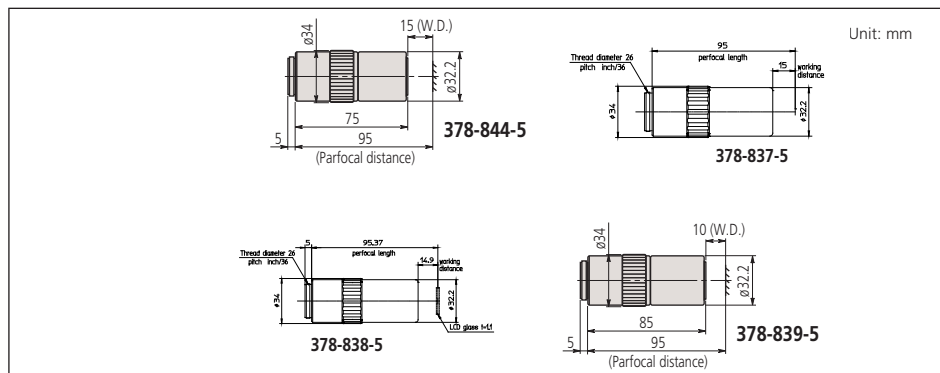
DIMENSIONS



Ultraviolet Radiation Corrected M Plan UV for Bright Field Observation

Order No.	Mag.	N.A.	W.D.	f	R	D.F.	View field 1	View field 2	Mass
378-844-5	10X	0.25	20mm	20mm	1.1 μ m	4.4 μ m	\varnothing 2.4mm	0.48x0.64mm	310g
378-837-5	20X	0.36	15.0mm	10mm	0.8 μ m	2.1 μ m	\varnothing 1.2mm	0.24x0.32mm	330g
378-838-5	50X	0.40	12.0mm	4mm	0.7 μ m	1.7 μ m	\varnothing 0.48mm	0.10x0.13mm	400g
378-839-5	80X	0.55	10.0mm	2.5mm	0.5 μ m	0.9 μ m	\varnothing 0.3mm	0.06x0.08mm	380g

DIMENSIONS



Note:

These near-infrared ($\lambda = 1800\text{nm}$) corrected objectives are designed for observing a workpiece through LCD glass (thickness = 1.1mm (378-827-5, 378-828-5, 378-752-5) or 0.7mm (378-829-5, 378-754-5)) and for laser repair.

Note:

These near ultraviolet corrected objectives are designed for observing a workpiece through LCD glass (thickness = 1.1mm (378-753-4, 378-751-4) or 0.7mm (378-820-4)) and for laser repair.

Note:

These ultraviolet corrected objectives are designed so that a workpiece's image can be focused within the focal depth even when the wavelength used is changed anywhere from the visible range ($\lambda = 550\text{nm}$) to the ultraviolet range ($\lambda = 266\text{nm}$). Therefore the M Plan UV Series are suitable for laser repair using a high frequency laser beam.

Mag.: Magnification
 N.A.: Numerical aperture
 W.D.: Working distance
 f: Focal distance
 R: Resolving power
 D.F.: Focal depth
 View field 1: Field of view when using \varnothing 24mm eyepiece
 View field 2: Field of view when using 1/2" CCD camera

MSM-400

SERIES 377 — Stereo Microscopes

FEATURES

- Continuous 1X - 4X magnification
- Image always in focus throughout zoom range
- Crisp, erect images with high resolution and excellent stereoscopic effect
- Stereo-tube can be rotated a full 360°, for viewing at any angle
- Bilateral zoom control knob adds convenience and increases operator efficiency
- Diopter adjustment for both eyepieces

- Binocular Tube Inclination: 45°
- Focusing Range: 1.46" (37mm)
- Interpupillary Adjustable Range: 2.12" - 2.99" (54mm - 76mm)
- Optional zoom ranges from 2.5X - 10X to 30X - 120X

The MSM-414L is a traditional binocular stereo microscope for industrial, medical, and classroom applications. It is ideal for electrical small part inspection, assembly, and medical/biological dissection.



377-972A

Optional Accessories

Illuminated Stand

Order No.	Description
377-412	Pole Type Stand (top: 12V/10W flat filament tungsten, bottom: 5W fluorescent)
377-413*	Pole Type Stand (top: 12V/10W flat filament tungsten, bottom: 12V/10W halogen with intensity control)
377-414	Fixed Arm Stand (top: 12V/10W flat filament tungsten, bottom: 5W fluorescent)
377-415	Fixed Arm Stand (top: 12V/10W flat filament tungsten, bottom: 12V/10W halogen with intensity control)
377-416	Fixed Arm Stand (top: 5W fluorescent, bottom: 5W fluorescent)

*Standard Accessory

Digital Imaging with Software

Order No.	Description
64PMI189*	Digital camera, 2.0 Megapixel, USB 2.0 interface
64PMI236	Digital camera, 3.0 Megapixel, USB 2.0 interface

* Can mount to both eyepiece slot & trinocular port.
If using trinocular, order **377-481** C mount.



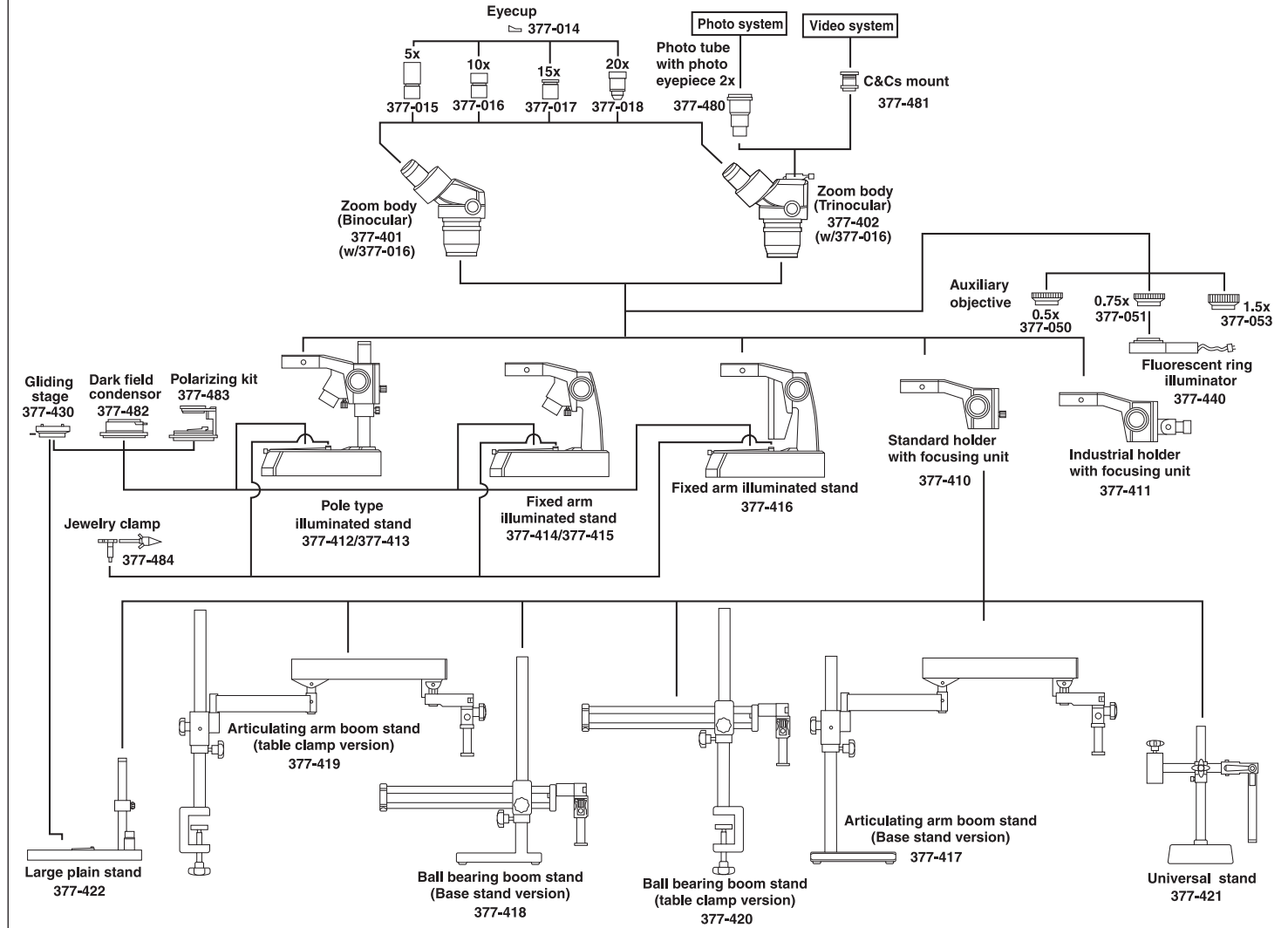
SPECIFICATIONS

Model.	MSM-414L	MSM-414TL
Order No.	377-972A	377-974A
Optical tube	Binocular	Trinocular
Total magnification	10X - 40X	
Eyepiece	10X (377-016)	
Objective	1X - 4X	
Working distance	80mm	
Field of view	20mm - 5mm	
Dimensions	H=13.2" x W=6.7" x D=9.3"	
Mass	13.2 lbs (6kg)	

Stereo Microscopes

SERIES 377

377-972A/377-974A SYSTEM DIAGRAM



MSM-400

SERIES 377 — Stereo Microscopes

FEATURES

- Superior quality optics provide high-resolution
- Crystal sharp, high color contrast image with excellent depth of field
- Always in sharp focus at all magnifications
- The Parfocal Optical System allows relaxed strain-free viewing
- Long working distance
- Extreme large field of view (23mm diameter)

The MSM-465L, Order No. 377-990A, is a high-accuracy four-step magnification stereo microscope. With a horizontal

changer allowing 6X, 12X, 25X, and 50X magnifications with a standard 1X objective and 10X eyepieces, the MSM-465L has limitless capabilities for electrical small part inspection.

The MSM-464L, Order No. 377-991A, with its vertical five-step magnification changer is ideal for small part assembly. This stereo microscope with standard 6.4X, 10X, 16X, 25X, and 40X magnifications, has flexibility from 3.2X to 160X magnifications.



MSM-465L
377-990A



MSM-464L
377-991A

Optional Accessories

Photo System and Video System

Order No.	Description
377-488	Video System for 377-990A
377-489	Video System for 377-991A

Digital Imaging with Software

Order No.	Description
64PM1189	Digital camera, 2.0 Megapixel, USB 2.0 interface
64PM1236	Digital camera, 3.0 Megapixel, USB 2.0 interface

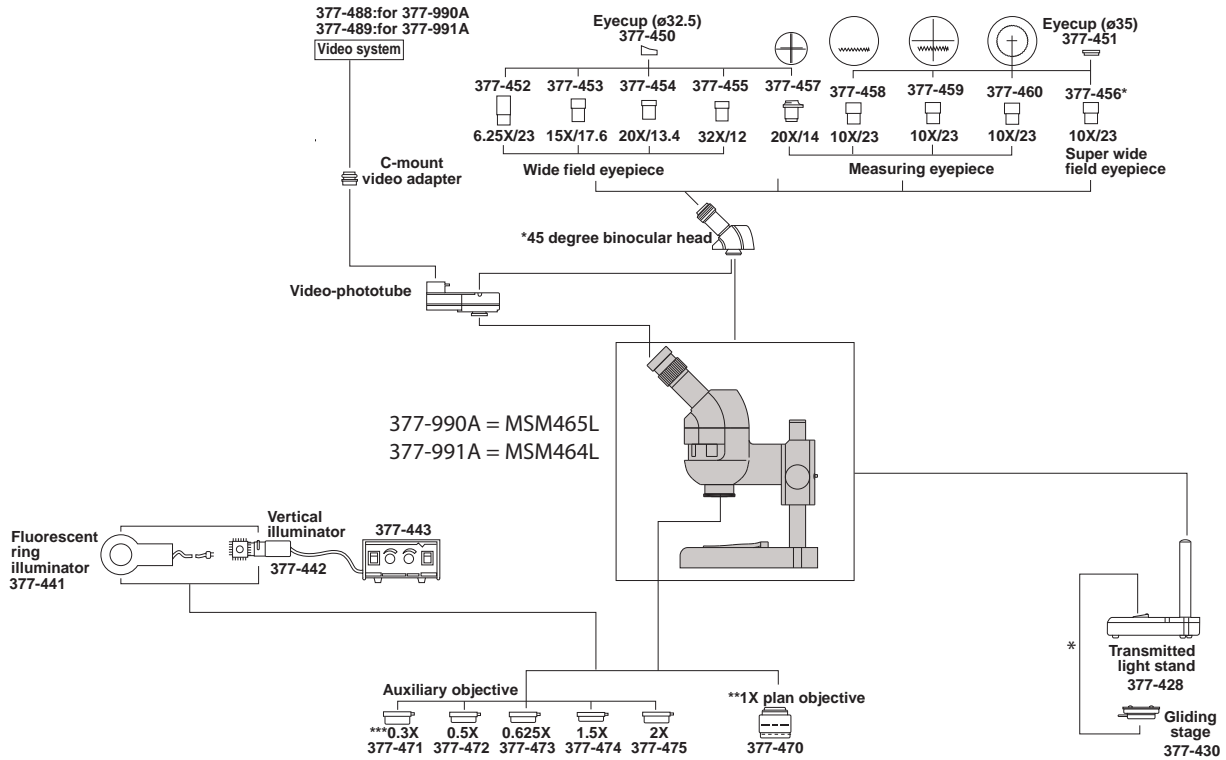
SPECIFICATIONS

Model. Order No.	MSM-465L 377-990A	MSM-464TL 377-991A
Optical tube	Binocular	Trinocular
Total magnification	6X - 50X	6.4X - 40X
Eyepiece	10X (377-456)	10X (377-456)
Objective	.6X, 1.2X, 2.5X, 5X	.6X, 1X, 1.6X, 2.5X, 4X
Working distance	89mm	89mm
Field of view	23mm (w/377-456)	23mm (w/377-456)
Dimensions	H=14.6" x W=13" x D=11"	H=14.3" x W=13" x D=11"
Mass	15.5 lbs (7kg)	15.5 lbs (7kg)
Stand	Transmitted Light Stand (377-428)	Transmitted Light Stand (377-428)

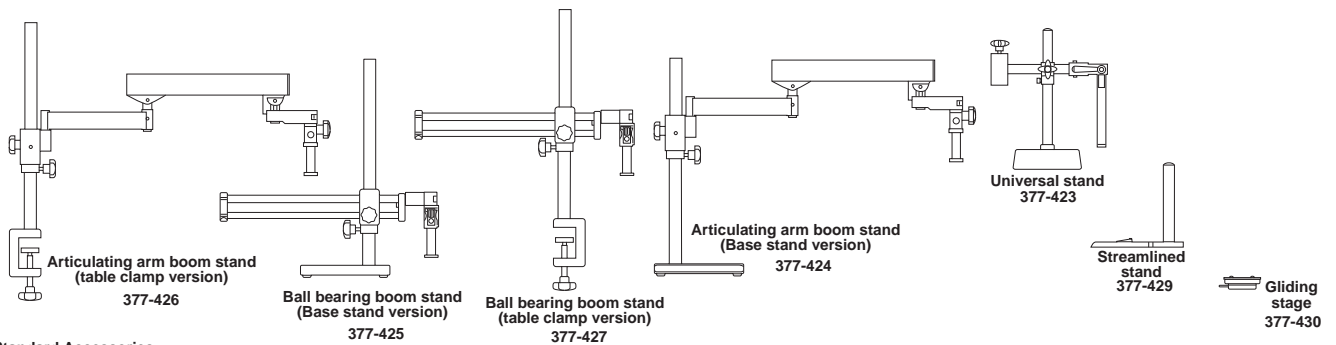
Stereo Microscopes

SERIES 377

377-990A/377-991A SYSTEM DIAGRAM



Optional Stand



- * Standard Accessories
- ** 1X plan objective can replace 1X standard built-in objective
- *** 350mm long stand post is required. (377-431)

Pocket Magnifiers

SERIES 183

FEATURES

- Suitable for inspecting metal surfaces.

SPECIFICATIONS

Magnification	Order No.	Remarks
25X	183-201	Pen type
	183-202	With stand
50X	183-203	With stand



183-201

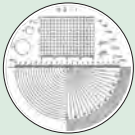


183-202



183-203

Optional Reticles for pocket comparators



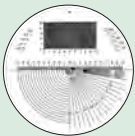
183-102



183-103



183-104



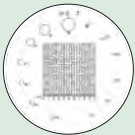
183-105



183-106



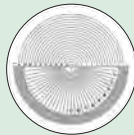
183-107



183-108



183-109



183-110



183-111



183-112



183-113



183-114



183-115

Pocket Comparator 8x with Reticles Set

Set No.

183-901 183-101, 183-106

183-902 183-101, 183-102, 183-106, 183-107,
183-112, 183-113, 183-114

183-903 183-101, 183-102, 183-106, 183-107,
183-109, 183-113, 183-115

183-904 183-101, 183-102

Pocket Comparators

SERIES 183

FEATURES

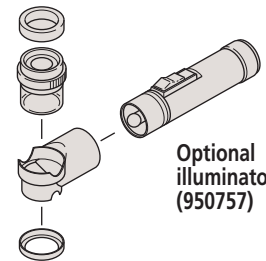
- By replacing optional reticles, dimensional, angle, and other types of measurements can be performed.
- Illuminator (950757) is available.

SPECIFICATIONS

Magnification	Order No.	Remarks
8X	183-101	Optional reticles available
10X	183-131	Optional reticles available



183-101



Optional illuminator (950757)

Zoom Loupe

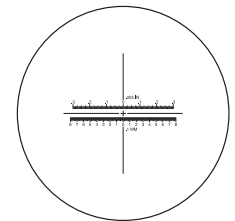
SERIES 183

FEATURES

- Allows the user 8X - 16X zoom observation.
- Magnification indicator is provided for 8X, 10X, 12X, 14X, and 16X observation.
- Metric and inch scales are provided for measuring.
- Comes with a carrying case.



183-304



Reticle provided

SPECIFICATIONS

Magnification	Order No.	Remarks
8X - 16X	183-304	With reticle (Scale graduation: 0.1mm, .0005")

Clear Loupe

SERIES 183



183-301



183-302



183-303

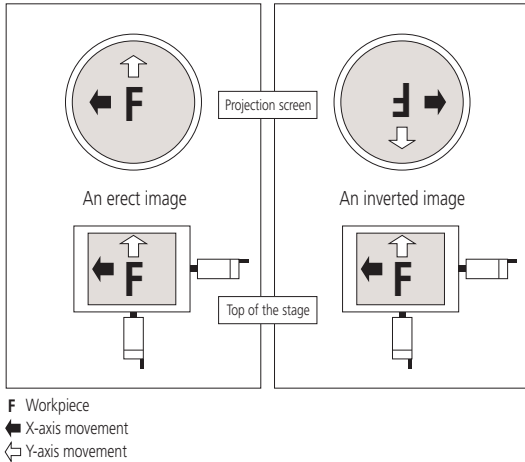
SPECIFICATIONS

Magnification	Order No.	Remarks
7X	183-301	Drawtube removable
10X	183-302	Drawtube removable
15X	183-303	Drawtube removable

Quick Guide to Precision Measuring Instruments

■ Erect Image and Inverted Image

An image of an object projected onto a screen is erect if it is orientated the same way as the object on the stage. If the image is reversed top to bottom, left to right and by movement with respect to the object on the stage (as shown in the figure below) it is referred to as an inverted image (also known as a reversed image, which is probably more accurate).



■ Magnification Accuracy

The magnification accuracy of a projector when using a certain lens is established by projecting an image of a reference object and comparing the size of the image of this object, as measured on the screen, with the expected size (calculated from the lens magnification, as marked) to produce a percentage magnification accuracy figure, as illustrated below. The reference object is often in the form of a small, graduated glass scale called a 'stage micrometer' or 'standard scale', and the projected image of this is measured with a larger glass scale known as a 'reading scale'.

(Note that magnification accuracy is not the same as measuring accuracy.)

$$\Delta M(\%) = \frac{L - \ell M}{\ell M} \times 100$$

- ΔM(%): Magnification accuracy expressed as a percentage of the nominal lens magnification
- L: Length of the projected image of the reference object measured on the screen
- ℓ: Length of the reference object
- M: Magnification of the projection lens

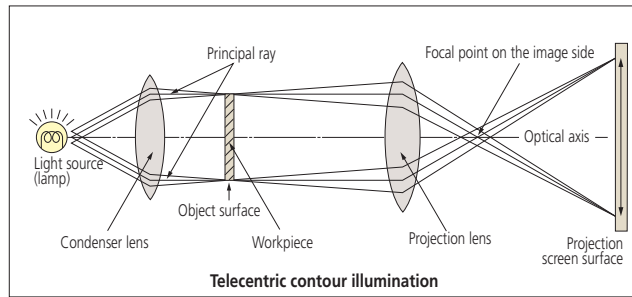
■ Type of Illumination

- **Contour illumination:** An illumination method to observe a workpiece by transmitted light and is used mainly for measuring the magnified contour image of a workpiece.
- **Coaxial surface illumination:** An illumination method whereby a workpiece is illuminated by light transmitted coaxially to the lens for the observation/measurement of the surface. (A half-mirror or a projection lens with a built-in half-mirror is needed.)
- **Oblique surface illumination:** A method of illumination by obliquely illuminating the workpiece surface. This method provides an image of enhanced contrast, allowing it to be observed three-dimensionally and clearly. However, note that an error is apt to occur in dimensional measurement with this method of illumination. (An oblique mirror is needed. Models in the PJ-H30 series are supplied with an oblique mirror.)

■ Telecentric Optical System

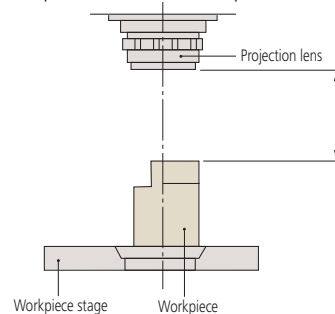
An optical system based on the principle that the principal ray is aligned parallel to the optical axis by placing a lens stop on the focal point on the image side. Its functional feature is that the image will not vary in size though the image blurs as the object is shifted along the optical axis.

For measuring projectors and measuring microscopes, an identical effect is obtained by placing a lamp filament at the focal point of a condenser lens instead of a lens stop so that the object is illuminated with parallel beams. (See the figure below.)



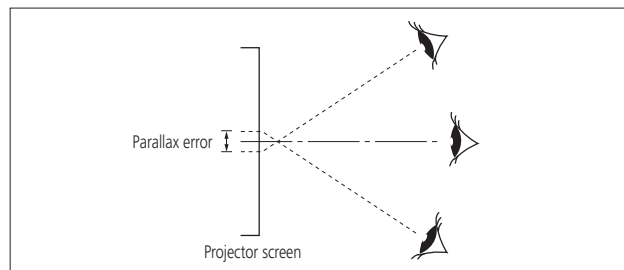
■ Working distance

Refers to the distance from the face of the projection lens to the surface of a workpiece in focus. It is represented by L in the diagram below.



■ Parallax error

This is the displacement of an object against a fixed background caused by a change in the observer's position and a finite separation of the object and background planes.



■ Field of view diameter

The maximum diameter of workpiece that can be projected using a particular lens.

$$\text{Field of view diameter (mm)} = \frac{\text{Screen diameter of profile projector}}{\text{Magnification of projection lens used}}$$

Example: If a 5X magnification lens is used for a projector with a screen of ø500mm:

$$\text{Field of view diameter is given by } \frac{500\text{mm}}{5} = 100\text{mm}$$