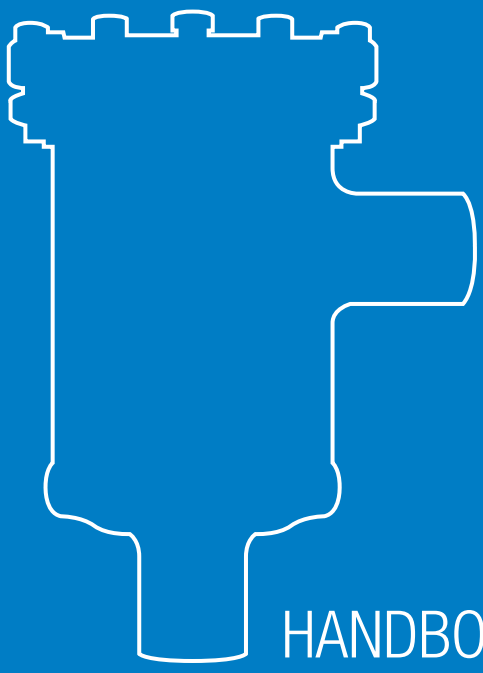


HANDBOOK

REFRIGERATING SYSTEM PROTECTORS

Castel®
Italian technology

Ed. 2017

CHAPTER 1
LIQUID INDICATORS & MOISTURE/LIQUID INDICATORS
CERTIFIED BY UNDERWRITERS LABORATORIES INC.
FOR REFRIGERATION PLANTS THAT USE HCFC, HFC, HC OR HFO REFRIGERANTS

APPLICATIONS

The liquid indicators and moisture/liquid indicators illustrated in this chapter ensure fast, safe inspection of the refrigerant fluid conditions in the liquid circuit in terms of its regular flow and the presence of moisture. They are designed for installation on commercial refrigeration systems and on civil and industrial air conditioning plants that use the following refrigerant fluids:

- HCFC (R22)
- HFC (R134a, R404A, R407C, R410A, R507)
- HFO and HFO/HFC mixtures (R1234ze, R448A, R449A, R450A, and R452A)

belonging to Group 2, as defined in Article 13, Chapter 1, Point (b) of Directive 2014/68/EU, with reference to EC Regulation No. 1272/2008.

Furthermore, the indicators of the series 3840 and 3940 can also be installed on systems that use the following refrigeration fluids:

- HFC (R32) and HFO (R1234yf), classified as A2L in the ASHRAE 34-2013 standard
- HC (R290, R600, or R600a), classified as A3 in the ASHRAE 34-2013 standard

belonging to Group 1, as defined in Article 13, Chapter 1, Point (a) of Directive 2014/68/EU, with reference to EC Regulation No. 1272/2008.

For specific applications with refrigerant fluids not listed above, please contact Castel Technical Department.

Note: The indicator series 3680, 3780, and 3781 are excluded from the scope of application of Directive 2014/68/EU as they are piping components.

OPERATION

The moisture/liquid indicators consist of a sensitive ring element that changes colour, from green to yellow, according to the percent moisture in the system.

The moisture content values that correspond to the “green” colour can be considered admissible for the proper operation of the system. When the sensitive element starts to yellow, “Chartreuse green”, the threshold value has been reached and operating conditions could become difficult. When the sensitive element becomes “yellow”, it’s time to replace the filter dryer.

If the charge and operating conditions of the plant are normal, the refrigerant fluid appears perfectly liquid underneath the “lens” of the indicator. The presence of bubbles indicates that the refrigerant fluid is partially evaporating along the liquid line.

CONSTRUCTION

The liquid indicators in series 38 and moisture/liquid indicators in series 39 are manufactured in a sealed hermetic unit to avoid any possible refrigerant leaks. The glass “lens”, with suitable gasket, is housed inside the brass body and is fixed in its seat with an edge calking operation. The main parts of these indicators are made from the following materials:

- Hot forged brass EN 12420 – CW 617N for the body
- Copper tube EN 12735-1 – Cu-DHP for solder connections
- Glass for lens
- PTFE for outlet gaskets

Liquid/moisture indicators series 36 and 37 are manufactured with the glass “lens” directly fused onto a steel metallic ring, with proper surface protection. This metallic ring, screwed on the indicator body, is equipped with a gasket:

- Hydrogenated nitrile butadiene (HNBR) for series 36
- Chloroprene (CR) for series 37

INSTALLATION

At start-up, the colour of the sensitive element may be yellow, due to exposure to air humidity or due to moisture in the circuit. When the moisture of the refrigerant is returned to acceptable levels by the filter drier, the indicator colour turns green again. This is evidence that equilibrium has been re-established. If the yellow colour persists, measures must be taken to eliminate moisture. Only when the sensitive element turns green again, is there evidence that measures adopted were effective. About 12 hours of system operation are required to achieve equilibrium. In any case, the moisture indication is usually read when the plant is in function and the fluid is flowing

Brazing of the indicators with solder connections should be carried out with care, using a low melting point filler material (min. 5% Ag). Avoid direct contact between the torch flame and the indicator body or glass, which could be damaged and compromise the proper functioning of the indicator.

For indicators in series 3680, 3780 and 3781, the ring must be disassembled before brazing. Note: the PS declared in Table 1 for saddle-type indicators in series 3680 and 3780, refers only to the body plus the ring (with its o-ring), which the customer must tighten to the torque indicated on the product instruction handbook. The aforesaid declaration doesn’t cover any possible leakage or malfunctions due to brazing the body on the copper pipe. The customer is totally responsible for the success of this operation.

APPROVALS

The liquid indicators in series 3810, 3840, and 3850 and the moisture/liquid indicators 3910 3940, and 3950 (excluding indicators p/n 3940/X01 and 3940/X02) are approved by the American certification authority, Underwriters Laboratories Inc. These indicators are certified **UL Listed** for the USA with file SA33318, in compliance with American standard UL 207.

TABLE 1: General characteristics of liquid indicators

Catalogue Nr.	Type	Connections					PS [bar]	TS [°C]		TA [°C]		Risk Category according to PED Recast
		SAE Flare	ODS		for pipe							
			Ø [in.]	Ø [mm]	Ø [in.]	Ø [mm]		min	max	min	max	
3810/22	male - male	1/4"	–	–	–	–	45 (1)	– 40	+120	– 40	+50	Art. 4.3
3810/33		3/8"	–	–								
3810/44		1/2"	–	–								
3810/55		5/8"	–	–								
3810/66		3/4"	–	–								
3840/2	brazing	–	1/4"	–								
3840/3		–	3/8"	–								
3840/M10		–	–	10								
3840/M12		–	–	12								
3840/4		–	1/2"	–								
3840/5		–	5/8"	16								
3840/M18		–	–	18								
3840/6		–	3/4"	–								
3840/7		–	7/8"	22								
3840/9		–	1.1/8"	–								
3850/22	male - female	1/4"	–	–								
3850/33		3/8"	–	–								
3850/44		1/2"	–	–								
3850/55		5/8"	–	–								
3850/66		3/4"	–	–								
3680/7	saddle type	-	-	-	7/8"	22	45	-40	+150	-30	50	excluded
3680/9					1.1/8"	28						
3680/11					1.3/8"	35						

(1) : MWP = 680 psi according to UL approval

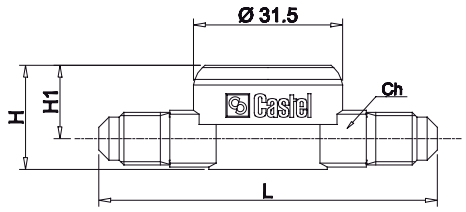
TABLE 2: General characteristics of liquid / moisture indicators

Catalogue Nr.	Type	Connections								PS [bar]	TS [°C]		TA [°C]		Risk Category according to PED Recast
		SAE Flare	ODS		ODM		for pipe				min	max	min	max	
			Ø [in.]	Ø [mm]	Ø [in.]	Ø [mm]	Ø [in.]	Ø [mm]	Hole Ø [mm]						
3910/22	male - male	1/4"	–	–	–	–									
3910/33		3/8"	–	–	–	–									
3910/44		1/2"	–	–	–	–									
3910/55		5/8"	–	–	–	–									
3910/66		3/4"	–	–	–	–									
3940/2	brazing	–	1/4"	–	–	–									
3940/3		–	3/8"	–	–	–									
3940/M10		–	–	10	–	–									
3940/M12		–	–	12	–	–									
3940/4		–	1/2"	–	–	–									
3940/5		–	5/8"	16	–	–									
3940/M18		–	–	18	–	–	–	–	–	45 (1)	– 40	+120	– 40	+50	Art. 4.3
3940/6		–	3/4"	–	–	–									
3940/7		–	7/8"	22	–	–									
3940/9		–	1.1/8"	–	–	–									
3940/X01		–	–	–	–	6									
3940/X02		–	–	–	–	6									
3950/22	male - female	1/4"	–	–	–	–									
3950/33		3/8"	–	–	–	–									
3950/44		1/2"	–	–	–	–									
3950/55		5/8"	–	–	–	–									
3950/66		3/4"	–	–	–	–									
3770/M28	soldering	–	–	–	–	28									Art. 4.3
3770/11		–	–	–	1.3/8"	35									
3770/13		–	–	–	1.5/8"	–									I
3770/M42		–	–	–	–	42	–	–	–						
3771/11			1.3/8"	35	–	–									Art. 4.3
3771/M42			–	42	–	–									I
3771/17			2.1/8"	–	–	–				45	-30	+110	-30	+50	
3780/5	saddle tyoe	–	–	–	–	–	5/8"	16							excluded
3780/M18							–	18							
3780/7							7/8"	22							
3780/9							1.1/8"	28							
3780/11							1.3/8"	35							
3781/M28	level glass						–	–	28						

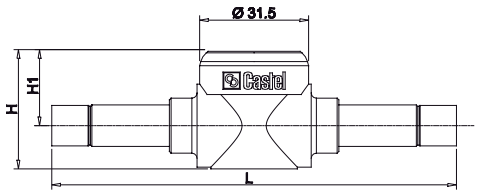
(1) : MWP = 500 psi according to UL approval

TABLE 3: Dimensions and weights						
Catalogue Number		Dimensions [mm]				Weight [g]
Liquid Indicators	Moisture Liquid Indicators	H	H1	L	Ch	
3810/22	3910/22	22	16,5	71,5	12	110
3810/33	3910/33	26,5	17,5	77,5	17	150
3810/44	3910/44	30	18,5	81,5	22	196
3810/55	3910/55	34	21,5	89,5	24	238
3810/66	3910/66	37,5	23,5	90	28	298
3840/2	3940/2	22	15,5	113		116
3840/3	3940/3					
3840/M10	3940/M10					
3840/M12	3940/M12	34	21,5	117		185
3840/4	3940/4					
3840/5	3940/5					
3840/M18	3940/M18			131	–	
3840/6	3940/6	34	21,5			195
3840/7	3940/7	37,5	23,5	151		306
3840/9	3940/9	43,5	26	186		501
–	3940/X01	22	15,5	242		155
	3940/X02	–	15,5	121		122
3850/22	3950/22	26,5	17,5	68	17	140
3850/33	3950/33	30	18,5	74	22	185
3850/44	3950/44	34	21,5	77	24	231
3850/55	3950/55	37,5	23,5	82	28	288
3850/66	3950/66	43,5	26	92	35	517
	3770/M28		38	150		300
	3770/11		41,5	160		349
	3770/13		45	170		516
	3770/M42					
–	3771/11		41,5	160		378
	3771/M42	–	45	170	–	516
	3771/17					550
	3780/5		30			
	3780/M18		31			
3680/7	3780/7		33	–		90
3680/9	3780/9		36			
3680/11	3780/11		39,5			
–	3781/M28	–	–	–	–	107

3810
3910



3840
3940



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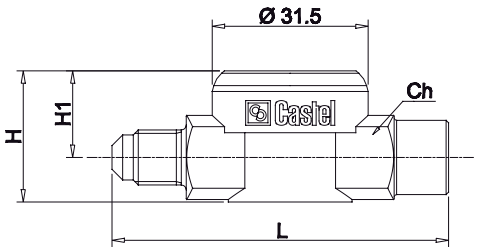
3950



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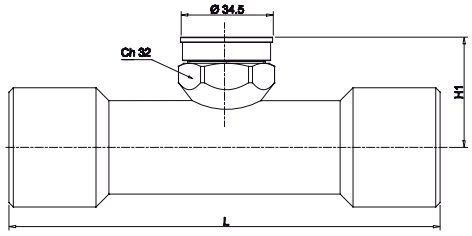

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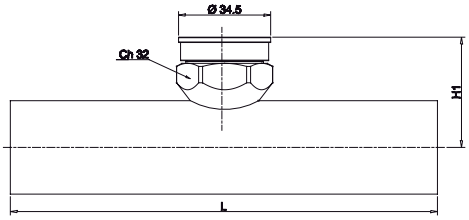
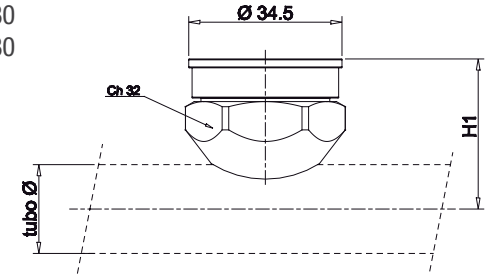


3680
3780



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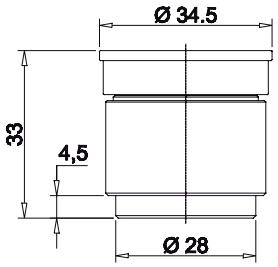
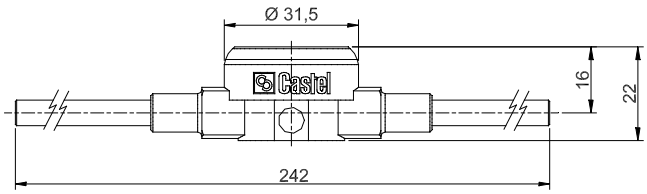
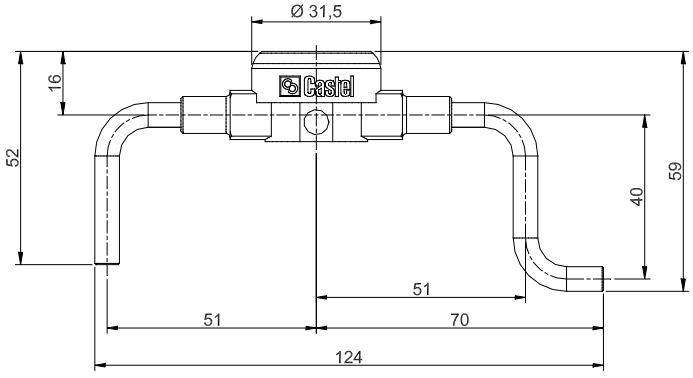


3940/X01



3940/X02



CHAPTER 2
MOISTURE/LIQUID INDICATORS
FOR REFRIGERATION PLANTS THAT USE THE R744 REFRIGERANT

APPLICATIONS

Castel has developed the moisture/liquid indicators, illustrated in this chapter, for all applications that use subcritical or transcritical R744 refrigeration fluid belonging to Group 2, defined in Article 13, Chapter 1, Point (b) of Directive 2014/68/EU, with reference to EC Regulation No. 1272/2008.

The moisture/liquid indicators for plants that operate using refrigerant fluid R744 are the following:

- Indicators in series 3940EL with PS = 60 bar, equipped with copper connections for subcritical plants.
- Indicators in series 3740E with PS = 80 bar, equipped with copper connections for transcritical plants low and medium pressure sides.
- Indicators in series 3747E with PS = 120 bar equipped with reinforced copper connections (K65) for transcritical plants high-pressure side.
- Indicators in series 3748E with PS = 140 bar equipped with stainless steel connections for transcritical plants high-pressure side.

CAUTION!: the indicators in this chapter <u>cannot</u> be used with other refrigerant fluids.

OPERATION

The moisture/liquid indicators consist of a sensitive ring element that changes colour, from green to yellow, according to the percent moisture in the system.

The moisture content values that correspond to the "green" colour can be considered admissible for the proper operation of the system. When the sensitive element starts to yellow, "Chartreuse green", the threshold value has been reached and operating conditions could become difficult. When the sensitive element becomes "yellow", it's time to replace the filter dryer.

CONSTRUCTION

Liquid indicators in series 3940EL are manufactured in a total hermetic construction to avoid any possible leaks. The glass "lens", with suitable gasket, is housed inside the brass body and is fixed in its seat with an edge calking operation. The main parts of these indicators are made from the following materials:

- Hot forged brass EN 12420 – CW 617N for the body
- Copper tube EN 12735-1 – Cu-DHP for solder connections
- Glass for lens
- PTFE for outlet gaskets

Indicators in series 3740E, 3747E, and 3748E are manufactured with the glass "lens" directly fused onto a steel metallic ring, with proper surface protection. This metallic ring, screwed on the indicator body, is equipped with an EPDM (ethylene-propylene) gasket. The main parts of these three series of indicators are manufactured with the following materials:

- Hot forged brass EN 12420 – CW 617N for the body
- Copper pipe EN 12735-1 – Cu-DHP for welded connections in series 3740EL
- Copper pipe EN 12735-1 – CuFe2P (K65) for welded connections in series 3747E
- Stainless steel pipe AISI 304 for welded connections in series 3748E

INSTALLATION

At start-up, the colour of the sensitive element may be yellow, due to exposure to air humidity or due to moisture in the circuit. When the moisture of the refrigerant is returned to acceptable levels by the filter drier, the indicator colour turns green again. This is evidence that equilibrium has been re-established. If the yellow colour persists, measures must be taken to eliminate moisture. Only when the sensitive element turns green again, is there evidence that measures adopted were effective. About 12 hours of system operation are required to achieve equilibrium. In any case, the moisture indication is usually read when the plant is in function and the fluid is flowing.

Copper connections: The brazing of indicators with copper connections should be carried out with care, using a low melting point filler material (min. 5% Ag). It is important to avoid direct contact between the torch flame

TABLE 4: General characteristics of liquid / moisture indicators for R744										
Catalogue Nr.	Type	Connections			PS [bar]	TS [°C]		TA [°C]		Risk Category according to PED Recast
		ODS		ODM		min	max	min	max	
		Ø [in.]	Ø [mm]	Ø [in.]						
3940EL/M6	brazing	–	6	–	60	– 40	+120	– 40	+50	Art. 4.3
3940EL/2		1/4"	–	–						
3940EL/3		3/8"	–	–						
3940EL/M10		–	10	–						
3940EL/M12		–	12	–						
3940EL/4		1/2"	–	–						
3940EL/5		5/8"	16	–						
3940EL/M18		–	18	–						
3940EL/6		3/4"	–	–						
3940EL/7		7/8"	22	–						
3940EL/9		1.1/8"	–	–						
3740E/M6	brazing	–	6	–	80	– 40	+120	– 40	+50	Art. 4.3
3740E/2		1/4"	–	–						
3740E/3		3/8"	–	–						
3740E/M10		–	10	–						
3740E/M12		–	12	–						
3740E/4		1/2"	–	–						
3740E/5		5/8"	16	–						
3740E/M18		–	18	–						
3740E/6		3/4"	–	–						
3740E/7		7/8"	22	–						
3740E/9		1.1/8"	–	–						
3747E/2	brazing	1/4"	–	–	120	– 40	+120	– 40	+50	Art. 4.3
3747E/3		3/8"	–	–						
3747E/4		1/2"	–	–						
3747E/5		5/8"	16	–						
3747E/6		3/4"	–	–						
3747E/7		7/8"	22	–						
3747E/9		1.1/8"	–	–						
3777E/11		1.3/8"	35	–						
3748E/M6	welding	–	–	6	120	– 40	+120	– 40	+50	Art. 4.3
3748E/M10		–	–	10						
3748E/M12		–	–	12						
3748E/M16		–	–	16						
3748E/M18		–	–	18						
3748E/M22		–	–	22						
3748E/M28		–	–	28						

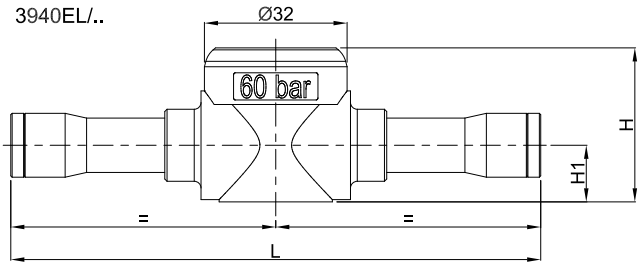
and the body, which could be damaged and compromise the proper functioning of the indicator.

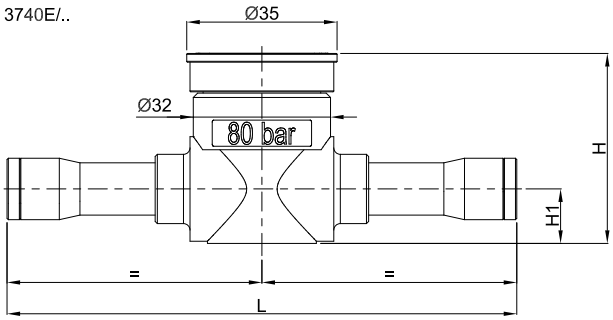
Steel connectors: TIG welding recommended, to be performed as quickly as possible according to the method shown in the product instruction sheet. The connection material is AISI 304: it is only possible to use AISI 308 filler material if welding to pipes made from the same type of material. For pipes made from other materials, please contact your welding supplies supplier.

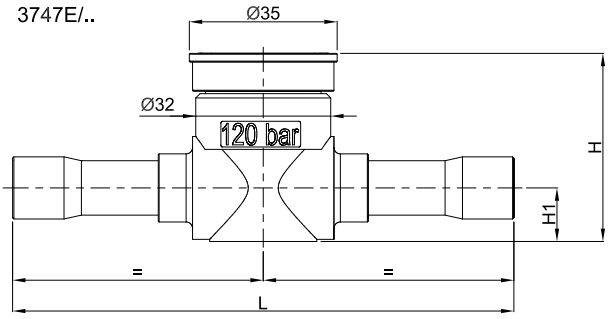
With indicators series 3740EL, 3747E and 3748E, it is necessary to disassemble the ring before starting to braze/weld.

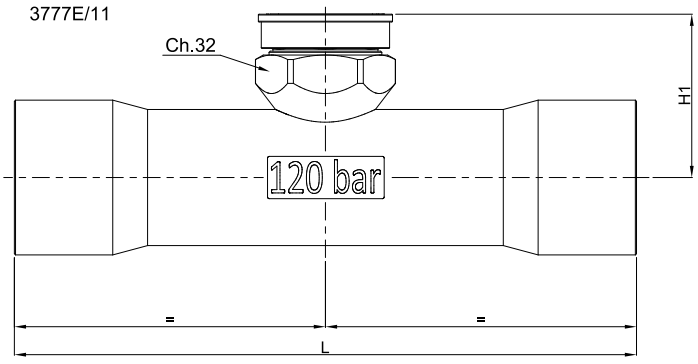
APPROVALS

The American certification authority Underwriters Laboratories Inc. has approved indicators in series 3940EL. These indicators are certified **UL Listed** for the USA with file SA33318, in compliance with American standard UL 207.









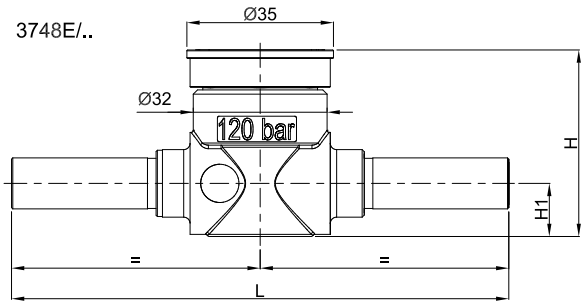


TABLE 5: Dimensions and weights				
Catalogue Number	Dimensions [mm]			Weight [g]
	H	H1	L	
3940EL/M6	22	15,5	113	120
3940EL/2				
3940EL/3	34	21,5	117	185
3940EL/M10				
3940EL/M12				
3940EL/4				
3940EL/5	34	21,5	131	195
3940EL/M18				
3940EL/6				
3940EL/7	37,5	23,5	151	306
3940EL/9	43,5	26	186	500
3740E/M6	43,5	31	117	140
3740E/2				
3740E/3				200
3740E/M10				
3740E/M12				
3740E/4				
3740E/5	43,5	31	131	215
3740E/M18				
3740E/6				
3740E/7	42,5	28,5	151	325
3740E/9	48,5	31	186	518
3747E/2	43,5	31	117	200
3747E/3				
3747E/4				
3747E/5	43,5	31	131	215
3747E/6				
3747E/7	42,5	28,5	151	325
3747E/9	48,5	31	186	575
3777E/11	-	41,5	160	378
3748E/M6	43,5	31	113	200
3748E/M10			117	
3748E/M12				
3748E/M16	43,5	31	131	234
3748E/M18				
3748E/M22	42,5	28,5	151	304
3748E/M28	48,5	31	186	530

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