C. Chemical Compatibility

Chemical Compatibility																											
CHEMICAL \ MATERIAL	Aluminium	Anodic Coating for Aluminum	Buna N	Cellulose Acetate Butyrate	Polyurethane Rotor Paint	Composite Carbon Fiber/Epoxy	Delrin™	EPDM rubber	Glass	Neoprene	Noryl™	Nylon	PET[1], Polyclear™,Clear Crimp™	Polyallomer	Polycarbonate	Polyester, Glass Thermoset	Polythermide	Polyethylene	Polypropylene	Polysulfone	Polyvynil Chloride	Rulon A™, Teflon™	Silicone Rubber	Stainless Steel	Titanium	Tygon™	Viton™
2-MERCAPTOETHANOL	S	S	U	/	S	M	S	/	S	U	S	S	U	S	S	/	S	S	S	S	U	S	S	S	S	S	S
ACETALDEHYDE	S	/	U	U	/	/	/	M	/	U	/	/	/	M	U	U	U	M	M	/	M	S	U	/	S	/	U
ACETONE	M	S	U	U	S	U	M	S	S	U	U	S	U	S	U	U	U	S	S	U	U	S	M	M	S	U	U
ACETONITRILE	S	S	U	/	S	M	S	/	S	S	U	S	U	M	U	U	/	S	M	U	U	S	S	S	S	U	U
ALCONOX™	U	U	S	/	S	S	S	/	S	S	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S	S	U
ALLYL ALCOHOL	/	/	/	U	/	/	S	/	/	/	/	S	/	S	S	M	S	S	S	/	M	S	/	/	S	/	/
ALUMINUM CHLORIDE	U	U	S	S	S	S	U	S	S	S	S	M	S	S	S	S	/	S	S	S	S	S	M	U	U	S	S
FORMIC ACID (100%)	/	S	M	U	/	/	U	/	/	/	/	U	/	S	M	U	U	S	S	/	U	S	/	U	S	/	U
AMMONIUM ACETATE	S	S	U	/	S	S	S	/	S	S	S	S	S	S	S	U	/	S	S	S	S	S	S	S	S	S	S
AMMONIUM CARBONATE	M	S	U	S	S	S	S	S	S	S	S	S	S	S	U	U	/	S	S	S	S	S	S	M	S	S	S
AMMONIUM HYDROXIDE (10%)	U	U	S	U	S	S	M	S	S	S	S	S	/	S	U	M	S	S	S	S	S	S	S	S	S	M	S
AMMONIUM HYDROXIDE (28%)	U	U	S	U	S	U	M	S	S	S	S	S	U	S	U	M	S	S	S	S	S	S	S	S	S	M	S

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U	Unsatisfactory, not recommended
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CHEMICAL \ MATERIAL	Aluminium	Anodic Coating for Aluminum	Buna N	Cellulose Acetate Butyrate	Polyurethane Rotor Paint	Composite Carbon Fiber/Epoxy	Delrin™	EPDM rubber	Glass	Neoprene	Noryl™	Nylon	PET[1], Polyclear™,Clear Crimp™	Polyallomer	Polycarbonate	Polyester, Glass Thermoset	Polythermide	Polyethylene	Polypropylene	Polysulfone	Polyvynil Chloride	Rulon A™, Teflon™	Silicone Rubber	Stainless Steel	Titanium	Tygon™	Viton™
Ammonium Hydroxide (conc.)	U	U	U	U	S	U	M	S	/	S	/	S	U	S	U	U	S	S	S	/	M	S	S	S	S	/	U
Ammonium Phosphate	U	/	S	/	S	S	S	S	S	S	S	S	/	S	S	M	/	S	S	S	S	S	S	M	S	S	S
Ammonium Sulfate	U	M	S	/	S	S	U	S	S	S	S	S	S	S	S	S	/	S	S	S	S	S	S	U	S	S	U
Amyl Alcohol	S	/	M	U	/	/	S	S	/	M	/	S	/	M	S	S	S	S	M	/	/	/	U	/	S	/	M
Aniline	S	S	U	U	S	U	S	M	S	U	U	U	U	U	U	U	/	S	M	U	U	S	S	S	S	U	S
Sodium Hydroxide (<1%)	U	/	M	S	S	S	/	/	S	M	S	S	/	S	M	M	S	S	S	S	S	S	M	S	S	/	U
Sodium Hydroxide (10%)	U	/	M	U	/	/	U	/	M	M	S	S	U	S	U	U	S	S	S	S	S	S	M	S	S	/	U
Barium Salts	M	U	S	/	S	S	S	S	S	S	S	S	S	S	S	M	/	S	S	S	S	S	S	M	S	S	S
Benzene	S	S	U	U	S	U	M	U	S	U	U	S	U	U	U	M	U	M	U	U	U	S	U	U	S	U	S
Benzyl Alcohol	S	/	U	U	/	/	M	M	/	M	/	S	U	U	U	U	U	U	U	/	M	S	M	/	S	/	S
Boric Acid	U	S	S	M	S	S	U	S	S	S	S	S	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S
Cesium Acetate	M	/	S	/	S	S	S	/	S	S	S	S	/	S	S	/	/	S	S	S	S	S	S	M	S	S	S
Cesium Bromide	M	S	S	/	S	S	S	/	S	S	S	S	S	S	S	/	/	S	S	S	S	S	S	M	S	S	S
Cesium Chloride	M	S	S	U	S	S	S	/	S	S	S	S	S	S	S	/	/	S	S	S	S	S	S	M	S	S	S
Cesium Formate	M	S	S	/	S	S	S	/	S	S	S	S	S	S	S	/	/	S	S	S	S	S	S	M	S	S	S

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Cesium Iodide	M	S	S	/	S	S	S	/	S	S	S	S	S	S	S	/	/	S	S	S	S	S	S	M	S	S	S
Cesium Sulfate	M	S	S	/	S	S	S	/	S	S	S	S	S	S	S	/	/	S	S	S	S	S	S	M	S	S	S
Chloroform	U	U	U	U	S	S	M	U	S	U	U	M	U	M	U	U	U	M	M	U	U	S	U	U	U	M	S
Chromic Acid (10%)	U	/	U	U	S	U	U	/	S	S	S	U	S	S	M	U	M	S	S	U	M	S	M	U	S	S	S
Chromic Acid (50%)	U	/	U	U	/	U	U	/	/	/	S	U	U	S	M	U	M	S	S	U	M	S	/	U	M	/	S
Cresol Mixture	S	S	U	/	/	/	S	/	S	U	U	U	U	U	U	/	/	U	U	/	U	S	S	S	S	U	S
Cyclohexane	S	S	S	/	S	S	S	U	S	U	S	S	U	U	U	M	S	M	U	M	M	S	U	M	M	U	S
Deoxycholate	S	S	S	/	S	S	S	/	S	S	S	S	S	S	S	/	/	S	S	S	S	S	S	S	S	S	S
Distilled Water	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Dextran	M	S	S	S	S	S	S	/	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	M	S	S	S
Diethyl Ether	S	S	U	U	S	S	S	U	S	U	U	S	U	U	U	U	U	U	U	U	U	S	S	S	S	M	U
Diethyl Ketone	S	/	U	U	/	/	M	/	S	U	/	S	/	M	U	U	U	M	M	/	U	S	/	/	S	U	U
Diethylpyro-carbonate	S	S	U	/	S	S	S	/	S	S	U	S	U	S	U	/	/	S	S	S	M	S	S	S	S	S	S
Dimethylsulfoxide	S	S	U	U	S	S	S	/	S	U	S	S	U	S	U	U	/	S	S	U	U	S	S	S	S	U	U
Dioxane	M	S	U	U	S	S	M	M	S	U	U	S	U	M	U	U	/	M	M	M	U	S	S	S	S	U	U
Ferric Chloride	U	U	S	/	/	/	M	S	/	M	/	S	/	S	/	/	/	S	S	/	/	/	M	U	S	/	S

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Acetic Acid (Glacial)	S	S	U	U	S	S	U	M	S	U	S	U	U	U	U	U	M	S	U	M	U	S	U	U	S	/	U
Acetic Acid (5%)	S	S	M	S	S	S	M	S	S	S	S	S	M	S	S	S	S	S	S	S	M	S	S	M	S	S	M
Acetic Acid (60%)	S	S	U	U	S	S	U	/	S	M	S	U	U	M	U	S	M	S	M	S	M	S	M	U	S	M	U
Ethyl Acetate	M	M	U	U	S	S	M	M	S	S	U	S	U	M	U	U	/	S	S	U	U	S	M	M	S	U	U
Ethyl Alcohol (50%)	S	S	S	S	S	S	M	S	S	S	S	S	U	S	U	S	S	S	S	S	S	S	S	M	S	M	U
Ethyl Alcohol (95%)	S	S	S	U	S	S	M	S	S	S	S	S	U	S	U	/	S	S	S	M	S	S	S	U	S	M	U
Ethylene Dichloride	S	/	U	U	/	/	S	M	/	U	U	S	U	U	U	U	U	U	U	/	S	U	S	/	S	/	S
Ethylene Glycol	S	S	S	S	S	S	S	S	S	S	S	S	/	S	U	S	S	S	S	S	S	S	S	M	S	M	S
Ethylene Oxide Vapor	S	/	U	/	/	U	/	/	S	U	/	S	/	S	M	/	/	S	S	S	U	S	U	S	S	S	U
Ficoll-Hypaque™	M	S	S	/	S	S	S	/	S	S	S	S	/	S	S	/	S	S	S	S	S	S	S	M	S	S	S
Hydrofluoric Acid (10%)	U	U	U	M	/	/	U	/	/	U	U	S	/	S	M	U	S	S	S	S	M	S	U	U	U	/	/
Hydrofluoric Acid (50%)	U	U	U	U	/	/	U	/	/	U	U	U	U	S	U	U	U	S	S	M	M	S	U	U	U	/	M
Hydrochloric Acid (conc.)	U	U	U	U	/	U	U	M	/	U	M	U	U	M	U	U	U	/	S	/	U	S	U	U	U	/	/
Formaldehyde (40%)	M	M	M	S	S	S	S	M	S	S	S	S	M	S	S	S	U	S	S	M	S	S	S	M	S	M	U

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Glutaraldehyde	S	S	S	S	/	/	S	/	S	S	S	S	S	S	S	/	/	S	S	S	S	/	S	S	S	/	/
Glycerol	M	S	S	/	S	S	S	S	S	S	S	S	S	S	S	S	/	S	S	S	S	S	S	S	S	S	S
Guanidine Hydrochloride	U	U	S	/	S	S	S	/	S	S	S	S	S	S	S	/	/	S	S	S	S	S	S	U	S	S	S
Haemo-Sol™	S	S	S	/	/	/	S	/	S	S	S	S	S	S	S	/	/	S	S	S	S	S	S	S	S	S	S
Hexane	S	S	S	/	S	S	S	/	S	S	U	S	U	M	U	S	S	U	S	S	M	S	U	S	S	U	S
Isobutyl Alcohol	/	/	M	U	/	/	S	S	/	U	/	S	U	S	S	M	S	S	S	/	S	S	S	/	S	/	S
Isopropyl Alcohol	M	M	M	U	S	S	S	S	S	U	S	S	U	S	U	M	S	S	S	S	S	S	S	M	M	M	S
Iodoacetic Acid	S	S	M	/	S	S	S	/	S	M	S	S	M	S	S	/	M	S	S	S	S	S	M	S	S	M	M
Potassium Bromide	U	S	S	/	S	S	S	/	S	S	S	S	S	S	S	S	S	S	S	/	S	S	S	M	S	S	S
Potassium Carbonate	M	U	S	S	S	S	S	/	S	S	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S
Potassium Chloride	U	S	S	/	S	S	S	S	S	S	S	S	S	S	S	/	S	S	S	S	S	S	S	U	S	S	S
Potassium Hydroxide (5%)	U	U	S	S	S	S	M	/	S	S	S	S	/	S	U	S	S	S	S	S	S	S	M	U	M	S	U
Potassium Hydroxide (conc.)	U	U	M	U	/	/	M	/	M	S	S	/	U	M	U	U	U	S	M	/	M	U	/	U	U	/	U
Potassium Permanganate	S	S	S	/	S	S	S	/	S	S	S	U	S	S	S	M	/	S	M	S	U	S	S	M	S	U	S

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Calcium Chloride	M	U	S	S	S	S	S	S	S	S	S	S	S	S	M	S	/	S	S	S	S	S	S	M	S	S	S
Calcium Hypochlorite	M	/	U	/	S	M	M	S	/	M	/	S	/	S	M	S	/	S	S	S	M	S	M	U	S	/	S
Kerosene	S	S	S	/	S	S	S	U	S	M	U	S	U	M	M	S	/	M	M	M	S	S	U	S	S	U	S
Sodium Chloride (10%)	S	/	S	S	S	S	S	S	/	/	/	S	S	S	S	S	/	S	S	S	S	/	S	S	M	/	S
Sodium Chloride (sat'd)	U	/	S	U	S	S	S	/	/	/	/	S	S	S	S	S	/	S	S	/	S	/	S	S	M	/	S
Carbon Tetrachloride	U	U	M	S	S	U	M	U	S	U	U	S	U	M	U	S	S	M	M	S	M	M	M	M	U	S	S
Aqua Regia	U	/	U	U	/	/	U	/	/	/	/	/	U	U	U	U	U	U	U	/	/	/	/	/	S	/	M
Solution 555 (20%)	S	S	S	/	/	/	S	/	S	S	S	S	S	S	S	/	/	S	S	S	/	S	S	S	S	S	S
Magnesium Chloride	M	S	S	/	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	M	S	S	S
Mercaptoacetic Acid	U	S	U	/	S	M	S	/	S	M	S	U	U	U	U	/	S	U	U	S	M	S	U	S	S	S	S
Methyl Alcohol	S	S	S	U	S	S	M	S	S	S	S	S	U	S	U	M	S	S	S	S	S	S	S	M	S	M	U
Methylene Chloride	U	U	U	U	M	S	S	U	S	U	U	S	U	U	U	U	U	M	U	U	U	S	S	M	U	S	U
Methyl Ethyl Ketone	S	S	U	U	S	S	M	S	S	U	U	S	U	S	U	U	U	S	S	U	U	S	S	S	S	U	U
Metrizamide™	M	S	S	/	S	S	S	/	S	S	S	S	/	S	S	/	/	S	S	S	S	S	S	M	S	S	S
Lactic Acid (100%)	/	/	S	/	/	/	/	/	/	M	S	U	/	S	S	S	M	S	S	/	M	S	M	S	S	/	S
Lactic Acid (20%)	/	/	S	S	/	/	/	/	/	M	S	M	/	S	S	S	S	S	S	S	M	S	M	S	S	/	S

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N/Butyl Alcohol	S	/	S	U	/	/	S	/	/	S	M	/	U	S	M	S	S	S	S	M	M	S	M	/	S	/	S
N/Butyl Phthalate	S	S	U	/	S	S	S	/	S	U	U	S	U	S	U	M	/	U	U	S	U	S	M	M	S	U	S
N, N-Dimethylformamide	S	S	S	U	S	M	S	/	S	S	U	S	U	S	U	U	/	S	S	U	U	S	M	S	S	S	U
Sodium Borate	M	S	S	S	S	S	S	S	S	S	S	U	S	S	S	S	/	S	S	S	S	S	S	M	S	S	S
Sodium Bromide	U	S	S	/	S	S	S	/	S	S	S	S	S	S	S	S	/	S	S	S	S	S	S	M	S	S	S
Sodium Carbonate (2%)	M	U	S	S	S	S	S	S	S	S	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S
Sodium Dodecyl Sulfate	S	S	S	/	S	S	S	/	S	S	S	S	S	S	S	/	S	S	S	S	S	S	S	S	S	S	S
Sodium Hypochlorite (5%)	U	U	M	S	S	M	U	S	S	M	S	S	S	M	S	S	S	S	M	S	S	S	M	U	S	M	S
Sodium Iodide	M	S	S	/	S	S	S	/	S	S	S	S	S	S	S	/	/	S	S	S	S	S	S	M	S	S	S
Sodium Nitrate	S	S	S	/	S	S	S	S	S	S	S	S	S	S	S	S	/	S	S	S	S	S	U	S	S	S	S
Sodium Sulfate	U	S	S	/	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	M	S	S	S
Sodium Sulfide	S	/	S	S	/	/	/	S	/	/	/	S	S	S	U	U	/	/	S	/	/	/	S	S	M	/	S
Sodium Sulfite	S	S	S	/	S	S	/	S	M	S	S	S	S	S	S	M	/	S	S	S	S	/	S	S	S	S	S
Nickel Salts	U	S	S	S	S	S	/	S	S	S	/	/	S	S	S	S	/	S	S	S	S	S	S	M	S	S	S
Oils (Petroleum)	S	S	S	/	/	/	S	U	S	S	S	S	U	U	M	S	M	U	U	S	S	S	U	S	S	S	S

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CHEMICAL / MATERIAL	Aluminium	Anodic Coating for Aluminum	Buna N	Cellulose Acetate Butyrate	Polyurethane Rotor Paint	Composite Carbon Fiber/Epoxy	Delrin™	EPDM rubber	Glass	Neoprene	Noryl™	Nylon	PET[1], Polyclear™,Clear Crimp™	Polyallomer	Polycarbonate	Polyester, Glass Thermoset	Polythermide	Polyethylene	Polypropylene	Polysulfone	Polyvynil Chloride	Rulon A™, Teflon™	Silicone Rubber	Stainless Steel	Titanium	Tygon™	Viton™
Oils (Other)	S	/	S	/	/	/	S	M	S	S	S	S	U	S	S	S	S	U	S	S	M	S	/	S	S	M	S
Oleic Acid	S	/	U	S	S	S	U	U	S	U	S	S	M	S	S	S	S	S	S	S	S	S	M	U	S	M	M
Oxalic Acid	U	U	M	S	S	S	U	S	S	S	S	S	U	S	U	S	S	S	S	S	S	S	S	U	M	S	S
Perchloric Acid (10%)	U	/	U	/	S	U	U	/	S	M	M	/	/	M	U	M	S	S	M	/	M	S	U	/	S	/	S
Perchloric Acid (70%)	U	U	U	/	/	U	U	/	S	U	M	U	U	M	U	S	U	M	M	U	M	S	U	U	S	U	S
Phenol (5%)	U	S	U	/	S	M	M	/	S	U	M	U	U	S	U	M	S	M	S	U	M	S	U	M	M	M	S
Phenol (50%)	U	S	U	/	S	U	M	/	S	U	M	U	U	U	U	S	S	U	M	U	U	S	U	U	U	M	S
Phosphoric Acid (10%)	U	U	M	S	S	S	U	S	S	S	S	U	/	S	S	S	S	S	S	S	S	S	U	M	U	S	S
Phosphoric Acid (conc.)	U	U	M	M	/	/	U	S	/	M	S	U	U	M	M	S	S	S	M	S	M	S	U	M	U	/	S
Physiologic Media (Serum, Urine)	M	S	S	S	/	/	S	/	S	S	S	S	S	S	S	S	S	S	S	U	S	S	S	S	S	S	S
Picric Acid	S	S	U	/	S	M	S	S	S	M	S	U	S	S	S	U	S	S	S	S	U	S	U	M	S	M	S
Pyridine (50%)	U	S	U	U	S	U	U	/	U	S	S	S	U	M	U	U	/	U	S	M	U	S	S	U	U	U	U
Rubidium Bromide	M	S	S	/	S	S	S	/	S	S	S	S	S	S	S	/	/	S	S	S	S	S	S	M	S	U	S
Rubidium Chloride	M	S	S	/	S	S	S	/	S	S	S	S	S	S	S	/	/	S	S	S	S	S	S	M	S	S	S
Sucrose	M	S	S	/	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S

S Satisfactory

M Moderate attack, may be satisfactory for use in centrifuge depending on length of exposure, speed involved, etc.; suggest testing under actual conditions of use

U Unsatisfactory, not recommended

/ Performance unknown; suggest testing, using sample to avoid loss of valuable material

Chemical Compatibility																											
CHEMICAL / MATERIAL	Aluminium	Anodic Coating for Aluminum	Buna N	Cellulose Acetate Butyrate	Polyurethane Rotor Paint	Composite Carbon Fiber/Epoxy	Delrin™	EPDM rubber	Glass	Neoprene	Noryl™	Nylon	PET[1], Polyclear™,Clear Crimp™	Polyallomer	Polycarbonate	Polyester, Glass Thermoset	Polythermide	Polyethylene	Polypropylene	Polysulfone	Polyvynil Chloride	Rulon A™, Teflon™	Silicone Rubber	Stainless Steel	Titanium	Tygon™	Viton™
Sucrose, Alkaline	M	S	S	/	S	S	S	/	S	S	S	S	S	S	U	S	S	S	S	S	S	S	S	M	S	S	S
Sulfosalicylic Acid	U	U	S	S	S	S	S	/	S	S	S	U	S	S	S	/	S	S	S	/	S	S	S	U	S	S	S
Nitric Acid (10%)	U	S	U	S	S	U	U	/	S	U	S	U	/	S	S	S	S	S	S	S	S	S	M	S	S	S	S
Nitric Acid (50%)	U	S	U	M	S	U	U	/	S	U	S	U	U	M	M	U	M	M	M	S	S	S	U	S	S	M	S
Nitric Acid (95%)	U	/	U	U	/	U	U	/	/	U	U	U	U	M	U	U	U	U	M	U	U	S	U	S	S	/	S
Hydrochloric Acid (10%)	U	U	M	S	S	S	U	/	S	S	S	U	U	S	U	S	S	S	S	S	S	S	S	U	M	S	S
Hydrochloric Acid (50%)	U	U	U	U	S	U	U	/	S	M	S	U	U	M	U	U	S	S	S	S	M	S	M	U	U	M	M
Sulfuric Acid (10%)	M	U	U	S	S	U	U	/	S	S	M	U	S	S	S	S	S	S	S	S	S	S	U	U	U	S	S
Sulfuric Acid (50%)	M	U	U	U	S	U	U	/	S	S	M	U	U	S	U	U	M	S	S	S	S	S	U	U	U	M	S
Sulfuric Acid (conc.)	M	U	U	U	/	U	U	M	/	/	M	U	U	S	U	U	U	M	S	U	M	S	U	U	U	/	S
Stearic Acid	S	/	S	/	/	/	S	M	S	S	S	S	/	S	S	S	S	S	S	S	S	S	M	M	S	S	S
Tetrahydrofuran	S	S	U	U	S	U	U	M	S	U	U	S	U	U	U	/	M	U	U	U	U	S	U	S	S	U	U
Toluene	S	S	U	U	S	S	M	U	S	U	U	S	U	U	U	S	U	M	U	U	U	S	U	S	U	U	M
Trichloroacetic Acid	U	U	U	/	S	S	U	M	S	U	S	U	U	S	M	/	M	S	S	U	U	S	U	U	U	M	U

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Chemical Compatibility																											
MATERIAL / CHEMICAL	Aluminium	Anodic Coating for Aluminum	Buna N	Cellulose Acetate Butyrate	Polyurethane Rotor Paint	Composite Carbon Fiber/Epoxy	Delrin™	EPDM rubber	Glass	Neoprene	Noryl™	Nylon	PET[1], Polyclear™,Clear Crimp™	Polyallomer	Polycarbonate	Polyester, Glass Thermoset	Polythermide	Polyethylene	Polypropylene	Polysulfone	Polyvynil Chloride	Rulon A™, Teflon™	Silicone Rubber	Stainless Steel	Titanium	Tygon™	Viton™
Trichloroethane	S	/	U	/	/	/	M	U	/	U	/	S	U	U	U	U	U	U	U	U	U	S	U	/	S	/	S
Trichloroethylene	/	/	U	U	/	/	/	U	/	U	/	S	U	U	U	U	U	U	U	U	U	S	U	/	U	/	S
Trisodium Phosphate	/	/	/	S	/	/	M	/	/	/	/	/	/	S	/	/	S	S	S	/	/	S	/	/	S	/	S
Tris Buffer (neutral pH)	U	S	S	S	S	S	S	/	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Triton X/100™	S	S	S	/	S	S	S	/	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Urea	S	/	U	S	S	S	S	/	/	/	/	S	S	S	M	S	S	S	S	/	S	S	S	M	S	/	S
Hydrogen Peroxide (10%)	U	U	M	S	S	U	U	/	S	S	S	U	S	S	S	M	U	S	S	S	S	S	S	M	S	U	S
Hydrogen Peroxide (3%)	S	M	S	S	S	/	S	/	S	S	S	S	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S
Xylene	S	S	U	S	S	S	M	U	S	U	U	U	U	U	U	M	U	M	U	U	U	S	U	M	S	U	S
Zinc Chloride	U	U	S	S	S	S	U	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	U	S	S	S
Zinc Sulfate	U	S	S	/	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Citric Acid (10%)	M	S	S	M	S	S	M	S	S	S	S	S	S	S	S	S	M	S	S	S	S	S	S	S	S	S	S

S	Satisfactory
M	Moderate attack, may be satisfactory for use in centrifuge depending on length of exposure, speed involved, etc.; suggest testing under actual conditions of use
U	Unsatisfactory, not recommended
/	Performance unknown; suggest testing, using sample to avoid loss of valuable material

[1] Polyethlyeneterephtalate

NOTICE Chemical resistance data is included only as a guide to product use. Because no organized chemical compatibility data exists for materials under the stress of centrifugation, when in doubt we recommend pretesting sample lots.

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thermo scientific

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Germany international +49 6184 90 6000
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India +91 22 6716 2200
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Countries not listed +49 6184 90 6000

en

50158487 is the original instruction manual.

ThermoFisher SCIENTIFIC

Iškarpa iš

Multifuge X4 Pro Centrifuge Series (thermofisher.com)

Multifuge X4 Pro Centrifuge Series

Catalog number: 75009500

3.4 Valdymas

Technical SupportCustomer Service

The X4/X4R PRO series centrifuges provide unmatched performance and versatility with an easy-to-use touch screen interface. Quickly and securely swap between 17 unique rotor options with the tool-less Auto-Lock rotor exchange. Available for purchase individually or in convenient application-based packages.

Cell Culture packages include the centrifuge, rotor, ClickSeal biocontainment lids and a set of four 15 mL and 50 mL conical tube adapters.

Blood Tube packages include the centrifuge, rotor, ClickSeal biocontainment lids and a set of four 5/7 mL and 9/10 mL blood tube adapters.

Product Overview
Recommendations
Documents

	Catalog Number	Specifications	Unit Size	Description	Voltage
	75009500	Full specifications	Each	Thermo Scientific Multifuge X4 Pro-MD, 208-240V 50/60 Hz	208/240 V
	75009501	Full specifications	Each	Thermo Scientific Multifuge X4 Pro-MD, 120V	120 V
	75009515	Full specifications	Each	Thermo Scientific Multifuge X4R Pro-MD, 220V-240V 50Hz/230V 60Hz	220V-240V / 230V

Catalog Number	Specifications	Unit Size	Description	Voltage
Certifications/Compliance			EN/UL/IEC 61010-1EN/UL/IEC 61010-2EN/UL/IEC 61326-1EN/UL/IEC 61326-2FCC part 15	
Controller Type			Microprocessor	
Description			Thermo Scientific Multifuge X4R Pro-MD, 220V-240V 50Hz/2 60Hz	
Capacity			196 x 5/7 mL Blood Tubes, 148 x 9/10 mL Blood Tubes, 96 x 1 Conical Tubes, 40 x 50 mL Conical Tubes, 6 Microplates, 4 x 1 mL BioBottles (with TX-1000 rotors)	
Max. RCF			25,830 x g Fixed Angle (with 30 x 2 mL rotor), 7,164 x g Swing (with BIOShield 1000A rotor)	
Product Line			Multifuge™	
Refrigerated			Yes, CFC-Free, Pre-Temp Available	

Catalog Number	Specifications	Unit Size	Description	Voltage
Display			Full Color Touch Screen Interface	
Drive System			Direct, Brushless Induction Low Profile	
For Use With (Equipment)			Purchase of Thermo Scientific rotor and accessories required fo operation	
Green Features			Energy efficient, less waste	
Includes			Printed English user manual, USB stick with 28 languages of us manual, corrosion resistance oil (70009824), power cord for the according country supply voltage, declaration of conformity	
Material			Front, top and sides are out of plastic(PC-ABS) painted with 2K lacquer(PUR based), metal housing is out of cold rolled steel wi powder paint(structured), centrifuge bowl is corrosion-resistant thermal conductivity(STAINLESS STEEL 1.4301 COLD ROL The unit feet are out of rubber.	

Catalog Number	Specifications	Unit Size	Description	Voltage
Noise Level		<64 dB(A) Rotor F15-8x50c; 14500 RPM		
Profile (Acceleration/Braking)		Choices of 9 Accel/10 Decel Rates		
Program Storage		Up to 100 Programs, including multi-step programming via Tou Screen; Including programmabile Pulse options		
Rotor		17 Rotor Options Available, rotor sold separately		
Rotor Included		No		
Run Time		Up to 99 hr. 59 min. 59 sec.		
Standards		ISO 14971, ISO 13485, ISO 9001		

Catalog Number	Specifications	Unit Size	Description	Voltage
Temperature Range		-10°C to +40°C, ±2°C		
Timer		Option to count up or down		
Type		Benchtop Centrifuge		
Warranty		5 Year Limited		
Dimensions (L x W x H) Exterior		690 x 746 x 361 mm		
Length (English) Exterior		27.2 in.		
Length (Metric) Exterior		690 mm		

Catalog Number	Specifications	Unit Size	Description	Voltage
Width (English) Exterior		29.4 in.		
Width (Metric) Exterior		746 mm		
Height (English) Exterior		14.2 in.		
Height (English) Exterior Lid Open		33.9 in.		
Height (Metric) Exterior		361 mm		
Height (Metric) Exterior Lid Open		861 mm		
Depth (English)		27.2 in.		

Catalog Number	Specifications	Unit Size	Description	Voltage
Depth (Metric)		690 mm		
Net Weight		120 kg		
Electrical Requirements		220/240 V 50 Hz, 230 V 60 Hz		
Voltage		220V-240V / 230V		
Wattage		1950 w		
Frequency		50/60 Hz		
Unit Size		Each		
75009516	Full specifications	Each	Thermo Scientific Multifuge X4R Pro-MD, 120V	120 V

Catalog Number	Specifications	Unit Size	Description	Voltage
75009615	Full specifications	Each	Thermo Scientific Multifuge X4R Pro-MD, 220V 60Hz	220 V
75009815	Full specifications	Each	Thermo Scientific Multifuge X4R Pro, 220V 60Hz	220 V
75009900	Full specifications	Each	Thermo Scientific Multifuge X4 Pro, 208-240V 50/60 Hz	208/240 V
75009915	Full specifications	Each	Thermo Scientific Multifuge X4R Pro, 220V-240V 50Hz/230V 60Hz	220/240 V
75016033	Full specifications	Each	Thermo Scientific Multifuge X4R Pro-MD, 120V TX-1000 Blood Tube Package	120 V
75016034	Full specifications	Each	Thermo Scientific Multifuge X4 Pro-MD, 120V TX-1000 Blood Tube Package	120 V

Showing 10 of 18**Show more**
Save to list

Simple Operation and Design

- Full color intuitive touch screen for fast programming, centrifuge health monitoring and up to 100 program storage
- Modern industrial design supports continuous improvement in rotor loading ergonomics, user safety and current needed certifications
- Detailed operation information, including display of set and actual parameters, maximizes run performance and temperature accuracy for improved sample protection
- Easily adjust speed, time and temperature, even during the run, with the convenient keyboard for direct input
- Innovative lid-locking technology enables one finger downward motion for easy closing and locking of centrifuge lid, even on tall benches

- Double temperature management system displays the air temperature in the chamber as well as the sample temperature, ensuring accurate control of the sample temperature during the run

Thermo Scientific™ Auto-Lock™ III Rotor System

- Secure locking system allows easy push-button installation and exchange of rotors
- Saves time in switch between applications
- Easy access to the chamber enables quick cleaning, a healthier working environment and longer unit life

Thermo Scientific™ ClickSeal™ Bucket Sealing System

- Biocontainment system seals with a snap; eliminates screw caps and complicated clips
- Glove-friendly, one-handed open/close capability
- Certified by CAMR™ in Porton Down, UK

Thermo Scientific™ SMARTSpin™ Technology

- Advanced rotor management system maximizes acceleration, braking and residual load imbalance for each rotor and bucket option
- Optimizes safety and improves separations

Space-Saving Design

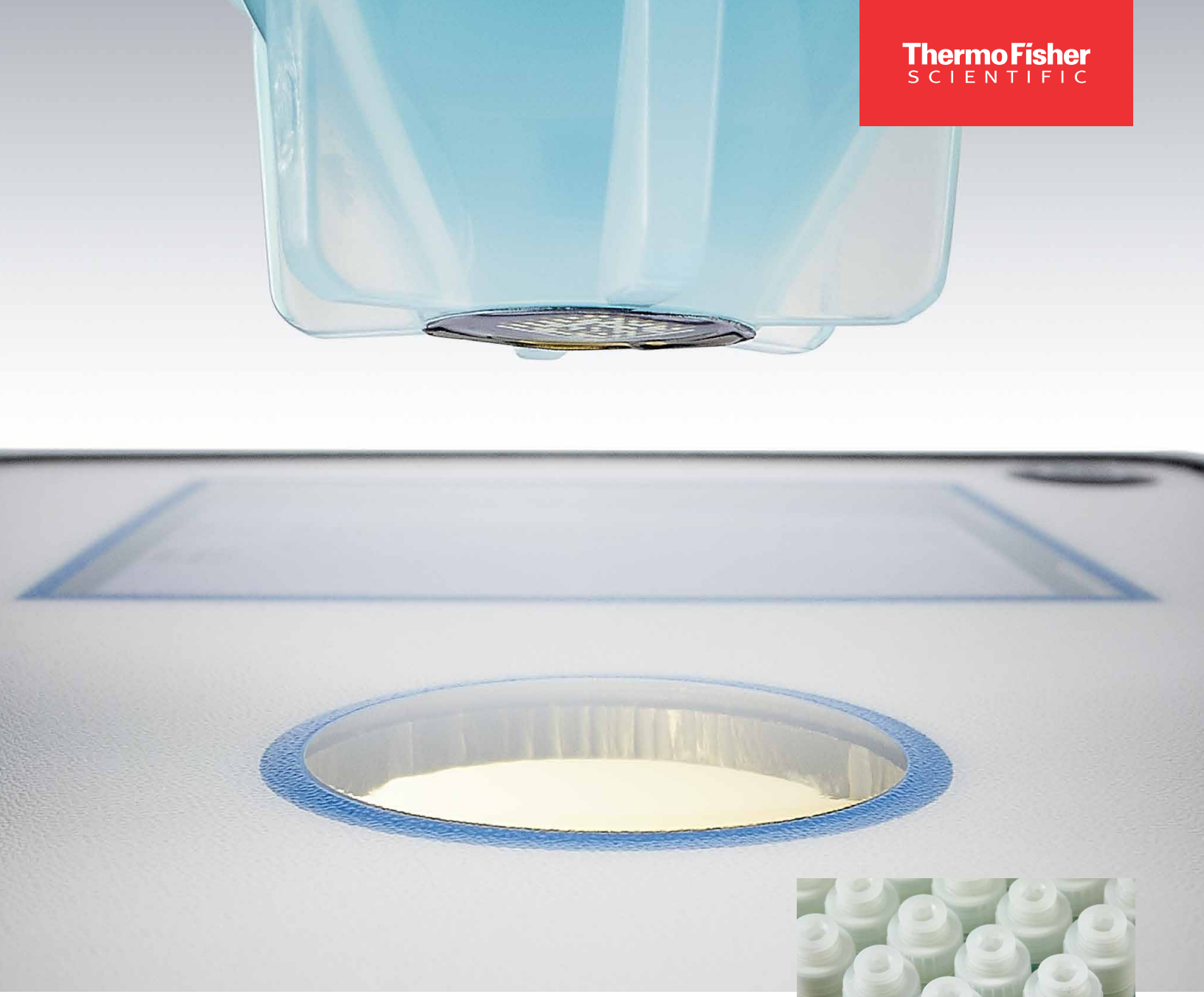
- Compact size conserves workspace on benchtop or floor
- Ergonomic height and curved design ensure comfortable sample handling and cleaning of unit

Energy Efficient

- Design saves up to 40% of energy on industry standard protocols such as blood separations or conical-tube processing
- CFC free refrigerant - nature friendly

3.10.3 Šaldymo sistema

ThermoFisher SCIENTIFIC



Cryopreservation

Nalgene and Nunc Cryopreservation Guide

thermo scientific

Contents

Written by Frank P. Simione, M.S. of the American Type Culture Collection (ATCC) in cooperation with Thermo Fisher Scientific

Introduction

To ensure reproducible results and continuity in research and biomedical processes, today's scientists are faced with the task of genetically stabilizing replicable materials such as living cells and organisms, and ensuring sub-cellular components such as nucleic acids and proteins are preserved unchanged. Serial subculturing of replicable materials is time consuming and can often result in contamination or genetic drift as smaller and smaller portions of a population are selected. Improper storage and handling of non-replicable materials can lead to divergent and irreproducible research results. However, a population of living cells or a suspension of subcellular components can be stabilized by subjecting them to cryogenic temperatures which, for all practical purposes, stops time.

The process of stabilizing biological materials at cryogenic temperatures is called cryopreservation, a practical application of cryobiology, or the study of life at low temperatures. Advances in cryopreservation technology have led to methods that allow low-temperature maintenance of a variety of tissues, cell types and subcellular materials. Techniques are available for the preservation of microorganisms, tissues, primary cells, established cell lines, small multicellular organisms, complex cellular structures such as embryos, as well as nucleic acid and proteins.

The freezing process involves complex phenomena that, even after decades of research, are not fully understood. Cryobiological studies have led to speculation on what occurs during the freezing of living cells and how adverse phenomena can be overcome. Since water is the major component of all living cells and must be available for the chemical processes of life to occur, cellular metabolism stops when all water in the system is converted to ice.

Ice forms at different rates during the cooling process. Slow cooling leads to freezing external to the cell before intracellular ice begins to form1. As ice forms external to the cell, water is removed from the extracellular environment and an osmotic imbalance occurs across the cell membrane leading to water migration out of the cell. The increase in solute concentration outside the cell, as well as intracellularly as water leaves the cell, can be detrimental to cell survival.[1] If too much water remains inside the cell, damage due to ice crystal formation and recrystallization during warming can occur and is usually lethal.

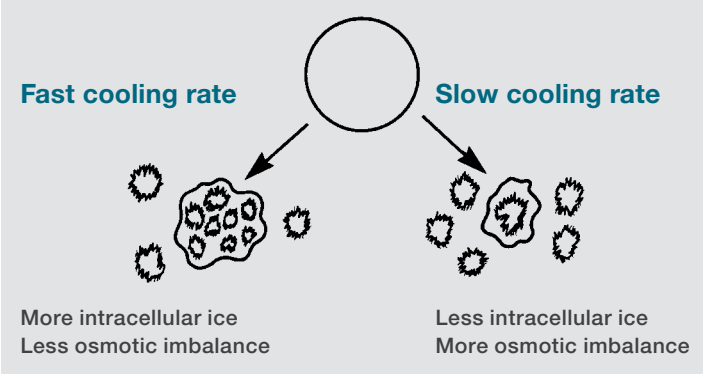


Figure 1. Use a cooling rate of 1°C/minute and a cryoprotective agent to minimize damage due to osmotic imbalance and ice crystal formation.

The rate of cooling has a dramatic effect on these phenomena (Fig. 1). Rapid cooling minimizes the solute concentration effects as ice forms uniformly, but leads to formation of more intracellular ice since water has not migrated out of the cell. Slow cooling on the other hand, results in a greater loss of water from the cell and less internal ice being formed, but results in an increase in the solution effects. Cell permeability affects the rate of water loss; more permeable cells are able to tolerate rapid cooling better than less permeable cells.[2] Mazur et al.3 postulated that ice crystal formation and solution effects both play a role in cell damage, and that an optimum cooling rate minimizes the effect of each. With few exceptions, a cooling rate of 1°C per minute is preferred.

Using cryoprotective additives, or chemicals that protect the cells during freezing also minimizes the detrimental effects of increased solute concentration and ice crystal formation. The most commonly used cryoprotective agents are dimethylsulfoxide (DMSO) and glycerol, although many other additives have been used for specific purposes. Additionally, maintaining frozen cells at the proper storage temperature and using an appropriate warming rate also contribute to minimizing damage to frozen cells and tissues.

A key element of a good cryopreservation program is standardization of the processes employed. Because of the complexity of the preservation process small variations in processing and storage can lead to subtle changes in the biological materials. By standardizing the methodologies there is greater assurance that research results will be consistent and comparable. Therefore, once a successful cryopreservation regimen is established efforts should be made to carefully document the methodology.

Seed lot system

To aid in maintaining the genetic stability of cultured cells, the frequency of subculturing beyond the original established culture must be minimized. When freezing cells, use a system that ensures that early passage material is always available for producing new working stock. One method of preserving early passage material is to use a seed lot system.[4]

When preparing the first frozen lot of a culture, a portion of the lot is set aside as seed material. The vials designated as seed material are maintained separately from the working stocks to ensure that they remain unused and are not handled during retrieval operations (Fig 2). When the first lot of working stock is depleted, a vial is retrieved from the seed lot and used to prepare a second working stock. This continues until all seed vials, except one have been depleted. The last seed vial is then used to prepare a second seed lot. The second seed lot remains only one or two passages from the original material, but may be separated by many years if the lots are adequately sized.

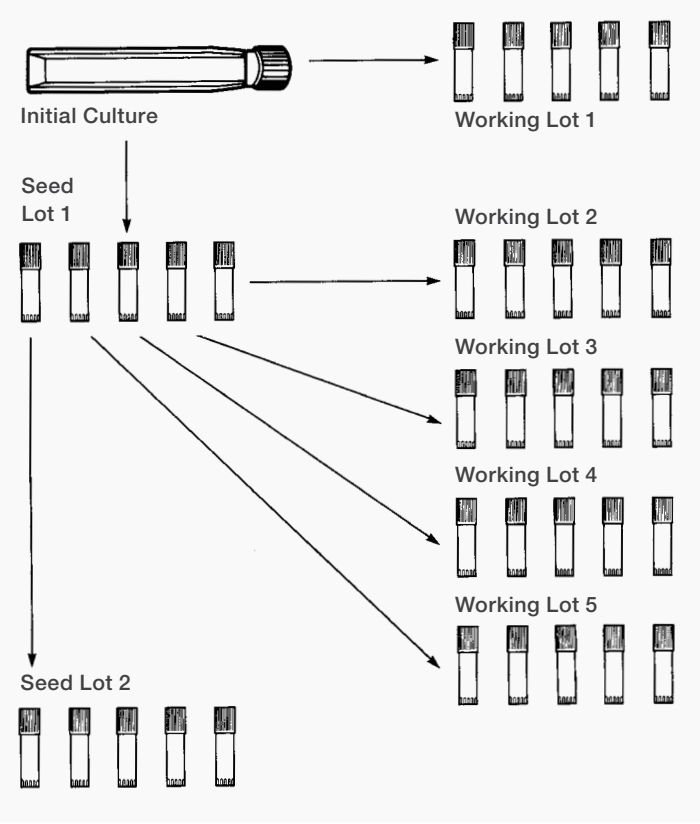


Figure 2. Seed lot system.

The seed stock concept is similar to cell banking practices whereby a master cell bank that is fully qualified is developed and maintained for use in preparing working cell banks used in a manufacturing process. A similar system could also be used for non-replicable materials, such as DNA and proteins, except for a different purpose. In this case, since the material is not renewable, the seed material would be available solely for comparative purposes when changes in the working material are suspected. Sufficient material should be retained as seed stock to allow for testing when necessary.

In addition to seed material, a small portion of the original lot, and even portions of working stocks, should be segregated and maintained in a location remote from all other material. This practice assures that the segregated materials are not handled during stocking and retrieval activities, and remain at a constant temperature. Backup materials should be stored in an off-site location if possible to ensure that preserved materials are not lost in the event of a physical disaster at the primary location. Using seed lots and maintaining off-site reserve material are of primary importance in ensuring continuity and longevity in any well-managed collection of biological materials.

Cryoprotective agents

Many compounds have been tried as cryoprotective agents, either alone or in combination, including sugars, solvents and even serum. Although there are no absolute rules in cryopreservation, glycerol and DMSO have been widely used and traditionally have been demonstrated to be the most effective agents for preserving living cells and organisms. Other cryoprotectants that have been used occasionally, either alone or in combination, include: polyethylene glycol, propylene glycol, glycerine, polyvinylpyrolidone, sorbitol, dextran and trehalose.

The need to preserve tissues and whole organs has led to the development of novel preservation methodologies that are also applicable to enhancing the recovery of frozen cells and organisms.[4,5] These include variations on the concentration of cryoprotectants, and additives that protect cells against apoptosis, or programmed cell death. For many years the death of cells following freezing was assumed to be caused by events causing physical changes or damage to cells. More recently it has been discovered that more subtle events that contribute ultimately to cell death may be manageable with proper additives.[4,5]

Cryoprotective agents serve several functions during the freezing process. Freezing point depression is observed when DMSO is used which serves to encourage greater dehydration of the cells prior to intracellular freezing. Cryoprotective agents also seem to be most effective when they can penetrate the cell, delay intracellular freezing and minimize the solution effects.[1] The choice of a cryoprotective agent is dependent upon the type of cell to be preserved. For most cells, glycerol is the agent of choice because it is usually less toxic than DMSO. However, DMSO is more penetrating and is usually the agent of choice for larger, more complex cells such as protists. The cryoprotective agent should be diluted to the desired concentration in fresh growth medium prior to adding it to the cell suspension. This minimizes the potentially deleterious effects of chemical reactions, and assures a more uniform exposure to the cryoprotective agent when it is added to the cell suspension, reducing potential toxic effects. DMSO and glycerol are generally used in concentrations ranging from 5-10% (v/v), and are not usually used together in the same suspension with the exception of plant cells.

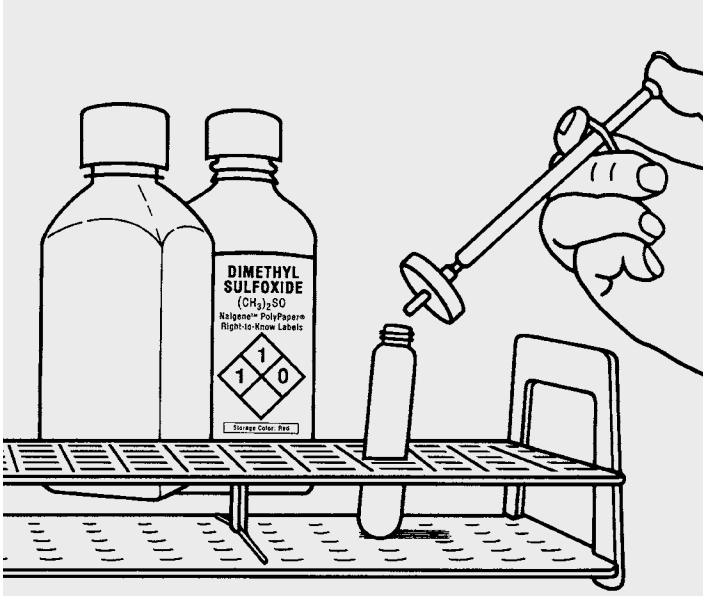


Figure 3. Sterilization of DMSO by filtration.

The optimum concentration of the cryoprotectant varies with the cell type and for optimal results thehighest concentration the cells can tolerate should be used. For some materials it may be advantageous to examine the sensitivity of the cells to increasing concentrations of the cryoprotective agent to determine the optimum concentration. The Quick-Reference Chart (page 9) lists the recommended concentrations of cryoprotective agents for each group of cells and serves as a general guide to choosing the proper agent.

Glycerol and DMSO should be of reagent grade or better, sterilized prior to use, and examined for undesirable properties. Each lot should be examined for toxic properties by exposing sensitive cells to concentrations previously used with success. Glycerol may be sterilized by autoclaving for 15 minutes at 121°C and 15 psig. Glycerol should be protected from light during storage. DMSO must be sterilized by filtration using a 0.2 micron nylon syringe filter or a Teflon® PTFE syringe filter which has been pre-washed with alcohol and rinsed with DMSO (Fig. 3). Cryoprotective agents should be prepared in single-use volumes to minimize the risk of contamination and moisture introduction with repeated use from one container.

Use caution when handling DMSO as it is quickly absorbed into the body through the skin and may transport harmful substances into the body with it.

Non-replicable materials generally do not require additives when frozen except when certain characteristics need to be protected. For example, tissue specimens that are frozen to preserve morphology may benefit from suspension in materials such as optimal cutting temperature (OCT) compound to optimize the results. Normally tissues are frozen in blocks, however combining freezing in OCT with storage in cryovials improves the handling of small tissue specimens.[6]

Preparation of biological materials

How materials are processed in preparation for freezing can have an affect on the outcome of the preservation process. For non-replicable materials such as tissues, nucleic acids and proteins, the preparation process consists of ensuring that the materials are in the proper solution or freezing medium in order to maximize the intended use of the materials when recovered. However the stability and recoverability of living cells and organisms is affected by the growth conditions and pre-freezing processing.

Several factors must be considered when preparing cells for cryopreservation. These include the type of cell, cell viability, growth conditions, physiological state of the cells, the number of cells, and how the cells are handled. When preparing the initial seed stock of a new isolate or cell line, the culture should be examined for identity and contaminating microorganisms at a minimum. This examination should be repeated after preservation and each time a new lot of the culture is prepared.

Microorganisms

Microbial cells, particularly bacteria and yeast, grown under aerated conditions demonstrate a greater resistance to the detrimental effects of cooling and freezing than non-aerated cells.[1] T. Nei et.al.[2] have demonstrated that cell permeability is greater in aerated cultures, and that the aerated cells dehydrate faster during cooling than non-aerated cells. Microbial cells harvested from late log or early stationary cultures also demonstrate greater resistance to the freezing process than younger or older cells.[1]

Generally, the greater the number of cells present initially, the greater the recovery. For most bacteria and yeast, approximately 107/mL cells are required to ensure adequate recovery.7 These can be conveniently harvested from agar slants or plates, or when greater quantities are required, grown in broth culture and harvested by centrifugation. In either case, cells are generally suspended in fresh growth medium containing the cryoprotective agent. Protists can also be concentrated by centrifugation, but are often suspended in the used medium and then diluted by adding an equal volume of fresh growth medium containing the cryoprotective agent.[7]

Spore-forming fungi require harvesting of spores and suspension of the spores in fresh growth medium containing the cryoprotective agent. When freezing fungal spores, care must be taken not to delay the freezing process too long to ensure that germination does not occur prior to freezing. For fungi that do not form spores, special procedures for harvesting mycelia prior to freezing must be utilized. For fungi with tough mycelia, the culture is harvested from agar growth by cutting and removing agar plugs containing the mycelia and placing the plugs into fresh growth medium containing the cryoprotective agent. Tough mycelia that do not adhere well to agar cultures are grown in broth culture and the mycelial mass is blended prior to freezing.[7]

The viability and an estimate of recovery should be determined both before and after freezing the culture. Viability is a measure of the culture's ability to grow and reproduce. For some material, such as protozoan cultures, this should include several passages to ensure stability. An estimate of the number of cells recovered can be made by several means including serial dilution, plate counts, or direct cell counting. A comparison of the counts prior to and after freezing gives an indication of the degree of recovery or the success of the preservation procedure.

Mammalian cells

When preparing mammalian cells for cryopreservation, cell populations need to be adjusted to levels that ensure adequate recovery without unnecessarily growing large numbers of cells. For most mammalian cells, a starting population between 106 to 107 cells/mL is optimum.7 The cell suspension should initially be prepared at a concentration twice that desired for preservation so that an equal volume of cryoprotectant (2 x cryoprotective agent + medium) can be added. Alternatively, the cell pellet can be resuspended in the cryoprotectant (1 x cryoprotective agent + medium) to the desired cell concentration. Gentle handling during cell harvesting and concentration procedures will ensure healthy cells prior to subjecting them to cold stress. Vigorous pipeting and high-speed centrifugation should be avoided if possible. Where appropriate, the pH should be maintained by gassing with 5% or 10% C02.

Factors which can affect the recovery of cryopreserved mammalian cells include: (a) type of cell, (b) the growth phase of the culture, (c) the stage of the cell in the cell cycle, and (d) the number and concentration of cells in the final suspension. Attempts to improve the viability of cryopreserved cells should consider these factors, as well as the nature of the cryoprotective agent and the freezing process.

Mammalian cell cultures are especially susceptible to contamination by other cells, such as HeLa8, and contaminating microorganisms. The species of origin of cell lines can be verified by isoenzyme analysis, karyotyping, immunological assays, or genomic analysis. These should be performed prior to and following preservation. Contamination by viruses and Mycoplasma sp. is of particular concern.[9] A good characterization program for mammalian cell lines should include a check for contamination by bacteria, fungi, appropriate viruses, mycoplasma, and in some cases, protozoa.

Stem cells

Stem cells are cryopreserved in a manner similar to other mammalian cells, with some exceptions to enhance recovery and clonogenic activity. Cryoprotection is normally afforded by using DMSO, sometimes in combination with serum, and freezing slowly is preferred. Trehalose can be used to reduce the potential toxicity associated with other cryoprotectants.10 Rapid warming is also preferred, and viability may vary depending on the cell type.

Vitrification can also be used to preserve stem cells. The protocol involves suspending the cells in a concentrated mixture typically composed of more than one cryoprotectant. For vitrification, the freezing and re-warming processes are rapid to avoid ice crystal formation, and in some studies the vitrification process resulted in greater viability.[11] DMSO, glycerol and propylene glycol have all been used successfully to cryopreserve stem cells.

Plant cells

Plant cells respond to cryopreservation in a manner similar to other cells.[12] The stage in the growth cycle from which they are harvested can affect their recovery, most optimum being late log phase. Also, cell density may play a role in recovery, the optimum cell density depending on the species being preserved.

Combinations of cryoprotective agents are sometimes more effective than agents used singly. The cooling rate is important, and in many cases a two-step cooling process where the cells are held at -30°C to -40°C for a period of time before cooling to liquid nitrogen temperatures, is beneficial. This process enhances the dehydration of the cytoplasm prior to freezing. Rapid thawing is preferred, but there is evidence that slow warming is just as effective in some cases. Vitrification can also be used to preserve plant cells by using concentrated cell suspensions and rapid rates of cooling.

Hardening of plants leads to greater tolerance of stressful conditions, such as experienced during the freezing process. Plants produce increased quantities of some compounds such as sugars and even glycerol which contribute to protecting the cells from osmotic stress during freezing. Undifferentiated callus tissue is often preserved in an effort to stabilize characteristics that can be affected by continued cultivation.

Preservation of seeds is also an acceptable method of stabilizing plant germplasm, and the most common method is storage at low humidity and cool temperatures. However some seeds are tolerant of the increased desiccation associated with freezing and cryogenic storage, and can be stored at liquid nitrogen temperatures.

Viruses

Most viruses can be frozen as cell-free preparations without difficulty and do not require controlled cooling.7 The exceptions are those viruses cultured in viable infected cells which require controlled cooling. For cell-adapted viruses the preservation process should be applicable to survival of the host cell. When viruses are harvested from eggs, the high protein content of the allantoic fluid or yolk sac provides protection during the freezing process.

Plant viruses can be preserved either in infected plant tissue or as purified virus preparations. The virus preparations are suspended in DMSO or another cryoprotectant prior to freezing. Recovery is generally best when the cooling rate is controlled, although most plant viruses will tolerate a rapid freezing procedure. Recovery of plant viruses simply involves thawing in a warm bath, followed by inoculation into the appropriate plant host.

Embryos

Embryos have been preserved both by controlled cooling and vitrification. Recovery depends on the stage of embryonic development, and is measured by successful implantation leading to fetal development.

Genetically modified materials

Genetically modified cells and organisms can be cryopreserved in a manner similar to the unmodified host cell.[13,14]

Non-Replicable materials

Non-replicable materials such as whole blood, serum, tissues, nucleic acids and proteins do not usually have any special requirements for successful preservation. The materials are generally frozen without a cryoprotectant, and the freezing process can be rapid. However, the process used depends on the end-use of the material. Successful recovery of the properties of whole blood requires cryoprotection and controlled cooling, and the quality of frozen tissues can be improved by using a suspension such as optimal cutting temperature (OCT) compound.

Equilibration

The period of time between mixing the cryoprotectant with the cell suspension and beginning the cooling process is called the equilibration period. For most cells, equilibration should occur for at least 15 minutes, but no longer than 45-60 minutes. The cryoprotective agent may be toxic to the cells if the equilibration time is too long. For tissues frozen in OCT, not technically a cryoprotectant, the period of equilibration is generally not significant since OCT does not usually penetrate the tissue but simply provides support during freezing and subsequent sectioning of the tissue.

Equilibration, which should take place at ambient temperature, allows time for the cryoprotective agent to penetrate the cells, with larger and less permeable cells as well as embryos requiring a longer equilibration period. During this period of equilibration the cell suspension may be dispensed into vials and otherwise manipulated in preparation for freezing. An optimal equilibration time should be determined empirically for the cells being cryopreserved to maximize later recovery.

Ampoules and vials

A variety of small containers such as flame-sealed glass ampoules and screw-cap plastic vials can be used for storing cells at ultra-low temperatures. The most commonly used sizes are 1.2- to 2.0-mL cryovials, the size and configuration of which maximize storage capacity while retaining ease of handling during stocking and retrieval activities. Generally, 0.5-1.0 mL of the cell suspension is placed into each container. Several factors must be considered when selecting a container, including its cryotolerance, storage conditions, type of cells to be stored, and safety considerations.

For temperatures above -100°C where low-temperature mechanical stresses are less severe, a variety of containers may be used. However, when storing material at liquid nitrogen temperatures, containers specifically designed to withstand cryogenic temperatures must be used. A variety of containers specifically designed for cryogenic use are available. Plastic vials have screw-on closures with external or internal threads (Fig. 4). The rate of warming may be affected by the type of container used since plastic vials usually require a longer warming period for complete thawing than glass ampoules. This difference in warming rate may be significant for some fastidious cells, but for most cells does not contribute to a loss of viability.

Other containers can be used to store cryopreserved materials including straws traditionally used for embryos, and microtiter plates commonly used for freezing cell arrays or clones. The container of choice should be one that maximizes the ability to maintain viable material during storage, retrieval and handling. Glass ampoules may be flame sealed, however care must be taken that sealing is performed properly, since improperly sealed glass ampoules may have microchannels[15] that lead to liquid nitrogen penetration over time. When these are retrieved from liquid nitrogen to ambient temperature, rapid conversion of the liquid nitrogen to vapor inside the ampoule can result in explosion of the ampoule. Plastic vials with screwtop closures are also susceptible to liquid nitrogen penetration,[16] and while the explosion potential is minimized, liquid can spray from the cap/vial interface with potential dissemination of the vial contents during warming and handling.

Storage by immersion in liquid nitrogen is not advised.

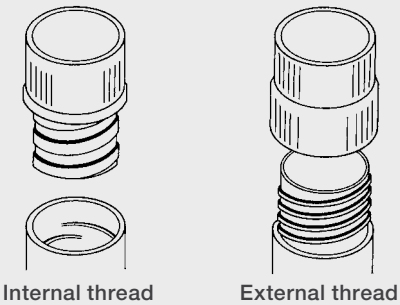


Figure 4. Internal vs. external vial thread design.

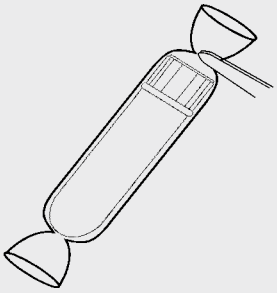


Figure 5. If plastic vials are stored in the liquid phase of liquid nitrogen, the use of Thermo Scientific™ Nunc™ CryoFlex™ is strongly recommended (Nunc Cat. No. 343958).

See warning on page 15.

3.12.3
min temperatūra

Table 1. Quick-reference chart (To be used as a general guide only)

Cell type	No. of cells	Cryoprotective agent	Temperature
Bacteria	10^7/mL	Glycerol (10%)	-60°C*
Bacteriophage	10^8 pfu/mL	Glycerol (10%)	(10%) -80°C
Fungi			
Hyphae	†	Glycerol (10%)	-150°C
Spores	10^6/mL	Glycerol (10%)	-80°C
Yeast	10^7/mL	Glycerol (10%)	-150°C
Protozoa	10^5-10^7/mL	DMSO (5-10%) or Glycerol (10-20%)	-150°C
Algae	10^5-10^7/mL	Methanol (5-10%) or DMSO (5-10%)	-150°C
Plant cells	**	DMSO (5 -10%) + Glycerol (5-10%)	-150°C
Animal cells	10^6-10^7/mL	DMSO (5-10%) or Glycerol (10-20%)	-150°C
Hybridomas	10^7/mL	DMSO (5-10%) + Serum (20%)	-150°C
Stem cells	10^5-10^6/mL	DMSO (5-10%) + Serum (20-90%)	-150°C
Sub/Non cellular materials			
Plant viruses	‡	None	-80°C
Animal viruses			
Cell Free	‡	None	-80°C
Infected Cells	10^6/mL	DMSO (7%) + Fetal Bovine Serum (10%)	-150°C
Plasmids	10^6/mL	Glycerol (10%)	-150°C
Phage libraries	‡	Glycerol (10%)	-150°C
DNA	◊	None	-80°C
RNA	◊	None	-80°C
Protein	◊	None	-80°C
Serum	◊	None	-80°C
Multicellular			
Embryos	20	1,2-propanediol, glycerol or ethylene glycol	-150°C
Tissues	◊	OCT	-80°C
Blood	◊	Glycerol	-150°C

* While -60°C is adequate for most organisms in the groups noted, some sensitive cells may not survive long periods of storage at this temperature.

† Mycelial masses are prepared for freezing of the hyphae of fungi without regard to numbers of cells.

** Plant cells are generally packed to 3-20% cell volume for freezing.

‡ The number of infectious particles has little effect on the recovery of viruses and bacteriophage.

◊ For non-replicable materials the concentration does not affect the ability to freeze the material, only the specific application for its intended use.

◊ ◊ Whole blood and most blood components can be stored at -80°C, however lymphocytes maintained for later development of established cell lines must be maintained at -150°C

Rate of cooling

Once the cells and the cryoprotectant have been combined and dispensed into vials, the next step is to cool the suspension. The rate of cooling is important since it affects the rate of formation and size of ice crystals, as well as the solution effects that occur during freezing. Different types of cells may require different cooling rates, however a uniform cooling rate of 1°C per minute from ambient temperature is effective for a wide variety of cells and organisms.

Generally, the larger the cells, the more critical slow cooling becomes. Most bacteria and spore-forming fungi will tolerate less-than-ideal cooling rates and can be frozen by placing the material at -80°C for a period of time. More fastidious bacteria and non-sporulating fungi require more uniform rates of cooling. Protists, mammalian cells and plant cells often require even greater control of the cooling rate including special manipulation to minimize the detrimental effects of undercooling and the heat liberated during the phase change from water to ice.

Despite the control applied to the cooling of cells, most of the water present will freeze at approximately -2°C to -5°C. The change in state from liquid to crystalline form results in the release of energy in the form of heat; this is known as the latent heat of fusion. Warming of the sample occurs until the equilibrium freezing point is reached, at which temperature ice continues to form. To minimize the detrimental effects of this phenomenon, undercooling must be minimized by artificially inducing the formation of ice. This can be accomplished by seeding the suspension with ice or some other nucleating agent, or by rapidly dropping the temperature of the external environment to encourage ice crystal formation.

To achieve uniform, controlled cooling rates, use a programmable-rate cell freezing apparatus. Simple units allow only the selection of a single cooling rate for the entire temperature range. More sophisticated units, however, allow a selection of variable rates for different portions of the cooling curve. Less costly and easier-to-use systems are available for simulating a controlled-rate cooling process by placing the vials in a mechanical freezer at -60°C to -80°C. In order to accomplish a uniform rate of cooling, the vials must be placed in specially designed containers.

Thermo Scientific™ Nalgene™ Mr. Frosty™ 1°C freezing container (Cat. No. 5100-0001) provides a simple-to-use system designed to achieve a rate of cooling very close to 1°C per minute. (Fig. 6) Typical cooling rates for homemade freezing systems lead to uncontrolled cooling that averages 1°C per minute but the cells actually experience more rapid rates of cooling during some parts of the cooling curve.16 Homemade freezing systems are also non-repeatable. Nalgene™ Mr. Frosty™ eliminates the need for direct immersion in an alcohol bath. This feature eliminates the potential for contamination due to wicking of the alcohol, as well as the presence of residual alcohol on the exterior of the vials. During handling at colder temperatures, the presence of alcohol on the vials makes the vials colder to the touch and extremely slippery.

Cryopreservation of embryos requires even greater control of the process because of their multicellular structure. In addition to the controlled rate freezing commonly used for single cells, a vitrification process is also used for preserving embryos.[17] This requires suspending the embryos in a highly viscous solution, and rapidly cooling the suspension to eliminate the formation of ice crystals. The resulting frozen mass is a vitreous glass that requires storage at liquid nitrogen temperatures. If the storage temperature rises above -130˚C ice crystals will form resulting in damage to the embryo.

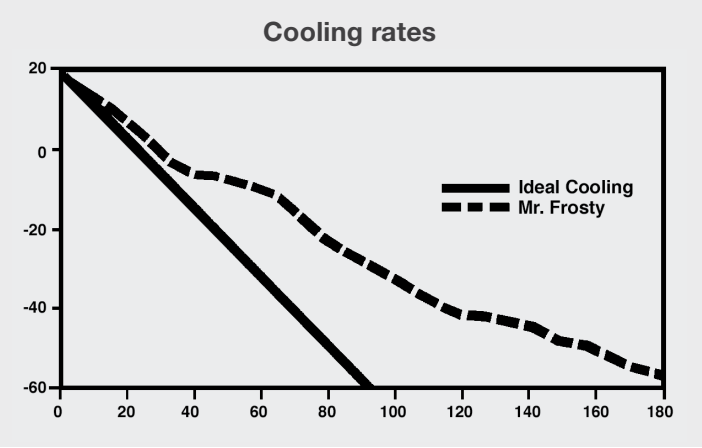


Figure 6. The ideal cell cooling rate and the cooling rate provided by Nalgene™ Mr. Frosty™ 1°C freezing container.

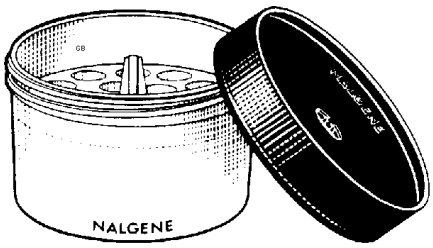
Storage

When the sample has been frozen for 48 hours, a vial should be thawed to determine whether the cells are viable and able to establish a cell population, (i.e. if they survived the freezing procedure).

See Determination of Recovered Cells, below.

The temperature at which frozen preparations are stored affects the length of time after which the material can be recovered. The lower the storage temperature, the longer the viable storage period. Ultimate stability of frozen cells cannot be assured unless the material is maintained below -130˚C.18 Some bacteria and spore-forming fungi may tolerate storage temperatures of -60˚C to -80˚C for long periods of time. However, more fastidious cells, such as mammalian tissue cultures, hybridomas and stem cells must be maintained below -130˚C to assure long-term stability. It has been demonstrated that some cells survive for less than one year when stored at -80˚C.[1]

For ultimate security and maximum stability, living cells and embryos should be stored in liquid nitrogen freezers. However, there are risks associated with immersing vials directly into liquid nitrogen, as discussed previously. Liquid nitrogen units that provide all-vapor storage are ideal as long as the working temperature at the opening of the unit remains below -130˚C.



Nalgene Mr. Frosty cyropreservation container

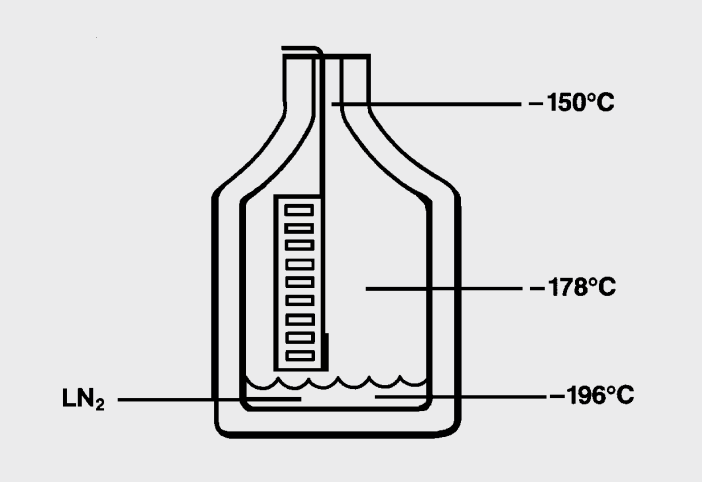


Figure 7. The ideal cell cooling rate and the cooling rate provided by Nalgene Mr. Frosty 1°C freezing container.

To assure that a liquid nitrogen freezer maintains the proper working temperature, the volume of liquid nitrogen in the unit should be adjusted to a level that results in a temperature of -150°C just above the stored material when the lid of the unit is removed19 (Fig. 7). An adequate working temperature can be attained in most liquid nitrogen freezers; however, the design of some models requires that the amount of liquid nitrogen necessary to attain the proper working temperature will reduce the amount of usable storage space. If vials are to be immersed in the liquid phase of liquid nitrogen, they must be correctly sealed in Thermo Scientific™ Nunc™ CryoFlex™ tubing to prevent penetration by liquid nitrogen. Improper use may cause entrapment of liquid nitrogen inside the vial and lead to pressure build up, resulting in possible explosion or biohazard release. Liquid phase LN penetration can also be a source of contamination for submerged samples not properly protected by Nunc Cryoflex tubing. In most cases, vapor phase storage at –130˚C is adequate and avoids the hazards of liquid phase storage. Mechanical freezers that cool to -150˚C are also available.

Improper handling of material maintained at cryogenic temperatures can have a detrimental effect on the viability of frozen cells. Each time a frozen vial is exposed to a warmer environment, even briefly, it experiences a dramatic change in temperature. Storage systems should be designed to avoid exposure of stored material to warmer temperatures, as well as minimizing prolonged exposure of personnel during specimen retrieval. Box stacking systems (i.e. stainless steel racks) necessitate exposure of boxes at the top to warmer temperatures when retrieving boxes at lower temperatures. When box stacking systems are used, maintain a small number of vials of each preparation in the top box of the rack and store the remaining vials of each preparation in lower boxes. By doing this, a vial of one preparation can be retrieved without exposing all vials of any particular culture or lot.[20]

To maximize the available space in liquid nitrogen freezers and minimize exposure of material during retrieval, use small storage boxes or aluminum canes. Press the vials onto the canes, putting no more than one lot of one culture on each cane. Canes provide a flat surface for coding their position and easy identification during retrieval. Place the canes into cardboard or plastic sleeves to eliminate the potential for vials to fall from the canes. (Fig. 8) When retrieving vials from canes, the cane should be lifted only to a level that exposes the first available vial, without removing the remaining vials from the working temperature of the freezer.[20]

Figure 8. Clear plastic sleeve allows identification of vials in an aluminum cane.

Reconstitution (thawing)

For most cells, warming from the frozen state should occur as rapidly as possible until complete thawing is achieved. To achieve rapid warming, place the frozen vial into a 37°C water bath. Remember, material frozen in plastic vials will take longer to thaw than that in glass ampoules, and sometimes gentle agitation of the vial during warming will accelerate the thawing process. Care must be taken, however, not to vigorously agitate vials containing fragile cells such as protists and mammalian cells. As soon as the contents of the vial have been thawed, remove the vial from the water bath. To minimize the risk of contamination during reconstitution, disinfect the external surface of the vial by wiping with alcohol-soaked gauze prior to opening.

Immediately transfer the contents of the vial to fresh growth medium following thawing to minimize exposure to the cryoprotective agent. For most cultures, the entire contents of the vial may be placed into fresh media, however further dilution may be necessary for cell lines. It is recommended that the cell suspension be centrifuged at 100 x g for 10 minutes after initial dilution, the supernatant removed, and the cells resuspended into fresh growth medium to remove residual cryoprotective chemicals.

Some materials that are not sensitive to the cryopreservation process may tolerate thawing and re-freezing. Most replicable cells will not tolerate refreezing unless they are in a resistant form such as a spore. However, for non-replicable materials such as serum, nucleic acids, and proteins, thawing and re-freezing may be acceptable. Keep in mind that each time an aliquot is thawed and re-frozen subtle changes may occur in the character of the material that could impact future use. An alternative to thawing and re-freezing is to store material in smaller aliquots for single use.

For more information on cryopreservation and cryoware products, visit us at www.thermoscientific.com/coldstorage

Determination of recovered cells

Methods used to estimate the number of viable cells recovered following freezing depend on the type of material preserved. Visual inspection alone can be deceptive, and although staining and dye exclusion are effective in determining the presence of viable cells for most mammalian cells, they do not indicate an ability to establish the cell population. For microbial cells, serial dilution and plate counts are effective in quantifying the population of cells recovered. Although there may be some vial-to-vial variation within a given lot, with constant storage conditions the number of recovered cells will generally be the same in all vials. Vial-to-vial variation may be an indication of problems occurring during storage and handling.

For stem cells the recovery is determined in the same manner as for other mammalian cells by estimating the number of viable cells. In addition measuring the differentiation capacity and clone forming capability are also important in assuring complete stem cell recovery[10]. Embryo recovery can be determined via morphological examination, and verified by implantation and fetal development. Recovery of non-replicable materials is determined by acceptable results following intended use.

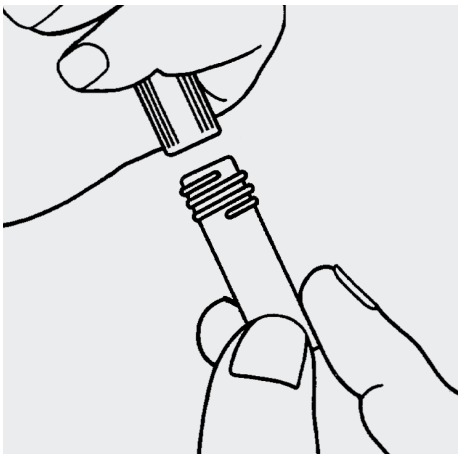
Inventory control

Appropriate record keeping is important in any laboratory and there are a number of methods available for keeping records on cryopreserved materials.[20] When establishing your own method, keep in mind that there is key information which will be important for future use: (a) the preservation methodology used; (b) the location and identification of the stored material; (c) preservation date; and (d) number of passages for replicable material. The item number should be linked to associated data for that material, and for some purposes each container may require a unique identifying code linked to specific information for that particular aliquot.

Identification begins with proper labeling of the storage container. The label information should include a name or identification code for the frozen material, as well as a lot number. The information on the label should be kept with the inventory records that include the location code for each vial. These records can be maintained as paper documents, or preferably as electronic files. Duplicate inventory records should be maintained in a location separate from working records. Locator codes should be specific enough to allow rapid and easy retrieval for a specific lot and should include freezer unit number, a code for a freezer section or inventory rack, a box or canister number, and possibly even a grid spot within the box or a cane number when canes are used. Detailed locator codes minimize hunting for material which risks warming the freezer unit, exposure of other materials to warmer temperatures, and prolonged exposure of laboratory personnel to extremely cold temperatures.

Biological materials management

Despite its use in stabilizing living material, low-temperature preservation can stress cells. Care must be taken to ensure that preserved material remains unchanged following preservation. A good preservation program should include effective characterization and cataloging programs, both of which combined, provide optimum biological materials collection practices. There is little use in preserving material that is of little value, inadequately characterized, contaminated or misidentified. The first step in maintaining a collection of biological materials is to assess the material to be preserved to ensure that it is of use and is worth keeping. This practice should continue throughout the collection process to minimize the accumulation of preserved material to unmanageable levels. To avoid duplication of collection materials, a system of identification of each item should be established. This can be done by devising unique numbering systems or number/letter combinations. Each identification number should be cross-referenced to other information about the biological material. Preservation of living cells ensures stability but does not correct any problems already present in the material.[20] All material to be preserved should be examined thoroughly for contamination, proper identification, and other key characteristics unique to the cells, prior to preservation. Since freezing can stress cells and handling exposes cells to the risks of contamination, characterization must continue after successful preservation is accomplished. Each time a new lot of frozen material is prepared, complete characterization of the material should be carried out. Cataloging and data record keeping are important aspects of all biological material collection programs. Cataloging ensures that duplication of material does not occur and is especially useful when collection material is to be made available to others. Maintaining records on data generated during the characterization and preservation of collection materials ensures that any future problems can be adequately addressed. An important aspect of good biological materials management is constant assessment of the usefulness of the material, and removal of materials that are no longer needed.



Aseptic technique minimizes possibility of contamination.

Safety considerations

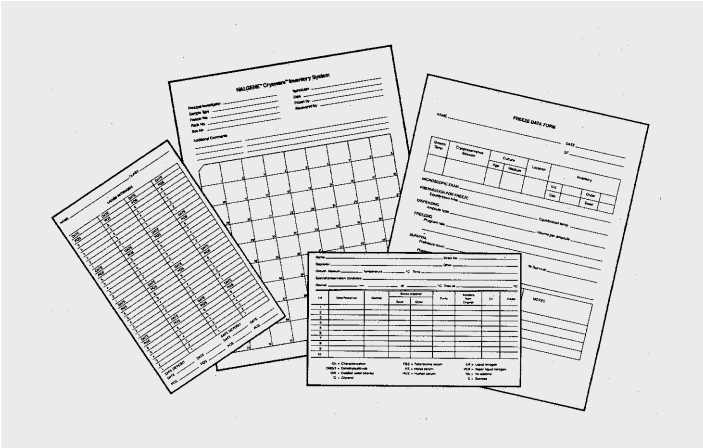
Safety precautions must be observed throughout the preservation and maintenance process. All work with hazardous cultures should be performed under proper containment, and U.S. Public Health Service Biosafety Level guidelines should be adhered to at all times.[21]

Human and other primate cells may contain adventitious viral agents that require special handling, and all primate cells that have not been thoroughly characterized should be handled at Biosafety Level II. At this level, laboratory staff must have training in handling pathogenic agents and work under the direction of a competent scientist. Access to the laboratory must be limited and biological safety cabinets must be used for large-volume work or when aerosols are generated.[21]

Low-temperature storage of cells presents unique hazards that necessitate safety precautions. Cryogenic temperatures can result in exposure of personnel to extremely cold conditions, and precautions must be taken to protect personnel during operations in liquid nitrogen freezers. Insulated gloves and long-sleeved laboratory coats or other garb protect the skin from exposure. It is extremely important to wear a full face and neck shield when working in the liquid portion of a liquid nitrogen freezer. As noted previously, improperly sealed glass ampoules may explode when retrieved from liquid nitrogen. To minimize the risk of potential explosions, leave vials retrieved from the liquid phase of the freezer in the vapor phase of the same freezer for a minimum of 24 hours. A face shield that provides neck protection should be mandatory when retrieving vials from liquid nitrogen. The use of Nunc CryoFlex tubing is also strongly recommended. See Warning on this page.

Special precautions must be taken when working with hazardous biological materials at liquid nitrogen temperatures. Always thaw and open vials containing hazardous material inside a biological safety cabinet. Be prepared for exploding and leaking ampoules/vials. Broken ampoules in a liquid nitrogen freezer are a potential source of contamination and contaminants may survive, despite the extremely cold temperatures.[22]

When a liquid nitrogen freezer becomes contaminated, the entire unit should be decontaminated after warming to room temperature. When closing down a liquid nitrogen freezer that is not obviously contaminated, remove all material to be retained, warm the unit to room temperature and disinfect it prior to further handling.

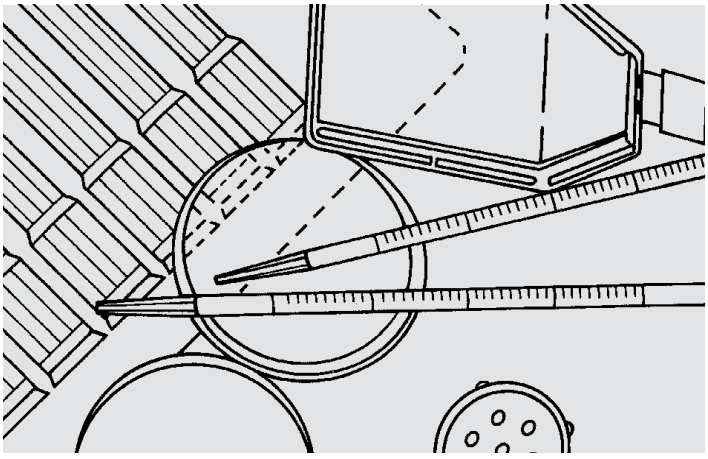


Accurate record keeping specifically for cryopreserved material. Full-size copies of these records are printed at the end of this manual and may be duplicated.

Step-by-step for cultured cells

(Not stem cells)

1. Harvest cells from late log or early stationary growth. Scrape cells from the growth surface if they are anchorage dependent. Centrifuge broth or anchorage independent cultures to obtain a cell pellet, if desired.
2. Prepare presterilized DMSO or glycerol in the concentration desired in fresh growth medium. When mixing with a suspension of cells, prepare the cryoprotective agents in twice the desired final concentration.
3. Add the cryoprotectant solution to the cell pellet or mix the solution with the cell suspension. Begin timing the equilibration period.
4. Gently dispense the cell suspension into vials.
5. Begin cooling the cells after the appropriate equilibration time.
   - Uncontrolled cooling—place the vials on the bottom of a -60˚C freezer for 90 minutes.
   - Semi-controlled cooling—use Mr. Frosty freezing container to freeze the vials in a -70˚C freezer.
   - Controlled cooling—use a programmable cooling unit to cool the cells at 1°C per minute to -40˚C.
6. Remove the cells from the cooling unit and place them at the appropriate storage temperature.
7. To reconstitute, remove a vial from storage and place into a water bath at 37˚C. When completely thawed, gently transfer the entire contents to fresh growth medium.



There are a number of tests you can perform to correctly identify cell lines. Correct identification is important to prevent cross-contamination.

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WARNING:

Do not use vials for storage in the liquid phase of liquid nitrogen unless correctly sealed in Nunc CryoFlex Tubing (Cat. No. 343958). Improper use may cause entrapment of liquefied nitrogen inside the vial and lead to pressure build-up, resulting in possible explosion or biohazard release. Use appropriate safety procedures as outlined in this manual when handling and disposing of vials.

Cryoware inventory system

Info	
Principle Investigator	Technician
Sample Type	Date
Freezer No.	Frozen by.
Rack No.	Recovered by
Box No.	

Additional comments

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Freeze data form

Name Date

Growth Temp.	Cryopreserative Solution	Culture		Location	Inventory			
		Age	Medium					
					Storage Temp.		Seed	
					Gas		Working Lot	

Microscopic Exam

Preparation for Freeze

Equilibration Time Equilibration Temp.

Dispensing

Vial Type Volume per Vial

Freezing

Program Rate

Survival

Prefreeze count	cells/ml	**Total vol. frozen**	ml	**% Viable**
Postfreeze count	cells/ml	**Total vol. resuspended**	cells/ml	

Date	Survival			Notes
	% Rec	Purity (free from contaminants)	No. pass.	

Liquid nitrogen storage canes

Name Date

Date:	Date:	Date:	Date:	Date:	Date:	Date:	Date:
Pos:	Pos:	Pos:	Pos:	Pos:	Pos:	Pos:	Pos:
6	6	6	6	6	6	6	6
5	5	5	5	5	5	5	5
4	4	4	4	4	4	4	4
3	3	3	3	3	3	3	3
2	2	2	2	2	2	2	2
1	1	1	1	1	1	1	1
Date:	Date:	Date:	Date:	Date:	Date:	Date:	Date:
Pos:	Pos:	Pos:	Pos:	Pos:	Pos:	Pos:	Pos:
6	6	6	6	6	6	6	6
5	5	5	5	5	5	5	5
4	4	4	4	4	4	4	4
3	3	3	3	3	3	3	3
2	2	2	2	2	2	2	2
1	1	1	1	1	1	1	1

Name **Strain**

Growth Medium **Temperature** °C **Time**

Special preservation conditions

Thaw at °C

Lot	Date Preserved	Method	Stock prepared		Purity (free from contaminants)	Transfers from original	Ch	Initials
			Seed	Order				
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

DMSO = Dimethylsulfoxide, **FBS** = Fetal bovine serum, **LN2** = Liquid nitrogen, **DW** = Distilled water (sterile), **HS** = Horse serum, **VLN2** = Vapor, liquid nitrogen, **G** = Glycerol, **HuS** = Human serum, **Ch** = Characterization, **No** = No additive

Liquid nitrogen storage canes

Name Date

Date:	Date:	Date:	Date:	Date:	Date:	Date:	Date:
Pos:	Pos:	Pos:	Pos:	Pos:	Pos:	Pos:	Pos:
6	6	6	6	6	6	6	6
5	5	5	5	5	5	5	5
4	4	4	4	4	4	4	4
3	3	3	3	3	3	3	3
2	2	2	2	2	2	2	2
1	1	1	1	1	1	1	1
Date:	Date:	Date:	Date:	Date:	Date:	Date:	Date:
Pos:	Pos:	Pos:	Pos:	Pos:	Pos:	Pos:	Pos:
6	6	6	6	6	6	6	6
5	5	5	5	5	5	5	5
4	4	4	4	4	4	4	4
3	3	3	3	3	3	3	3
2	2	2	2	2	2	2	2
1	1	1	1	1	1	1	1

Name Strain

Growth Medium Temperature °C Time

Special preservation conditions

Thaw at °C

Lot	Date Preserved	Method	Stock prepared		Purity (free from contaminants)	Transfers from original	Ch	Initials
			Seed	Order				
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

DMSO = Dimethylsulfoxide, **FBS** = Fetal bovine serum, **LN2** = Liquid nitrogen, **DW** = Distilled water (sterile), **HS** = Horse serum, **VLN2** = Vapor, liquid nitrogen, **G** = Glycerol, **HuS** = Human serum, **Ch** = Characterization, **No** = No additive

Nalgene and Nunc cryoware products

include everything you need to safely contain and organize your cryogenically preserved samples.

Thermo Scientific Freezers

Our freezers offer maximum temperature, operational efficiency and quiet operation for a more comfortable lab environment.

Our LN2 and mechanical cryopreservation storage systems offer improved viability and reliable long term storage for your valuable biological specimens.

For more information on Cryopreservation and Cryoware Products, visit us at **thermofisher.com/coldstorage**

thermo scientific

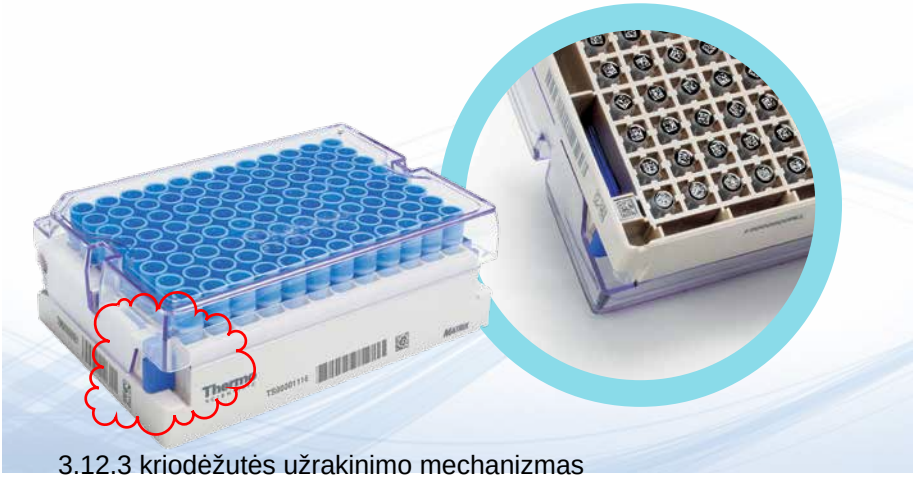
Thermo Scientific Matrix Barcoded Tubes and Racks

Identify and track your samples
for optimal sample storage

Thermo Scientific™ Matrix™ 2D Barcoded ScrewTop Tubes in Barcoded Racks

Matrix 2D Barcoded ScrewTop Storage tubes are now available in a standard barcoded latch rack. The barcoded latch rack provides permanent 2D, linear, and human readable codes on 3 sides of the rack. A 2D barcode on the rack bottom enables orientation detection and identification when using automated storage equipment. These additions to the Matrix ScrewTop Storage tube portfolio allow visual sample identification in a range of laboratory procedures and eliminate the need for secondary labeling.

3.12.3 Krodėžutė markiruota brūšniniu kodu



3.12.3 kriodėžutės užrakinimo mechanizmas

3.12.3 2D kodas - unikalus

Eliminate Secondary Labeling Steps. Matrix 2D Barcoded ScrewTop Storage tubes are available pre-printed with 1D and human-readable codes that match the tube's 2D code. Laser etched 2D, linear and human readable barcodes are also included on the sides of the standard latch racks. The additional barcoding on tube and rack eliminates the need for the secondary application of labels, streamlining storage procedures.

Enhanced Secure Tracking. A permanently bonded, unique 2D barcode is laser etched onto the base of every tube to securely identify and track samples. The linear and human readable codes match this unique 2D barcode, allowing 1D scanning or visual identification of samples across satellite or collaborative sites without 2D readers. Complementary Thermo Scientific 2D and 1D barcode readers scan and instantly decode each tube's barcode into any application or database. Laser etched 2D, linear, and human readable barcodes are included on three sides of the standard latch rack, providing traceability at the rack level and providing readability to laboratories with or without barcode decoding equipment. The 2D barcode included on the bottom of the rack serves as both an orientation and identification feature for automated and benchtop storage equipment.

Superior Storage Format. Matrix 2D Barcoded ScrewTop storage tubes are available in specially designed, barcoded, stackable, microplate-footprint Latch Racks to save precious space in storage and on the bench top while maintaining traceability. Lid can be positioned to rest on the rack, preventing contamination during manual pipetting. Or remove lid completely for robotic handling.

Flexibility. Side-printed Matrix ScrewTop tubes and barcoded latch racks maintain compatibility with existing ScrewTop tube storage systems and accessories. ScrewTop Removal Tool caps/decaps tubes individually to enable one-handed pipetting. The Thermo Scientific ScrewTop Cap Tray can be used to cap/decap several tubes at once with automated capping systems or to fill tubes on an automated liquid handling platform, then cap an entire rack at once. Seven color cap options allow easy identification of samples at a glance.

Stringent Quality Control. Every 2D barcoded storage tube is scanned to ensure readability. All barcodes are checked against our database of previously assigned codes to prevent duplicates.

Thermo SCIENTIFIC

Product Specifications

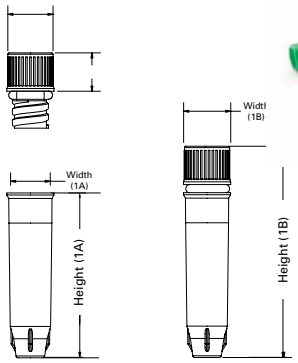
Tube Material	Virgin Class VI Medical Grade Polypropylene
Rack Material	Polycarbonate with acetal latches
Cap Material	Virgin Class VI Medical Grade Polypropylene with Santoprene™ gasket
ScrewTop Cap Tray Material	Acrylonitrile Butadiene Styrene (ABS)
Contaminant-free	All tubes and tray are supplied free from DNA, RNAse, DNAse and endotoxins
Autoclavable	Racked and unracked tubes are autoclavable with the caps loosened; ScrewTop trays are not autoclavable
2D Code	Non-proprietary, 12x12 Data-matrix with ECC200 Built-in Error Correction
Tube/Cap Temp Range	-196°C to 121°C; Autoclaving and boiling to vapor phase liquid nitrogen storage
Latch Rack Coding	2D Datamatrix; Linear EAN Code 128; Human Readable

Description	**500 µl ScrewTop Storage Tubes**		**1.0 ml ScrewTop Storage Tubes**
Item Number	3743, 3744, 3745 3744-WP; 3744-WP1D; 3745-WP; 3745-WP1D		3740, 3741, 3742 3741-WP; 3741-WP1D; 3742-WP; 3742-WP1D
Figure 1A: Tube Side View	Width (1A)	7.40±0.10 [0.290±0.002]	7.40±0.10 [0.290±0.002]
	Height (1A)	30.60±0.20 [1.204±0.007]	44.00±0.10 [1.732±0.003]
Figure 1B: Tube Side View w/ ScrewTop	Width (1B)	8.70±0.10 [0.344±0.003]	8.70±0.10 [0.344±0.003]
	Height (1B)	39.20 [1.543]	52.60 [2.071]
Figure 2: Rack Side View	Height (2A)	29.50±0.10 [1.160±0.005]	38.10±0.10 [1.500±0.005]
	Height (2B)	29.10±0.10 [1.145±0.005]	42.50±0.20 [1.673±0.008]
	Height (2C)	32.60±0.30 [1.282±0.012]	46.00±0.20 [1.809±0.008]
	Height (2D)	41.30±0.40 [1.626±0.017]	54.60±0.30 [2.149±0.110]
Figure 3: Rack Top View	Length	127.75±0.13 [5.029±0.005]	127.75±0.13 [5.029±0.005]
	Width	85.46±0.13 [3.364±0.005]	85.46±0.13 [3.364±0.005]
Figure 4: Stacked Rack View	Single Height (4A)	44.32±0.24 [1.745±0.010]	58.42±0.25 [2.300±0.010]
	Incremental Height (4B)	43.31±0.25 [1.705±0.010]	57.30±0.25 [2.220±0.010]
	Stacked Height (4C)	87.63±0.51 [3.450±0.020]	114.81±0.51 [4.520±0.020]

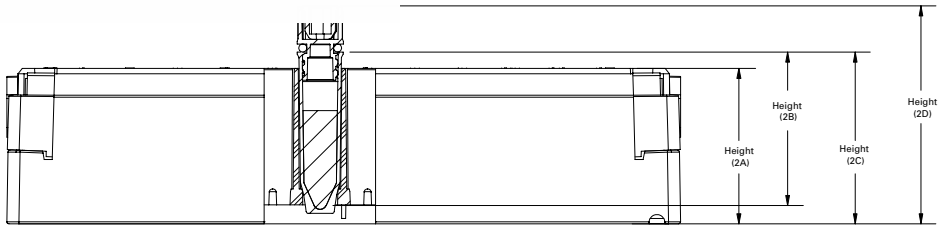
Description	**Storage Tubes Barcoded Rack**	
Item Number	3743-BR, 3744-BR, 3745-BR, 3744-WP-BR, 3744-WP1D-BR, 3745-WP-BR, 3745-WP1D-BR, 3740-BR, 3741-BR, 3742-BR, 3741-WP-BR, 3741-WP1D-BR, 3742-WP-BR, 3742-WP1D-BR, 3748-BR	
Figure 5: Rack Bottom View		
	Distance to barcode from short side (5A)	120.48 ± 0.254 [4.74 ± 0.010]
	Distance to barcode from short side (5B)	1.443 ± 0.203 [0.057 ± 0.008]
	Barcode length	5.83 ± 0.127 [0.230 ± 0.005]
	Distance to barcode from long side (5C)	71.98 ± 0.254 [2.834 ± 0.010]
	Distance to barcode from long side (5D)	8.18 ± 0.203 [0.322 ± 0.008]
	Barcode width	5.30 ± 0.127 [0.209 ± 0.005]

Description	**ScrewTop Cap Tray**	
Item Number	4906, 4477	
Figure 6: Tray Top View	Length	127.75±0.25 [5.03±0.010]
	Width	85.58±0.25 [3.37±0.010]
Figure 7: Stacked Tray View	Single Height (2A)	19.81±0.13 [0.78±0.005]
	Incremental Height (2B)	18.29±0.25 [0.72±0.010]
	Stacked Height (2C)	38.10±0.25 [1.50±0.010]

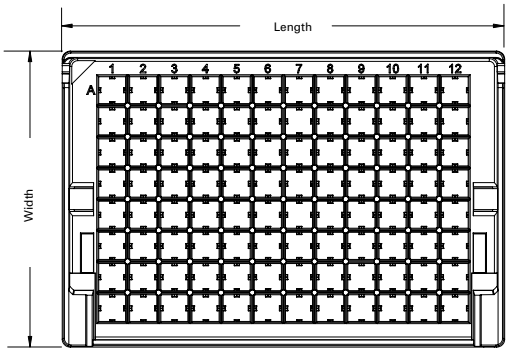
Matrix Barcoded ScrewTop Tubes



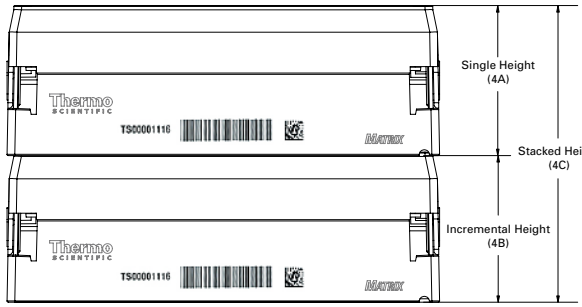
▲ Figure1: Tube Side View



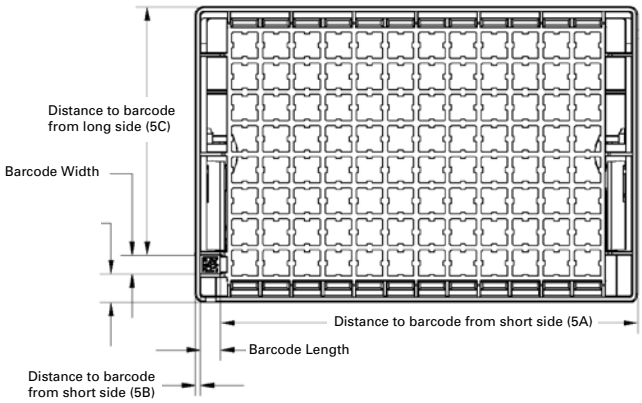
▲ Figure 2: Rack Side View



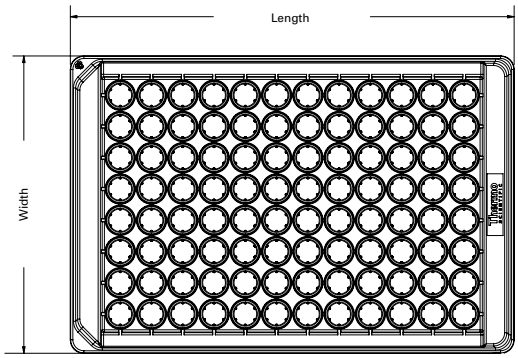
▲ Figure 3: Rack Top View



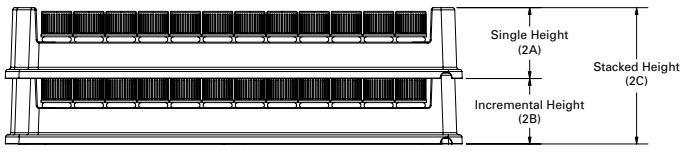
▲ Figure 4: Stacked Rack View



▲ Figure 5: Rack Bottom View



▲ Figure 6: Tray Top View



▲ Figure 7: Stacked Tray View

3.12.3 1ml, sterilūs mėgintuvėliai su 2D kodu. dėžutėja telpa 96 mėgintuvėliai

Cat. No. Non-Barcoded Rack	Cat. No. Barcoded Rack	Description	Max Working Volume, µL	Cap Color	Qty	
3744	3744-BR	Tube, ScrewTop, 500 µL 2D, V-Bottom	590	Colorless	5 racks of 96/case	Sterile
3744RED	3744RED-BR	Tube, ScrewTop, 500 µL 2D, V-Bottom	590	Red	5 racks of 96/case	Sterile
3744YEL	3744YEL-BR	Tube, ScrewTop, 500 µL 2D, V-Bottom	590	Yellow	5 racks of 96/case	Sterile
3744BLU	3744BLU-BR	Tube, ScrewTop, 500 µL 2D, V-Bottom	590	Blue	5 racks of 96/case	Sterile
3744GRE	3744GRE-BR	Tube, ScrewTop, 500 µL 2D, V-Bottom	590	Green	5 racks of 96/case	Sterile
3744WHI	3744WHI-BR	Tube, ScrewTop, 500 µL 2D, V-Bottom	590	White	5 racks of 96/case	Sterile
3744PUR	3744PUR-BR	Tube, ScrewTop, 500 µL 2D, V-Bottom	590	Purple	5 racks of 96/case	Sterile
3744AMB	3744AMB-BR	Amber Tube, ScrewTop, 500µL 2D, V-bottom	590		5 racks of 96/case	Sterile
3743AMB	3743AMB-BR	Amber Tube, ScrewTop, 500µL 2D, V-bottom	590	Red	5 racks of 96/case	Sterile
3745	3745-BR	Tube, ScrewTop, 500 µL 2D, V-Bottom, No Caps	590		5 racks of 96/case	Sterile
3744-WP	3744-WP-BR	Tube, ScrewTop, 500 µL 2D, WP, V-Bottom	590	Colorless	5 racks of 96/case	Sterile
3744-WP1D	3744-WP1D-BR	Tube, ScrewTop, 500 µL 2D, WP/1D, V-Bottom	590	Colorless	5 racks of 96/case	Sterile
3745-WP	3745-WP-BR	Tube, ScrewTop, 500 µL 2D, WP, V-Bottom, No caps	590		5 racks of 96/case	Sterile
3745-WP1D	3745-WP1D-BR	Tube, ScrewTop, 500 µL 2D, WP/1D, V-Bottom, No caps	590		5 racks of 96/case	Sterile
3743		Tube, ScrewTop, 500 µL 2D, V-Bottom	590	Colorless	Bulk, 480/case	Sterile
3743RED		Tube, ScrewTop, 500 µL 2D, V-Bottom	590	Red	Bulk, 480/case	Sterile
3743YEL		Tube, ScrewTop, 500 µL 2D, V-Bottom	590	Yellow	Bulk, 480/case	Sterile
3743BLU		Tube, ScrewTop, 500 µL 2D, V-Bottom	590	Blue	Bulk, 480/case	Sterile
3743GRE		Tube, ScrewTop, 500 µL 2D, V-Bottom	590	Green	Bulk, 480/case	Sterile
3743WHI		Tube, ScrewTop, 500 µL 2D, V-Bottom	590	White	Bulk, 480/case	Sterile
3743PUR		Tube, ScrewTop, 500 µL 2D, V-Bottom	590	Purple	Bulk, 480/case	Sterile
3741	3741-BR	Tube, ScrewTop, 1.0 mL 2D, V-Bottom	940	Colorless	5 racks of 96/case	Sterile
3741RED	3741RED-BR	Tube, ScrewTop, 1.0 mL 2D, V-Bottom	940	Red	5 racks of 96/case	Sterile
3741YEL	3741YEL-BR	Tube, ScrewTop, 1.0 mL 2D, V-Bottom	940	Yellow	5 racks of 96/case	Sterile
3741BLU	3741BLU-BR	Tube, ScrewTop, 1.0 mL 2D, V-Bottom	940	Blue	5 racks of 96/case	Sterile
3741GRE	3741GRE-BR	Tube, ScrewTop, 1.0 mL 2D, V-Bottom	940	Green	5 racks of 96/case	Sterile
3741WHI	3741WHI-BR	Tube, ScrewTop, 1.0 mL 2D, V-Bottom	940	White	5 racks of 96/case	Sterile
3741PUR	3741PUR-BR	Tube, ScrewTop, 1.0 mL 2D, V-Bottom	940	Purple	5 racks of 96/case	Sterile
3741AMB	3741AMB-BR	Amber Tube, ScrewTop, 1.0mL 2D, V-Bottom	940	Red	5 racks of 96/case	Sterile
3742AMB	3742AMB-BR	Amber Tube, ScrewTop, 1.0mL 2D, V-Bottom	940		5 racks of 96/case	
3742	3742-BR	Tube, ScrewTop, 1.0 mL 2D, V-Bottom, No Caps	940		5 racks of 96/case	Sterile
3741-WP	3741-WP-BR	Tube, ScrewTop, 1.0 mL 2D, WP, V-Bottom	940	Colorless	5 racks of 96/case	Sterile
3741-WP1D	3741-WP1D-BR	Tube, ScrewTop, 1.0 mL 2D, WP/1D, V-Bottom	940	Colorless	5 racks of 96/case	Sterile
3742-WP	3742-WP-BR	Tube, ScrewTop, 1.0 mL 2D, WP, V-Bottom, No caps	940		5 racks of 96/case	Sterile
3742-WP1D	3742-WP1D-BR	Tube, ScrewTop, 1.0 mL 2D, WP/1D, V-Bottom, No caps	940		5 racks of 96/case	Sterile
3740		Tube, ScrewTop, 1.0 mL 2D, V-Bottom	940	Colorless	Bulk, 480/case	Sterile
3740RED		Tube, ScrewTop, 1.0 mL 2D, V-Bottom	940	Red	Bulk, 480/case	Sterile
3740YEL		Tube, ScrewTop, 1.0 mL 2D, V-Bottom	940	Yellow	Bulk, 480/case	Sterile
3740BLU		Tube, ScrewTop, 1.0 mL 2D, V-Bottom	940	Blue	Bulk, 480/case	Sterile
3740GRE		Tube, ScrewTop, 1.0 mL 2D, V-Bottom	940	Green	Bulk, 480/case	Sterile
3740WHI		Tube, ScrewTop, 1.0 mL 2D, V-Bottom	940	White	Bulk, 480/case	Sterile
3740PUR		Tube, ScrewTop, 1.0 mL 2D, V-Bottom	940	Purple	Bulk, 480/case	Sterile

Sterile ScrewTop Tube Caps

Cat. No.	Description	Cap Color	Qty/Case	Cat. No.	Description	Cap Color	Qty/Case
4906	Tray, ScrewTop Cap, Empty		5 trays	4470	Caps, ScrewTop Tube	Colorless	Bulk, 500
4477	Tray, ScrewTop Cap	Coloreless	5 trays of 96 caps	4470RED	Caps, ScrewTop Tube	Red	Bulk, 500
4477RED	Tray, ScrewTop Cap	Red	5 trays of 96 caps	4470YEL	Caps, ScrewTop Tube	Yellow	Bulk, 500
4477YEL	Tray, ScrewTop Cap	Yellow	5 trays of 96 caps	4470BLU	Caps, ScrewTop Tube	Blue	Bulk, 500
4477BLU	Tray, ScrewTop Cap	Blue	5 trays of 96 caps	4470GRE	Caps, ScrewTop Tube	Green	Bulk, 500
4477GRE	Tray, ScrewTop Cap	Green	5 trays of 96 caps	4470WHI	Caps, ScrewTop Tube	White	Bulk, 500
4477WHI	Tray, ScrewTop Cap	White	5 trays of 96 caps	4470PUR	Caps, ScrewTop Tube	Purple	Bulk, 500
4477PUR	Tray, ScrewTop Cap	Purple	5 trays of 96 caps				

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Taiwan + 886-2-87516655; India: +91-22-6680-3000 **Europe:** Austria: +43-1-801-40-0; Belgium: +32-2-482-30-30;
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Iškarpa iš gamintojo puslapio

Finnpipette™ F2 Variable Volume Pipettes (thermofisher.com)

Thermo Scientific™

Finnpipette™ F2 Variable Volume Pipettes

Catalog number: 4642010

Related applications: Pipettes & Pipette Tips

Technical SupportCustomer Service

Meet the challenges of highly demanding applications where robustness and durability are essential with the sleek, rugged design of Thermo Scientific™ Finnpipette™ F2 Variable Volume Pipettes. Built with tough PVDF components that stand up to harsh chemicals and the damaging effects of UV light, these variable volume pipettes are fully autoclavable without disassembling. They feature a wide selection of expressly designed tips for optimal performance, precision and accuracy.

Product Overview
Videos
Documents

Catalog Number	Volume (Metric)	Compatible Tips	4.13 pipečių spalvinis kodavimas Color	Increments
4642010 4.2. pipetė 1	0.2 to 2 µL	Finntip 10 Micro, Filter 10 Micro, Flex 10, Flex Filter 10	Pink	0.002µL
4642020	0.5 to 5 µL	Finntip 10 Micro, Filter 10 Micro, Flex 10, Flex Filter 10	Pink	0.01µL

Catalog Number	Volume (Metric)	Compatible Tips	Color	Increments
4642030	1 to 10 µL	Finntip 10 Micro, Filter 10 Micro, Flex 10, Flex Filter 10	Pink	0.02µL
4642040	1 to 10 µL	Finntip 250, Filter 10, Flex 200, Flex Filter 30, 200 Ext, Wide 250	Yellow	0.02µL
4642050 4.3. Pipetė 2	2 to 20 µL	Finntip 50 Micro, Filter 50 Micro	Turquoise Button	0.02µL
4642060	2 to 20 µL	Finntip 250, Filter 20, Flex 200, Flex Filter 30, 200 Ext, Wide 250	Yellow	0.02µL
4642070	10 to 100 µL	Finntip 250, Filter 100, Flex 200, Flex Filter 100, 200 Ext, Filter 100 Ext, Wide 250	Yellow	0.2µL
4642080 4.4. Pipetė 3	20 to 200 µL	Finntip 250, Filter 200, Flex 200, Flex Filter 200, 200 Ext, Filter 200 Ext, Wide 250	Yellow	0.2µL

Catalog Number	Volume (Metric)	Compatible Tips	Color	Increments
4642090 4.5 Pipetė 4	100 to 1000 µL	Finntip 1000, Filter 1000, Flex Filter 1000, 1000 Ext, Filter 1000 Ext, Wide 1000	Blue	1µL
4642100 4.6 pipetė 5	0.5 to 5 mL	Finntip 5mL, Filter 5mL	Green	0.01mL
4642110 4.7. pipetė 6	1 to 10 mL	Finntip 10mL, Filter 10mL, Flex 10mL, Flex Filter 10mL Ext	Red	0.02mL
4642120	5 to 50 µL	Finntip 50 Micro, Filter 50 Micro	Turquoise Button	0.1µL
4642130	5 to 50 µL	Finntip 250, Filter 100, Flex 200, Flex Filter 100, 200 Ext, Filter 100 Ext, Wide 250	Yellow	0.1µL

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For decades, Thermo Scientific Finnpipette pipetting systems have delivered unmatched productivity and ergonomics across thousands of labs and applications worldwide.

Finnpipette F2: Proven reliable for long-term intensive use

Rugged and Durable

Finnpipette F2 contains tough PVDF components that stand up to harsh chemicals and the damaging effects of UV light. Its rugged design withstands physical use without damage.

Fully Autoclavable
Decontamination of the Finnpipette F2 is simple as there is no need to disassemble the F2 for autoclaving, minimizing disruption and downtime.

4.12 Autoklavavimas

Maintenance is Easy
Simply detach the tip cone for efficient daily maintenance or decontamination when not using an autoclave.

Super Blow-out
150% increase in air boost to ensure efficient delivery of micro-volumes and prevent capillary action in 50µL models and below.

Wide Selection of Finntip Pipette Tips
Finntips are designed and manufactured expressly for Finnpipette models, enabling optimal performance, precision and accuracy.

5 Year Warranty
With convenient online registration, and may vary by country.

Iškarpa iš: Finnpipette™ F2 Multichannel Pipettes (thermofisher.com)

Thermo Scientific™

Finnpipette™ F2 Multichannel Pipettes

Catalog number: 4662000

Related applications: **Pipettes & Pipette Tips**
SARS-CoV-2 Pathogen Research Solutions
Technical SupportCustomer Service

Use the Thermo Scientific™ Finnpipette™ F2 Multichannel Pipette for highly demanding applications where robustness and durability are essential. With a sleek, rugged design, this pipette is built with PVDF components that stand up to harsh chemicals and the damaging effects of UV light. Fully autoclavable and available in 8-, 12- and 16-channel models with a selection of volume ranges. In the low volume models, the super blow-out function ensures accurate dispensing for even the lowest volumes.

4.12 Autoklavavimas

Product Overview
Videos
Documents

Catalog Number	Specifications	Number of Channels	Volume (Metric)	Compatible Tips
4662000	Full specifications	8	1 to 10 µL	Finntip 10 Micro, Filter 10 Micro, Flex 10, Flex Filter 10
4662010 Pipetė 7	Full specifications	8	5 to 50 µL	Finntip 250, Filter 100, Flex 200, Flex Filter 100, 200 Ext, Filter 100 Ext

Catalog Number	Specifications	Number of Channels	Volume (Metric)	Compatible Tips
Compatible Tips	Finntip 250, Filter 100, Flex 200, Flex Filter 100, 200 Ext, Filter 100 Ext			
Description	Finnpipette™ F2			
Autoclavable	Autoclavable			
Color	Yellow			
Number of Channels	8			

Catalog Number	Specifications	Number of Channels	Volume (Metric)	Compatible Tips
Product Line	Finnpipette™ F2			
Type	Pipette			
Volume (Metric)	5 to 50 µL			
Increments	0.02µL			
Color Code	Yellow			

Catalog Number	Specifications	Number of Channels	Volume (Metric)	Compatible Tips
Unit Size	Each			
4662020	Full specifications	8	10 to 100 µL	Finntip 250, Filter 100, Flex 200, Flex Filter 100, 200 Ext, Filter 100 Ext, 250 Wide
4662030 Pipetė 8	Full specifications	8	30 to 300 µL	Finntip 300, Filter 300, Flex 300, Flex Filter 300
Compatible Tips	Finntip 300, Filter 300, Flex 300, Flex Filter 300			
Description	Finnpipette™ F2			

Catalog Number	Specifications	Number of Channels	Volume (Metric)	Compatible Tips
Autoclavable	Autoclavable			
Color	Orange			
Number of Channels	8			
Product Line	Finnpipette™ F2			
Type	Pipette			

Catalog Number	Specifications	Number of Channels	Volume (Metric)	Compatible Tips
Volume (Metric)	30 to 300 µL			
Increments	1µL			
Color Code	Orange			
Unit Size	Each			
4662040	Full specifications	12	1 to 10 µL	Finntip 10 Micro, Filter 10 Micro, Flex 10, Flex Filter 10

Catalog Number	Specifications	Number of Channels	Volume (Metric)	Compatible Tips
4662050	Full specifications	12	5 to 50 µL	Finntip 250, Filter 100, Flex 200, Flex Filter 100, 200 Ext, Filter 100 Ext
4662060	Full specifications	12	10 to 100 µL	Finntip 250, Filter 100, Flex 200, Flex Filter 100, 200 Ext, Filter 100 Ext, 250 Wide
4662070	Full specifications	12	30 to 300 µL	Finntip 300, Filter 300, Flex 300, Flex Filter 300
4662080	Full specifications	16	1 to 10 µL	Finntip 20 Micro, Filter 20 Micro
4662090	Full specifications	16	5 to 50 µL	Finntip 50 Micro, Filter 50 Micro

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For decades, Thermo Scientific Finnpipette pipetting systems have delivered unmatched productivity and ergonomics across thousands of labs and applications worldwide.

Finnpipette F2: Proven reliable for long-term intensive use

Rugged and Durable
Finnpipette F2 contains tough PVDF components that stand up to harsh chemicals and the damaging effects of UV light. Its rugged design withstands physical use without damage.

4.11 Medžiagiškumas

Fully Autoclavable
Decontamination of the Finnpipette F2 is simple as there is no need to disassemble the F2 for autoclaving, minimizing disruption and downtime.

Maintenance is Easy
Simply detach the tip cone for efficient daily maintenance or decontamination when not using an autoclave.

Super Blow-out
150% increase in air boost to ensure efficient delivery of micro-volumes and prevent capillary action in 50µL models and below.

Wide Selection of Finntip Pipette Tips
Finntips are designed and manufactured expressly for Finnpipette models, enabling optimal performance, precision and accuracy.

User Manual

Finnpipette® F2
Single Channel
Variable & Fixed Volume
Multichannel

Instructions for Use
Bedienungsanleitung
Guide d´utilisation
Instruccions de uso
取扱説明書

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This product complies with the European Union Directive 98/79/EC, and it is marked with CE-symbol. If the pipette is used according to this directive, the user shall read the additional information at **www.thermoscientific.com/finnpipette** or contact the manufacturer.

Product specifications are subject to change without prior notice. Finnpipette® and Finntip® are registered trademarks of Thermo Fisher Scientific Oy.

Dieses Produkt entspricht der Richtlinie 98/79/EG der Europäischen Union und ist mit dem CE-Symbol gekennzeichnet. Wird die Pipette entsprechend dieser Richtlinie verwendet, muss der Anwender die zusätzlichen Informationen auf **www.thermoscientific.com/finnpipette** lesen oder den Hersteller kontaktieren.

Wir behalten uns das Recht auf unangekündigte Änderungen der Produktspezifikationen vor. Finnpipette® und Finntip® sind eingetragene Warenzeichen der Fa. Thermo Fisher Scientific Oy.

Ce produit est conforme à la directive de l'Union européenne 98/79/CE et porte le marquage CE. Si la pipette est utilisée selon cette directive, l'utilisateur est tenu de contacter le fabricant ou de lire les informations supplémentaires données sur **www.thermoscientific.com/finnpipette**.

Les spécifications du produit sont sujettes à modification sans avis préalable. Finnpipette® et Finntip® sont des marques déposées de Thermo Fisher Scientific Oy.

Este producto cumple la Directiva de la Unión Europea 98/79/CE y presenta el símbolo CE. Si la pipeta se usa de acuerdo con esta Directiva, el usuario debe leer la información adicional presente en **www.thermoscientific.com/finnpipette** o ponerse en contacto con el fabricante.

Las especificaciones del producto pueden cambiar sin previo aviso. Finnpipette® y Finntip® son marcas registradas de Thermo Fisher Scientific Oy.

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Product description

The Finnpipette F2 is a continuously adjustable, general purpose micropipette for sampling and dispensing accurate liquid volumes.
It operates on an air displacement principle (i.e. an air interface) and uses detachable, disposable tips.
The adjusted delivery volume is displayed digitally on a readout window in the handle.
The thirteen different models of Finnpipette F2 pipettes cover a volume range from 0,2 µl to 10 ml.

Order No.	Volume Range	Finntip
4642010	0,2 µl to 2 µl	**Flex 10**, 10, 20, 50
4642020	0,5 µl to 5 µl	**Flex 10**, 10, 20, 50
4642030	1 µl to 10 µl	**Flex 10**, 10, 20, 50
4642040	1 µl to 10 µl	**Flex 200**, 250 Univ., 200 Ext, 300, Flex 300
4642050	2 µl to 20 µl	**20**, 50
4642060	2 µl to 20 µl	**Flex 200**, 250 Univ., 200 Ext, 300, Flex 300
4642120	5 µl to 50 µl	**50**
4642130	5 µl to 50 µl	**Flex 200**, 250 Univ., 200 Ext, 300, Flex 300
4642070	10 µl to 100 µl	**Flex 200**, 250 Univ., 200 Ext, 300, Flex 300
4642080	20 µl to 200 µl	**Flex 200**, 250 Univ., 200 Ext, 300, Flex 300
4642090	100 µl to 1000 µl	**Flex 1000**, 1000, 1000 Ext
4642100	0,5 ml to 5 ml	**5 ml**
4642110	1 ml to 10 ml	**10 ml**, Flex 10 ml Ext

The fifteen different models of Finnpipette F2 Fixed Volume pipettes cover a volume range from 1 µl to 10 ml.

Order No.	Volume Range	Finntip
4652000	1 µl	**Flex 10**, 10, 20, 50
4652010	5 µl	**Flex 10**, 10, 20, 50
4652020	10 µl	**Flex 200**, 250 Univ., 200 Ext, 300, Flex 300
4652130	20 µl	**Flex 200**, 250 Univ., 200 Ext, 300, Flex 300
4652030	25 µl	**Flex 200**, 250 Univ., 200 Ext, 300, Flex 300
4652040	50 µl	**Flex 200**, 250 Univ., 200 Ext, 300, Flex 300
4652050	100 µl	**Flex 200**, 250 Univ., 200 Ext, 300, Flex 300
4652140	200 µl	**Flex 200**, 250 Univ., 200 Ext, 300, Flex 300
4652060	250 µl	**Flex 1000**, 1000, 1000 Ext
4652070	500 µl	**Flex 1000**, 1000, 1000 Ext
4652080	1000 µl	**Flex 1000**, 1000, 1000 Ext
4652090	2000 µl	**5 ml**
4652100	3000 µl	**5 ml**
4652110	5000 µl	**5 ml**
4652120	10000 µl	**10 ml**, Flex 10 ml Ext

The ten different models of Finnpipette F2 Multichannel pipettes cover a volume range from 1 µl to 300 µl.

Order No.	Channel	Volume Range	Finntip
4662000	8	1 µl to 10 µl	**Flex 10**, 10, 20, 50
4662010	8	5 µl to 50 µl	**Flex 200**, 250 Univ., 200 Ext, 300, Flex 300
4662020	8	10 µl to 100 µl	**Flex 200**, 250 Univ., 200 Ext, 300, Flex 300
4662030	8	30 µl to 300 µl	**Flex 300**, 300
4662040	12	1 µl to 10 µl	**Flex 10**, 10, 20, 50
4662050	12	5 µl to 50 µl	**Flex 200**, 250 Univ., 200 Ext, 300, Flex 300
4662060	12	10 µl to 100 µl	**Flex 200**, 250 Univ., 200 Ext, 300, Flex 300
4662070	12	30 µl to 300 µl	**Flex 300**, 300
4662080	16	1 µl to 10 µl	**20**, 50
4662090	16	5 µl to 50 µl	**50**

Digital display

The adjusted delivery volume is clearly indicated in the large digital display on the handle.

Raw materials

The Finnpipette F2 is made of mechanically durable and chemically resistant materials.

Description of tips

Finntips are recommended for use with the Finnpipette F2.
They are made of virgin natural colour polypropylene, generally regarded as the only contamination free material suitable for tips. Finntips are also autoclavable (121°C).

Pipette operation

Setting the delivery volume

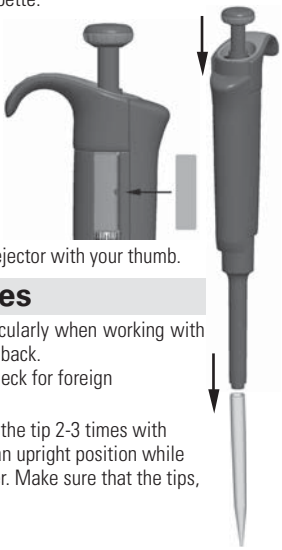
1. Set the delivery volume using the push button on the top of the pipette. To increase the delivery volume, turn the push button counterclockwise. To decrease the delivery volume, turn it clockwise.
2. Make sure that the desired delivery volume clicks into place.
3. Do not set volumes outside the pipette´s specified volume range. Using excessive force to turn the push button outside the range may jam the mechanism and eventually damage the pipette.

Safety Label

You can mark the pipette application, your initials, the calibration date, etc. on the safety label. Remove the old label with a sharp needle. Mark the new label with a pencil and slide the label back in place.

Tip ejection

To help eliminate the risk of contamination, each pipette is fitted with a tip ejector system. To release the tip, point the pipette at suitable waste receptacle and press the tip ejector with your thumb.



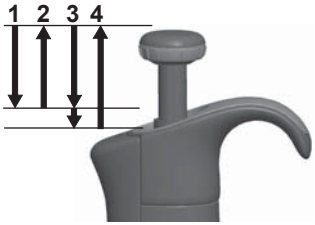
Pipetting techniques

Push and release the push button slowly at all times particularly when working with high viscosity liquids. Never allow the push button to snap back.
Make sure that the tip is firmly attached to the tip cone. Check for foreign particles in the tip.

Before you begin your actual pipetting work, fill and empty the tip 2-3 times with the solution that you will be pipetting. Hold the pipette in an upright position while aspirating liquid. The grippy should rest on your index finger. Make sure that the tips, pipette and solution are at the same temperature.

Forward technique

Fill a clean reagent reservoir with the liquid to be dispensed.

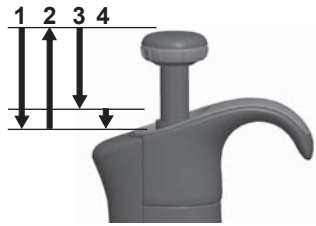


1 Depress the push button to the first stop.
2. Dip the tip under the surface of the liquid in the reservoir to a depth of about 1 cm and slowly release the push button. Withdraw the tip from the liquid touching it against the edge of the reservoir to remove excess liquid.
3. Deliver the liquid by gently depressing the push button to the first stop. After a delay of about one second, continue to depress the push button all the way to the second stop. This action will empty the tip.
4. Release the push button to the ready position. If necessary, change the tip and continue pipetting.

Reverse technique

The reverse technique is suitable for dispensing liquids that have a high viscosity or a tendency to foam easily. The technique is also recommended for dispensing very small volumes. Fill a clean reagent reservoir with the liquid to be dispensed.

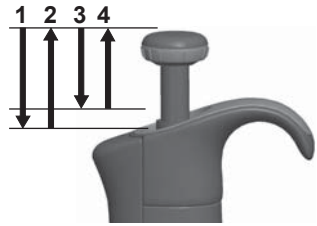
1. Depress the push button all the way to the second stop.
2. Dip the tip under the surface of the liquid in the reservoir to a depth of about 1 cm, and slowly release the push button. This action will fill the tip. Withdraw the tip from the liquid touching it against the edge of the reservoir to remove excess liquid.
3. Deliver the preset volume by gently depressing the push button to the first stop. Hold the push button at the first stop. Some liquid will remain in the tip and this should not be included in the delivery.
4. The remaining liquid should either be discarded with the tip or pipetted back into the container.



Repetitive technique

The repetitive technique offers a rapid and simple procedure for repeated delivery of the same volume. Fill a clean reagent reservoir with the liquid to be dispensed.

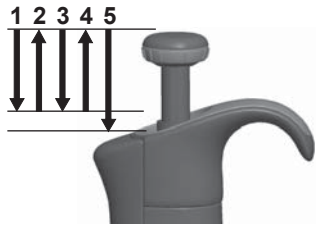
1. Depress the push button all the way to the second stop.
2. Dip the tip under the surface of the liquid in the reservoir to a depth of about 1 cm, and slowly re lease the push button. This action will fill the tip. Withdraw the tipfrom the liquid touching against the edge of the reservoir to remove excess liquid.
3. Deliver the preset volume by gently depressing the push button to the first stop. Hold the push button at the first stop. Some liquid will remain in the tip and this should not be included in the delivery.
4. Continue pipetting by repeating steps 3 and 4.



Pipetting of heterogeneous samples

(deproteinization in blood glucose determination, for example)
Use steps 1 and 2 of the forward technique to fill the tip with blood.
Wipe the tip carefully with a dry clean tissue.

1. Immerse the tip into the reagent and depress the push button to the first stop, making sure the tip is well below the surface.
2. Release the push button slowly to the ready position.
   This will fill the tip. Keep the tip in the solution.
3. Depress the push button to the first stop and release slowly. Keep repeating this procedure until the interior wall of the tip is clear.
4. Finally, depress the push button all the way to the second stop to completely empty the tip.



Calibration and adjustment

All Finnpipettes are factory calibrated and adjusted to give the volumes as specified with distilled or deionized water using the forward pipetting technique. It should be noted that the use of other pipetting techniques may affect the calibration results. The pipettes are constructed to permit re-adjustment for other pipetting techniques or liquids of different temperature and viscosity.

Device requirements and test conditions

An analytical balance must be used. The scale graduation value of the balance should be chosen according to the selected test volume of the pipette:

Volume range	**readable graduation**
under 10 µl	0.00 1 mg
10-100 µl	0.01 mg
above 100 µl	0.1 mg

Test liquid: Water, distilled or deionized, "grade 3" water conforming ISO 3696. Tests are done in a draft-free room at a constant (±0.5°C) temperature of water, pipette and air between 15°C to 30°C. The relative humidity must be above 50%. Especially with volumes under 50 µl the air humidity should be as high as possible to reduce the effect of evaporation loss. Special accessories, such as the evaporation trap, are recommended.

Procedure to check calibration

The pipette is checked with the maximum volume (nominal volume) and with the minimum volume. A new tip is first pre-wetted 3-5 times and a series of ten pipettings is done with both volumes. A pipette is always adjusted for delivery (Ex) of the selected volume. Use of forward pipetting technique is recommended. The maximum permissible errors are designed for forward method.

Procedure:

1. Do 10 pipettings with the minimum volume.
2. Do 10 pipettings with the maximum volume.
3. Calculate the inaccuracy (A) and imprecision (cv) of both series.
4. Compare the results to the limits in the Table 1.

If the calculated results are within the selected limits, the adjustment of the pipette is correct.

TABLE 1: Maximum permissible errors according ISO8655

Range	***Volume***	***Inaccuracy***		***Imprecision***	
	µl	***µl***	***%***	***s.d. µl***	***cv%***
0,2-2 µl	*2*	*±0.080*	*±4*	*0.040*	*2.0*
	0.2	*±0.080*	*±40*	*0.040*	*20.0*
0,5-5 µl	*5*	*±0.125*	*±2.5*	*0.075*	*1.5*
	0.5	*±0.125*	*±25*	*0.075*	*15*
1-10 µl	*10*	*±0.120*	*±1.2*	*0.080*	*0.8*
	1	*±0.120*	*±12*	*0.080*	*8.0*
2-20 µl	*20*	*±0.20*	*±1.0*	*0.10*	*0.5*
	2	*±0.20*	*±10.0*	*0.10*	*5.0*
5-50 µl	*50*	*±0.50*	*±1.0*	*0.20*	*0.4*
	5	*±0.50*	*±10*	*0.20*	*4.0*
10-100 µl	*100*	*±0.80*	*±0.8*	*0.30*	*0.3*
	10	*±0.80*	*±8.0*	*0.30*	*3.0*
20-200 µl	*200*	*±1.60*	*±0.8*	*0.60*	*0.3*
	20	*±1.60*	*±8.0*	*0.60*	*3.0*
100-1000 µl	*1000*	*±8.0*	*±0.8*	*3.0*	*0.3*
	100	*±8.0*	*±8.0*	*3.0*	*3.0*
0,5-5 ml	*5000*	*±40.0*	*±0.8*	*15.0*	*0.3*
	500	*±40.0*	*±8.0*	*15.0*	*3.0*
1-10 ml	*10000*	*±60.0*	*±0.6*	*30.0*	*0.3*
	1000	*±60.0*	*±6.0*	*30.0*	*3.0*

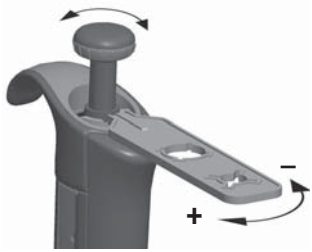
Fixed Volume	Inaccuracy		Imprecision	
µl	µl	%	s.d.µl	cv%
1	±0.050	±5.00	0.050	5.00
5	±0.125	±2.50	0.075	1.50
10	±0.120	±1.20	0.080	0.80
20	±0.20	±1.00	0.10	0.50
25	±0.50	±2.00	0.20	0.80
50	±0.50	±1.00	0.20	0.40
100	±0.80	±0.80	0.30	0.30
200	±1.60	±0.80	0.60	0.30
250	±4.00	±1.60	1.50	0.60
500	±4.00	±0.80	1.50	0.30
1000	±8.00	±0.80	3.00	0.30
2000	±16.0	±0.80	6.00	0.30
3000	±40.0	±1.33	15.00	0.50
5000	±40.0	±0.80	15.00	0.30
10000	±60.0	±0.60	30.00	0.30

Range	Channel	Volume	Inaccuracy		Imprecision	
		µl	µl	%	s.d.µl	cv%
1-10 µl	8, 12, 16	10	±0.24	±2.4	0.16	1.6
		1	±0.24	±24	0.16	16
5-50 µl	8, 12, 16	50	±1.0	±2.0	0.4	0.8
		5	±1.0	±20	0.4	8.0
10-100 µl	8, 12	100	±0.80	±0.8	0.30	0.3
		10	±0.80	±8.0	0.30	3.0
30-300 µl	8, 12	300	±8.0	±2.7	3.0	1.0
		30	±8.0	±26.7	3.0	10.0

Adjustment

Adjustment is done only for one volume. The recommended adjustment volume is the minimum volume or 10% of the maximum volume.

1. Place the service tool into the openings of the calibration nut at the top of the handle.
2. Turn the service tool clockwise to increase, or counterclockwise to decrease the volume.
3. After adjustment check the calibration according to the instructions above.



Formulas for calculating results

Conversion of mass to volume

V = (w + e) x Z

V = volume (µl)
w = weight (mg)
e = evaporation loss (mg)
Z = conversion factor for µl/mg conversion

Evaporation loss can be significant with low volumes. To determine mass loss, dispense water to the weighing vessel, note the reading and start a stopwatch. See how much the reading decreases during 30 seconds (e.g. 6 mg = 0.2 mg/s).
Compare this to the pipetting time from taring to reading. Typically pipetting time might be 10 seconds and the mass loss is 2 mg (10 s x 0.2 mg/s) in this example. If an evaporation trap or lid on the vessel is used the correction of evaporation is usually unnecessary.
The factor Z is for converting the weight of the water to volume at test temperature and pressure. A typical value is 1.0032 µl/mg at 22°C and 95 kPa. See the conversion table on page 48.

Inaccuracy (systematic error)

Inaccuracy is the difference between the dispensed volume and the selected volume of a pipette.

$A = \bar{V} - V_0$

$\underline{A}$ = inaccuracy
$\bar{V}$ = mean volume
V_0 = nominal volume

Inaccuracy can be expressed as a relative value: **$A\% = 100\% \times A / V_0$**

Imprecision (random error)

Imprecision refers to the repeatability of the pipettings. It is expressed as standard deviation (s) or coefficient of variation (cv)

$$S = \sqrt{\frac{\sum_{i=1}^{n} (V_i - \bar{V})^2}{n-1}}$$

s = standards deviation
$\bar{v}$ = mean volume
n = number of measurements

Standard deviation can be expressed as a relative value (CV) **CV = 100% x S / $\bar{V}$**

Maintenance

When the Finnpipette F2 is not in use, make sure it is stored in an upright position. We recommend a Finnpipette stand for this purpose.

The part # refer to exploded views beginning at page 49.

Short-term service

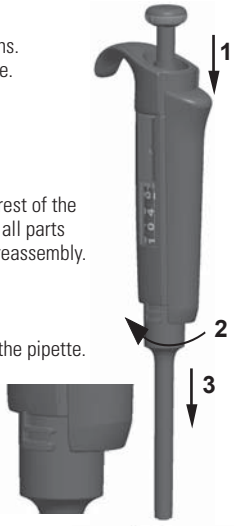
The pipette should be checked at the beginning of each day for dust and dirt on the outside surfaces of the pipette.
Particular attention should be paid to the tip cone. No other solvents except 70 % ethanol should be used to clean the pipette.

Long-term service, single channel pipettes

If the pipette is used daily it should be checked every three months.
The servicing procedure starts with the disassembly of the pipette.

1-1000 µl pipettes

1. Press the tip ejector.
2. Rotate the tip ejector 11 counterclockwise and pull it out.
3. Turn out the tip cone counterclockwise with the service tool.
4. Pull out the piston and other parts. Push out with piston the rest of the piston assembly. Then turn the tip cone upside down and tap all parts from tip cone. Remember keep all parts in order on table for reassembly.
5. Clean the piston, the piston spring and the O-rings with a dry napless cloth.
6. Check the tip cone for foreign particles.
7. Grease the cleaned parts with the lubricant that comes with the pipette.
8. Reassemble the pipette components.



0.2-2µl, 0.5-5µl & 1-10 µl: First, slide spring 22, o-ring support 23 and o-ring 24 on the tube 21. With the 0.2-2µl model insert the tube 27 into the tube 21. Then slide the spring 13, spring support 16 and tubes 17 and 18, bigger o-ring 19 and smaller o-ring 20 back on the piston. Compress the spring with fingers by pressing piston and spring support 16 against each other and slide the tube 21 with rest of the parts on the piston. Hold the spring compressed and carefully slide the entire assembly into the tip cone and release the spring.

2-20 µl & 5-50 µl: Slide the spring 13, spring support 16 and tubes 17 and 18, bigger o-ring 19 and smaller o-ring 20 back on the piston. Compress the spring with fingers by pressing piston and spring support 16 against each other and slide the bigger o-ring 19, smaller o-ring 20, spring support 21 and the spring 22 (smaller diameter against spring support 21) on the piston. Hold the spring compressed and carefully slide the entire assembly into the tip cone and release the spring.

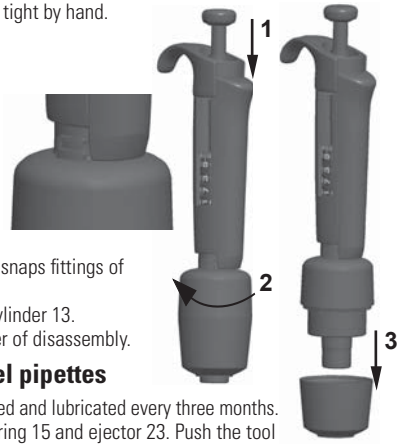
10-100 µl & 20-200 µl: Slide the spring 13, spring support 16 and o-ring 17 back on the piston. Slide the entire assembly into the tip cone.

100-1000µl: Put the o-ring 17 and support ring 16 to the tip cone. Slide the spring 13 on the piston and slide the entire assembly into thetip cone.

9. **All:** Put the spring 15 and support 14 on top of the tip cone and carefully insert the tip cone assembly to the handle and turn it tight by hand.
10. Reassemble the tip ejector.

0.5-5ml & 1-10 ml pipettes

1. Press the tip ejector.
2. Rotate the tip ejector 10 counterclockwise to open it.
3. Disassemble the lower part of the tip ejector 14 (snap fitting).
4. Turn the cylinder 13 counterclockwise and pull out the tip cone assembly.
5. Remove the cylinder 13 by pressing the snaps fittings of the cylinder.
5. Clean and regrease the O-ring 12 and cylinder 13.
7. Assemble the parts in the opposite order of disassembly.



Long-term service, multichannel pipettes

If the pipette is used daily it should be checked and lubricated every three months.

1. Place the service tool head#1 between ring 15 and ejector 23. Push the tool until the partssnap from each other.
2. Check that the ejector lever is in up position and pull down the tip ejector part of the module. Place the service tool head#2 in the hole of adapter tube 46.
3. Open the upper end of the tip ejector slightly and remove the tip ejector.
4. Screw out the module of the handle.
5. Pull out the module spring 19 and clip 22.
6. Press the spring 13 and remove the locking pieces 12 from the groove. Remove the spring 13.
7. Take off the locking claws 44 and 45 and pull out the adapter tube and tube 43.
8. Use a screwdriver to remove the four screws in the module cover and lift off the cover.
9. Remove the piston bar and clean the pistons and tip cones with a dry nap–free cloth.
10. If needed, service the tip cones:

16-channel 1-10µl: The tip cones cannot be serviced, please replace if necessary.

30-300 µl, 10-100µl & 5-50 µl: Open the tip cone by carefully releasing the cover ring from its snap joint with the screwdriver. Remove all the parts from the tip cone. Clean all the parts. If needed, replace the o-rings. Take one piston. Slide the spring 33, cover ring 32 (larger hole), spring 34, support ring 35, (o–ring 37 bigger 5-50µl/10-100µl) and o–ring 36 (smaller) onto the piston. Grease the o–ring with the lubricant provided in the pipette package. Slide all the parts into the tip cone and close the snap joint of the cover ring.

1–10 µl: Open the tip cone by carefully releasing the cover ring from its snap joint with the screwdriver. Remove all the parts from the tip cone. Clean all the parts. If needed, replace the o-rings. Take one piston. Slide spring 33, cover ring 32 (larger hole), support 35, o–ring 36 (bigger), o–ring 37 (smaller) and o–ring support 38 onto the piston. Then slide spring 39, spring support 40 (sharp edges first) and o–ring 41 onto the o–ring sup port 38. Grease the o–rings with the lubricant provided in the pipette package. Slide all the parts into the tip cone and close the snap joint of the cover ring.

11. Install the piston bar with pistons and tip cones in the cover. Place aligning studs to the same side when assembling the module. Close the cover with the four screws. Insert the clip 22.
12. Place the adapter tube and tube 43 on the neck of the module and insert the locking claws 44 and 45. Insert the module spring 19.
13. Insert spring 13 and locking pieces 12 to the piston rod 16.
14. Place the tip ejector on the module. Push the spring 19 inside tip ejector parts and close the upper end of the ejector and keep closed with fingers.
15. Screw the module in the handle and tighten with service tool head#2.
16. Push the tip ejector lever down, until you hear a “click”.

Service Instructions for Multichannel Pipette Tip Cones

To ensure even performance between all channels in a multichannel pipette, all tip cones have to be changed at the same time, if any of them needs to be changed. Don't mix tip cones of different packages, because one bag contains a matched set of tip cones. Place aligning studs to the same side when assembling the module. See picture on page 54.

Sterilization 4.12 Autoklavavimas

The entire pipette can be sterilized by autoclaving it at 121°C (252°F) (2 ata) (minimum 20 minutes). No special preparations are needed for autoclaving. You can use steam sterilization bags if needed.
After autoclaving the pipette must be cooled to room temperature for at least two hours. Before pipetting, make sure that the pipette is dry. We recommend that you check the calibration after every sterilization cycle to achieve the best possible accuracy.

Trouble shooting

The table below lists possible problems and their solutions.

Defect	***Possible reason***	***Solution***
Leakage	*Tip incorrectly attached*	*Attach firmly.*
	Foreign particlesbetween tip and tip cone	*Clean tip cones attach new tips.*
	Foreign particles between the piston, the O-ring and the cylinder	*Clean and grease O-ring and cylinder.*
	Insufficient amount of grease on cylinder and O-ring	*Grease accordingly.*
	O-ring damaged	*Change the O-ring.*
Inaccurate dispensing	*Incorrect operation*	*Follow instructions carefully.*
	Tip incorrectly attached	*Attach firmly.*
	Calibration altered: caused by misuse, for example	*Recalibrate according to instructions.*
	Tip cone (Single channel) or module (Multichannel) loose	*Tighten the tip cone or module with the service tool.*
Piston jammed	*Pipette has been unused for a long period Highly volatile solvent is pipetted repeatedly cleaning the grease*	*Remove tip if attached. Press the plunger to the second stop and release several times to re-spread the grease.*
Inaccurate dispensing with certain liquids	*Unsuitable calibration High viscosity liquids may require recalibration*	*Recalibrate with the liquids in question.*

Package

The Finnpipette F2 is shipped in a specially designed package containing the following items:

1. The Finnpipette
2. Service tool
3. Multichannel service tool
4. Finntip sample
5. Tube of grease **(Order No. 2203130)**
6. Instruction manual
7. Calibration certificate
8. Shelf hanger **(Order No. 2206040)**
9. Two stickers

CAUTION!

The Finnpipette is designed to allow easy in-lab service. If you would prefer to have us or your local representative service your pipette, please make sure that the pipette has been decontaminated before you send it to us.
Please note that the postal authorities in your country may prohibit or restrict the shipment of contaminated material by mail.

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4.10 Pipečių stovai

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