# ANEXO 1: CONTROL DE CALIDAD

1. HOJA DE EMBALAJE ........................................................ 2
2. DIAGRAMA DE FLUJO DEL PROCESO ........................................................ 11
3. ANÁLISIS MODAL DE FALLOS Y EFECTOS (FMEA) ........................................................ 13
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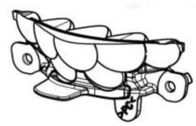
## COLIMATORS MODULE LED

Ref. Novatec: 151.044.00
Ref. cliente: 90113814

OPERARIOS

INSPECTORES

AUDITORES



Rev.306/03/2017

## COLIMATORS MODULE LED

INICIO

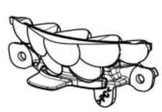
Ref. Novatec: 151.044.00
Ref. cliente: 90113814

# OPERARIOS

LAY-OUT

PAUTA DE REVISIÓN

AYUDA VISUAL



HISTORICO DE INCIDENCIAS

HOJA DE PROCESO

HOJA EMBALAJE

Rev.306/03/2017

## COLIMATORS MODULE LED

Ref. Novatec: 151.044.00
Ref. cliente: 90113814

INICIO

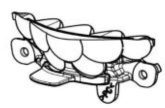
# INSPECTORES

LAY-OUT

AYUDA VISUAL

HOJA DE PROCESO

PAUTA DE REVISIÓN



HISTORICO DE INCIDENCIAS

DEFECTOS ACEPTABLES

HOJA DE CONTROL

REGISTRO DE FORMACIÓN

Rev.306/03/2017

## COLIMATORS MODULE LED

Ref. Novatec: 151.044.00
Ref. cliente: 90113814

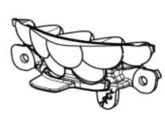
INICIO

# AUDITORES

AYUDA VISUAL

DEFECTOS ACEPTABLES

PAUTA DE REVISIÓN



HOJA DE AUDITORIAS

HISTORICO DE INCIDENCIAS

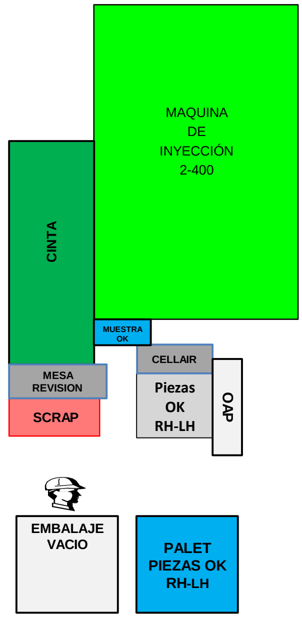
HOJA DE EMBALAJE

Rev.306/03/2017

# PROCESS LAY-OUT 2/400

COLIMATORS MODULE LED

Ref. Novatec: 151.044.00
Ref. cliente: 90113814

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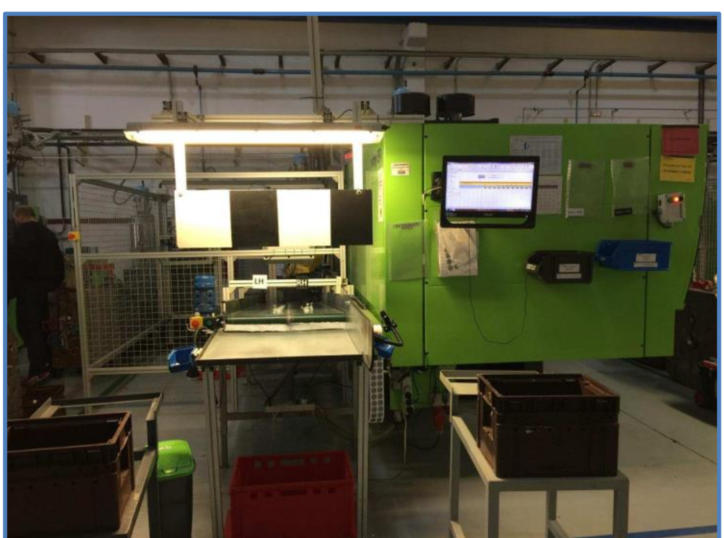
MENU OPE INS

# PUESTO DE TRABAJO 2/400

COLIMATORS MODULE LED

Ref. Novatec: 151.044.00
Ref. cliente: 90113814



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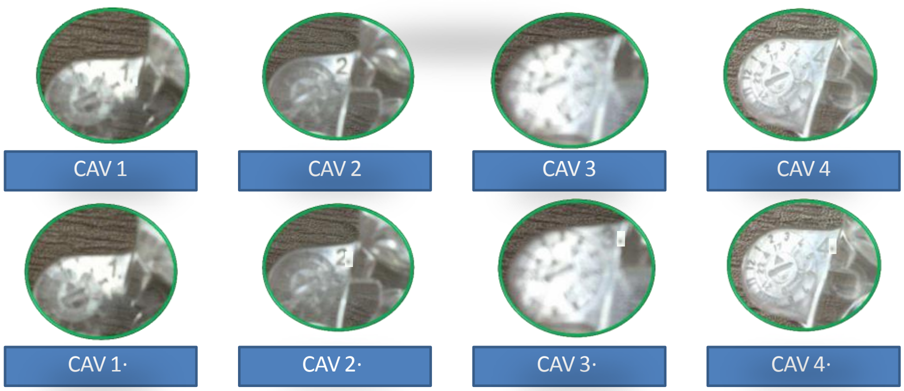
MENU OPE INS

# AYUDA VISUAL DISTINCIÓN DE CAVIDADES

COLIMATORS MODULE LED

Ref. Novatec: 151.044.00
Ref. cliente: 90113814

CARA NO VISTA

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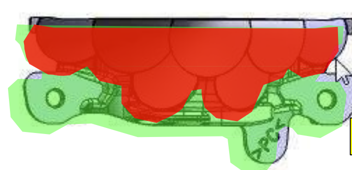
# PAUTA DE REVISIÓN CARA VISTA

COLIMATORS MODULE LED

Ref. Novatec: 151.044.00
Ref. cliente: 90113814

1 **Verificar:**
-Ausencia de marcas, arrastres, manchas y defectos superficiales.
-Ausencia de rebabas, rechupes, falta de material en contorno.
-Ausencia de defectos superficiales (racheados, falta compactación, contaminados, marcas de expulsores, etc.) en zona roja.
- No existencia de diferencias de brillos.

2 **Verificar:**
-Ausencia rebabas, falta de material en clipajes, patas de fijación, etc.
·Ausencia de falta de material en la zona de clipaje.
· Ausencia de deformaciones




USO OBLIGATORIO DE GUANTES

TIEMPO INSPECCIÓN:
5 seg

| Defectos | ROJO | VERDE |
|---|---|---|
| Racheados | No aceptable | Aceptable |
| Puntos blancos/negros | No aceptable | Aceptable |
| Rechupes | No aceptable | Aceptable |
| Rayas/Roces | No aceptable | Aceptable |
| Lineas Flujo | No aceptable | Aceptable |
| Ausencia brillo | No aceptable | Aceptable |
| Inclusiones/ Burbujas | No aceptable | Aceptable |
| Polvo/humedad | No aceptable | Aceptable |
| Rebabas | No aceptable | No aceptable |

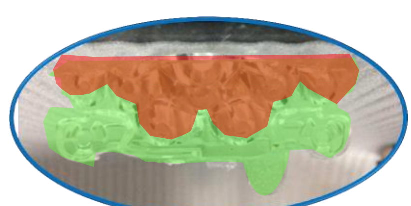


IMAGEN REAL

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# PAUTA DE REVISIÓN CARA NO VISTA

COLIMATORS MODULE LED

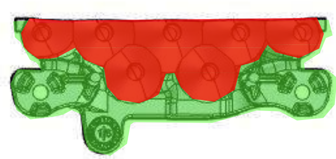
Ref. Novatec: 151.044.00
Ref. cliente: 90113814

**1**

**Verificar:**
-Ausencia de marcas, arrastres, manchas y defectos superficiales.
-Ausencia de rebabas, rechupes, falta de material en contorno.
-Ausencia de defectos superficiales (racheados, falta compactación, contaminados, marcas de expulsores, etc.) en zona roja.
- No existencia de diferencias de brillos.

**2**

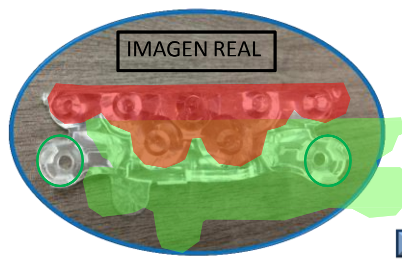
**Verificar:**
-Ausencia rebabas, falta de material en clipajes, patas de fijación, etc.
·Ausencia de falta de material en la zona de clipaje.
· Ausencia de deformaciones




USO OBLIGATORIO DE GUANTES

TIEMPO INSPECCIÓN:
5 seg

| Defectos | ROJO | VERDE |
|---|---|---|
| Racheados | No aceptable | Aceptable |
| Puntos blancos/negros | No aceptable | Aceptable |
| Rechupes | No aceptable | Aceptable |
| Rayas/Roces | No aceptable | Aceptable |
| Lineas Flujo | No aceptable | Aceptable |
| Ausencia brillo | No aceptable | Aceptable |
| Inclusiones/ Burbujas | No aceptable | Aceptable |
| Polvo/humedad | No aceptable | Aceptable |
| Rebabas | No aceptable | No aceptable |

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# HOJA DE PROCESO

COLIMATORS MODULE LED

Ref. Novatec: 151.044.00
Ref. cliente: 90113814

## METODO DE REVISION

1º - COGEMOS LA PIEZA COMO SE OBSERVA EN LA IMAGEN Y SE REVISARA LA PASANDO POR LOS PANELES BLANCOS Y NEGROS COMPROBANDO PRIMERO LA CARA VISTA Y EL ANGULO FRONTAL.

**1**

2º - REPETIREMOS LA REVISION COMO EL PUNTO 1 POR LA CARA NO VISTA DE LA PIEZA COMPROBANDO TAMBIEN EL ANGULO CORRESPONDIENTE DE ESA CARA.

**2**

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MENU OPE INS

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# HOJA DE CONTROL

COLIMATORS MODULE LED

Ref. Novatec: 151.044.00
Ref. cliente: 90113814

| Nº | Característica | Tipo | Especificación | Tamaño Muestra | Frecuencia | Método Control |
|---|---|---|---|---|---|---|
| 1 | Comprobar material correcto | | PC Makrolon Led 2245 | N/A | Saco | Visual |
| 2 | Confirmación proceso homologado | | Check list arranque molde/proceso C04i09 | N/A | Arranque | Evaluación inspector calidad |
| 3 | Verificación dimensional | SC | PESO: 17 g. +/-1 g. | 1 inyectada | Arranque / 8 horas | Báscula |
| 4 | Verificación dimensional | | Verificacion con contraparte | 1 inyectada | Arranque / 4 horas | Contraparte |
| 5 | Defectos generales de inyección | | FALTA DE MATERIAL | 100 % | Arranque / 2 horas | Comprobación con pieza patrón |
| 6 | Defectos generales de inyección | | RAFAGAS | 100% | Arranque / 2 horas | Comprobación con pieza patrón |
| 7 | Defectos generales de inyección | | BRILLOS | 100% | Arranque / 2 horas | Comprobación con pieza patrón |
| 8 | Defectos generales de inyección | | LINEAS DE UNIÓN | 100% | Arranque / 2 horas | Comprobación con pieza patrón |
| 9 | Defectos generales de inyección | | PIEZA DEFORMADA | 100 % | Arranque / 2 horas | Comprobación con pieza patrón |
| 10 | Defectos generales de inyección | | CONTAMINACIÓN Y/O PUNTOS NEGROS FUERA DE LOS TAMAÑOS ESPECIFICADOS | 100 % | Arranque / 2 horas | Comprobación con pieza patrón |
| 11 | Defectos generales de inyección | | PIEZA RECHUPADA | 100 % | Arranque / 2 horas | Comprobación con pieza patrón |
| 12 | Defectos generales de inyección | | PIEZA CON QUEMAZOS | 100 % | Arranque / 2 horas | Comprobación con pieza patrón |
| 13 | Defectos generales de inyección | | PUNTOS FRIOS | 100 % | Arranque / 2 horas | Comprobación con pieza patrón |

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# HOJA DE CONTROL

COLIMATORS MODULE LED

Ref. Novatec: 151.044.00
Ref. cliente: 90113814

| Nº | Característica | Tipo | Especificación | Tamaño Muestra | Frecuencia | Método Control |
|---|---|---|---|---|---|---|
| 14 | Defectos generales de inyección | | PUNTO DE INYECCIÓN FUERA DE ESPECIFICACIÓN | 100 % | Arranque / 2 horas | Comprobación con pieza patrón |
| 15 | Defectos generales de inyección | | BURBUJAS | 100 % | Arranque / 2 horas | Comprobación con pieza patrón |
| 14 | Defectos generales de inyección | | REBABAS GENERALES | 100 % | Arranque / 2 horas | Comprobación con pieza patrón |
| 15 | Defectos generales de inyección | | SUCIEDAD / MANCHAS | 100 % | Arranque / 2 horas | Comprobación con pieza patrón |
| 16 | Defectos generales de inyección | | MARCAS / GOLPES | 100% | Arranque / 2 horas | Comprobación con pieza patrón |
| 17 | Defectos generales de inyección | | AGUJEROS POSICIONADORES NOK | 100% | Arranque / 2 horas | Comprobación con contraparte |
| 18 | Defectos generales de inyección | | HUMO | 100 % | Arranque / 2 horas | Comprobación con pieza patrón |
| 19 | Defectos generales de inyección | | GRIETAS | 100 % | Arranque / 2 horas | Comprobación con pieza patrón |
| 20 | Defectos generales de inyección | | AMARILLEAMIENTO | 100 % | Arranque / 2 horas | Comprobación con pieza patrón |

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MENU INS

# TIPO DE EMBALAJE

**EXPEDICION**



## HOJA DE PROCESO EMBALAJE

COLIMATORS MODULE LED

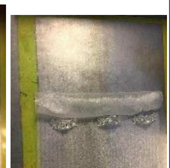
Ref. Novatec: 151.044.00
Ref. cliente: 90113814

1º- Cogemos cellair BC y colocamos 3 piezas como se observa en la imagen.

2º-Enrollamos el cellair BC las 3 piezas. Ponemos otras 3 piezas en el cellair.

3º-Repetimos procedimiento , enrollamos las 3 piezas y colocamos otras 3.

4º-Repetimos procedimiento , enrollamos las 3 piezas y colocamos otras 3.



5º-Por último enrollamos las 3 piezas finales , un total de 12 piezas por cellair BC.



MENU OPE INS

# HOJA DE EMBALAJE EXPEDICION

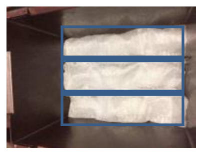
COLIMATORS MODULE LED

Ref. Novatec: 151.044.00
Ref. cliente: 90113814

| DESCRIPCIÓN | CÓDIGO | UDS/CONTENEDOR | UDS/PALET |
|---|---|---|---|
| COLIMATORS MODULE LED | 151.044.00 | 180 | 7200 |
| KLT 43270 CAJA MARRON (400X300X270) | 408.000.43 | 1 | 40 |
| LAMINA CELL AIR BC (550x380) | 403.000.07 | 15 | 600 |
| LAM. CELL AIR PE 40 330x235 | 403.000.09 | 4 | 160 |
| PALET ST ( 1200 X 1000 ) | 407.000.06 | 1/40 | 1 |

**1.-Ponemos 12 piezas envueltas en cellair BC , según hoja de proceso de embalaje.**

**2.- Completamos el piso con 3 packs de 12 piezas cada uno y separamos piso con cellair PE 40.**



**3.-Completamos el embalaje con 5 pisos.**

Rev.3 06/03/2017

-**IMPORTANTE:** ETIQUETA IDENTIFICATIVA EN CADA KLT DE 180 UDS Y MARCAJE DE 7200 UDS POR CADA PISO(10 CAJAS)

# HOJA DE AUDITORIAS

COLIMATORS MODULE LED

Ref. Novatec: 151.044.00
Ref. cliente: 90113814

| Nº | Característica | Tipo | Especificación | Tamaño Muestra | Frecuencia | Método Control |
|---|---|---|---|---|---|---|
| 1 | Comprobar referencia correcta | | Fechador de referencia / Fotografía versión | 1 inyectada | Al comienzo de la auditoria | Comprobar en la ayuda visual |
| 2 | Verificar código de la pieza con código de la etiqueta | | Código de la pieza | 1 inyectada | Al comiendo de la auditoria | Comprobar en la ayuda visual |
| 3 | Defectos generales de inyección | | FALTA DE MATERIAL | 100% | 100% | Comprobación con pieza patrón |
| 4 | Defectos generales de inyección | | RAFAGAS | 100% | 100% | Comprobación con pieza patrón |
| 5 | Defectos generales de inyección | | BRILLOS | 100% | 100% | Comprobación con pieza patrón |
| 6 | Defectos generales de inyección | | LINEAS DE UNIÓN | 100% | 100% | Comprobación con pieza patrón |
| 7 | Defectos generales de inyección | | PIEZA DEFORMADA | 100% | 100% | Comprobación con pieza patrón |
| 8 | Defectos generales de inyección | | CONTAMINACIÓN Y/O PUNTOS NEGROS FUERA DE LOS TAMAÑOS ESPECIFICADOS | 100% | 100% | Comprobación con pieza patrón |
| 9 | Defectos generales de inyección | | PIEZA RECHUPADA | 100% | 100% | Comprobación con pieza patrón |
| 10 | Defectos generales de inyección | | PIEZA CON QUEMAZOS | 100% | 100% | Comprobación con pieza patrón |
| 11 | Defectos generales de inyección | | PUNTOS FRIOS | 100% | 100% | Comprobación con pieza patrón |
| 12 | Defectos generales de inyección | | PUNTO DE INYECCIÓN FUERA DE ESPECIFICACIÓN | 100% | 100% | Comprobación con pieza patrón |

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# HOJA DE AUDITORIAS

COLIMATORS MODULE LED

Ref. Novatec: 151.044.00
Ref. cliente: 90113814

| Nº | Característica | Tipo | Especificación | Tamaño Muestra | Frecuencia | Método Control |
|---|---|---|---|---|---|---|
| 13 | Defectos generales de inyección | | BURBUJAS | 100% | 100% | Comprobación con pieza patrón |
| 14 | Defectos generales de inyección | | REBABAS GENERALES | 100% | 100% | Comprobación con pieza patrón |
| 14 | Defectos generales de inyección | | SUCIEDAD / MANCHAS | 100% | 100% | Comprobación con pieza patrón |
| 14 | Defectos generales de inyección | | MARCAS / GOLPES | 100% | 100% | Comprobación con pieza patrón |
| 14 | Defectos generales de inyección | | AGUJEROS POSICIONADORES NOK | 100% | 100% | Comprobación con pieza patrón |
| 14 | Defectos generales de inyección | | HUMO | 100% | 100% | Comprobación con pieza patrón |
| 14 | Defectos generales de inyección | | GRIETAS | 100% | 100% | Comprobación con pieza patrón |
| 14 | Defectos generales de inyección | | AMARILLEAMIENTO | 100% | 100% | Comprobación con pieza patrón |
| 17 | Verificación del embalaje | | Piezas embaladas en el embalaje ok | Cada palet | 100 % | Visual con pauta de embalaje |
| 18 | Verificación de etiquetaje | | Comprobar que la etiqueta corresponde con la pieza | Cada klt | 100 % | Visual con pauta de embalaje |
| 19 | Pauta de revisión | | Tiempos de revisión cara vista y no vista | Cada pieza | 100% | Visual |

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MENU AUD

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# REGISTRO DE CAMBIOS

COLIMATORS MODULE LED

Ref. Novatec: 151.044.00
Ref. cliente: 90113814

| •Nº REV | •FECHA | •DESCRIPCION | •MODIFICADO POR: |
|---|---|---|---|
| • REV 1 | • 30/09/2016 | • CREACION DE DOCUMENTO | • CRISTIAN DURÁ |
| • REV 2 | • 03/02/2017 | • MODIFICACIÓN DE PAUTA DE REVISIÓN | • CRISTIAN DURÁ |
| • REV 2 | • 06/03/2017 | • MODIFICACIÓN DE EMBALAJE EXPEDICION | • CRISTIAN DURÁ |
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Rev.3 06/03/2017

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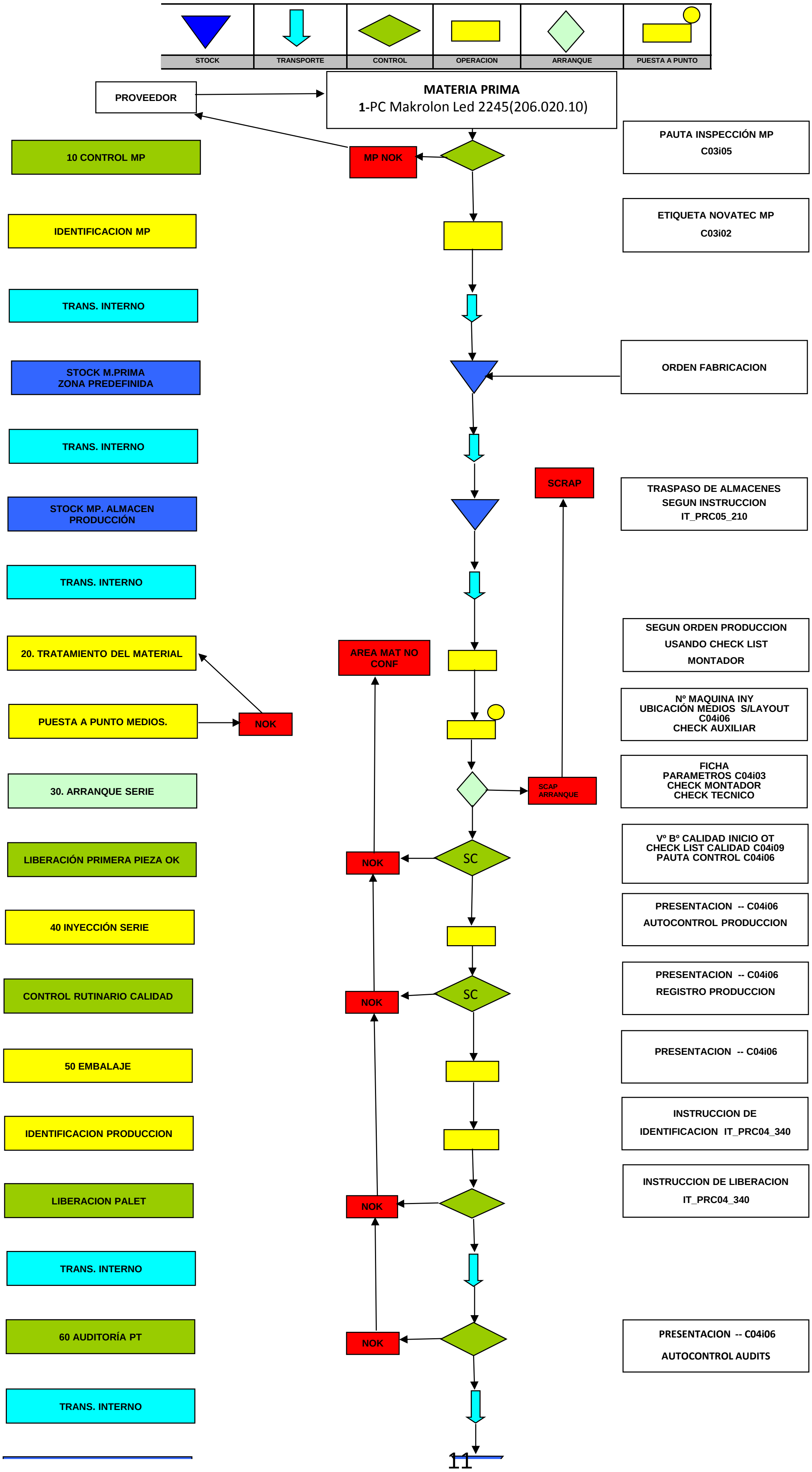
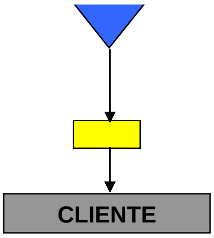
# DIAGRAMA DE FLUJO DEL PROCESO C0101i01 rev 1

Cliente: **VALEO**
Ref: **151.044.00**
Pz: **COLIMATORS MODULE LED**
REF cliente **– 90113814**



70 STOCK ALMCEN P. TERMINADO

80 EXPEDICIÓN




**PROCEDIMIENTO DE EXPEDICION**

| | | | | |
|---|---|---|---|---|
| **Elaborado por:** | I.LORENTE | **VºBº por:** | J.DIB |
| **Dpto:** | CALIDAD | **Dpto:** | PROYECTOS |
| **Fecha:** | 30/09/2016 | **Fecha:** | 30/09/2016 |

| REV | FECHA | MOTIVO |
|---|---|---|
| 1 | 30/09/2016 | CREACION DE DOCUMENTACION |
| | | |
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# POTENTIAL
# FAILURE MODE AND EFFECTS ANALYSIS
# (PROCESS FMEA)

C0101i02
REV 2 27/2/2011

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Part number** | 151.044.00 | | | **FMEA Number** | 1 | | |
| **Item** | COLIMATORS MODULE LED | **Process Responsibility** | J. Dib | **Page** | of | | |
| **Model Year(s)/Vehicle(s)** | VW PASSAT CC 2017 | **Drawing** | DRW_L90113814_001 (12/05/2016) | **Prepared By** | I.LORENTE | | |
| **Core Team** | I. Lorente, J Dib , C. Dura, C.Lopez | | | **FMEA Date (Orig.)** | 30/09/2016 | (Rev.) 1 | 30/09/2016 |

| Process Function / Requirements | Potential Failure Mode | Potential Effect(s) of Failure | Sev | Class | Potential Cause(s) / Mechanism(s) of Failure | Occur | Current Process Controls Prevention | Current Process Controls Detection | Detec | R.P.N. | Recommended Action(s) | Responsibility & Target Completion Date | Action Results: Actions Taken | Sev | Occ | Det | R.P.N. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **10.- RECEPCION MATERIA - PC Makrolon Led 2245 (206.020.10) ESPECIFICACIONES MATERIAL SEGUN NORMA CLIENTE.** | EMBALAJE DETERIORADO | CANTIDAD NOK | 2 | | TRANSPORTE DESCARGA ALMACENAMIENTO | 3 | FORMACION ALMACENEROS INTERNO | PAUTA DE RECEPCIÓN MATERIALES | 4 | 24 | | | | | | | |
| | | 1 -PIEZA TRANSFORMADA NOK: - HUMEDAD DEL MATERIAL.(2) - CONTAMINACIÓN DEL MATERIAL(2) | 2 | | ERROR PROVEEDOR. EMBALAJE INCORRECTO. MANIPULACIÓN INCORRECTA | 2 | FORMACION ALMACENEROS INTERNO | PAUTA DE RECEPCIÓN MATERIALES | 4 | 16 | | | | | | | |
| | CARACTERÍSTICAS MATERIALES INCORRECTAS | PIEZA TRANSFORMADA NOK. | 7 | | ERROR PROVEEDOR. | 2 | CONTROLES INTERNOS DEL FABRICANTE | CERTIFICADO DEL PROVEEDOR. ANALISIS SEGÚN PAUTA DE RECEPCIÓN | 3 | 42 | | | | | | | |
| | | | 7 | | ERROR DE IDENTIFICACIÓN DEL PROVEEDOR DE MATERIALES | 2 | CONTROLES INTERNOS DEL FABRICANTE | CERTIFICADO DEL PROVEEDOR. ANALISIS SEGÚN PAUTA DE RECEPCIÓN | 4 | 56 | | | | | | | |
| | IDENTIFICACIÓN INCORRECTA DEL MATERIALES | PIEZA NO CUMPLE ESPECIFICACIONES. | 7 | | ERROR PROVEEDOR. | 2 | CONTROLES INTERNOS DEL FABRICANTE | ANÁLISIS SEGÚN PAUTA DE RECEPCIÓN. | 2 | 28 | | | | | | | |
| | | | 7 | | ERROR ALMACEN INTERNO DE MATERIA PRIMA | 2 | IDENTIFICACION DEL MATERIAL COMPARANDO LA REF DEL ALBARAN CON RESPECTO A LOS MATERIALES RECIBIDOS | ANÁLISIS SEGÚN PAUTA DE RECEPCIÓN. | 2 | 28 | | | | | | | |
| **20.- TRATAMIENTO DEL MATERIAL** | PIEZA NO CUMPLE CON LAS ESPECIFICACIONES DE CLIENTE | RAFAGAS PUNTOS FRIOS | 7 | | INCORRECTO TRATAMIENTO DEL MATERIAL ACORDE A ESPEC. FICHA MATERIAL. | 3 | REGISTRO EN EQUIPOS DE SECADO DE LA CARGA DE MATERIAL, TEMPERATURA Y HORA DE PUESTA EN MARCHA | CHECK LIST DE ARRANQUE DE PROCESO | 2 | 42 | | | | | | | |

C0101i02
REV 2 27/2/2011

# POTENTIAL
# FAILURE MODE AND EFFECTS ANALYSIS
# (PROCESS FMEA)

| | | | | | |
|---|---|---|---|---|---|
| **Part number** | 151.044.00 | | | **FMEA Number** | 1 |
| **Item** | COLIMATORS MODULE LED | **Process Responsibility** | J. Dib | **Page** | of |
| **Model Year(s)/Vehicle(s)** | VW PASSAT CC 2017 | **Drawing** | DRW_L90113814_001 (12/05/2016) | **Prepared By** | I.LORENTE |
| **Core Team** | I. Lorente, J Dib , C. Dura, C.Lopez | | | **FMEA Date (Orig.)** | 30/09/2016 (Rev.) 1 30/09/2016 |

| Process Function / Requirements | Potential Failure Mode | Potential Effect(s) of Failure | Sev | Class | Potential Cause(s) / Mechanism(s) of Failure | Occur | Current Process Controls Prevention | Current Process Controls Detection | Detec | R.P.N. | Recommended Action(s) | Responsibility & Target Completion Date | Action Results: Actions Taken | Sev | Occ | Det | R.P.N. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | FALTA MATERIAL / CONTAMINACIÓN | 7 | | CONTAMINACION DEL MATERIAL | 3 | INSTRUCCIONES DE LIMPIEZA DE EQUIPOS DE SECADO Y TOLVAS DE MP Y COLOCACION ZONA ESPECIFICA MATERIALES TRANSPARENTES | CHECK LIST DEL MONTADOR | 2 | 42 | | | | | | | |
| **30-ARRANQUE DE SERIE** | PROCESO DISTINTO DEL HOMOLOGADO. | - PIEZA NO CUMPLE ESPECIFICACIONES | 8 | | - MONTAJE NOK MOLDE. | 2 | - CHECK-LIST MONTADOR; - TPM - MANTENIEMIENTO MOLDES MAQUINAS Y PERIFÉRICOS - HOJAS DE PARÁMETROS | INSPECCIÓN MUESTRA INICIAL AL ARRANQUE Y LIBERACION 1ª PIEZA OK | 2 | 32 | | | | | | | |
| | | | 8 | | - PARAMETROS NOK | 2 | - CHECK-LIST MONTADOR; - CHECK LIST TÉCNICO DE INYECCIÓN; - HOJAS DE PARÁMETROS | REVISION CONTROL TECNICO DE INYECCION | 2 | 32 | | | | | | | |
| | | | 8 | | - PERIFERICOS NOK | 2 | - TÉCNICO DE INYECCIÓN - MANTENIEMIENTO MOLDES MAQUINAS Y PERIFÉRICOS - HOJAS DE PARÁMETROS | .-REVISION CONTROL -TECNICO DE INYECCION -AUDITORIA DE PROCESO | 2 | 32 | | | | | | | |
| | | | 8 | | - UTILES CONTROL NOK | 2 | - PLAN CALIBRACIÓN UTILES CONTROL | CALIDAD PLAN DE CONTROL | 2 | 32 | | | | | | | |
| **40.-INYECCIÓN SERIE** | MATERIAL INCORRECTO | PIEZA NO CUMPLE CON ESPECIFICACIONES DE CLIENTE | 8 | | ERROR DE PREPARACIÓN DEL MATERIAL POR EL AUXILIAR / ERROR DEL MONTADOR | 2 | ORDEN DE PRODUCCIÓN IDENTIFICACIÓN DE LOS EQUIPOS AUXILIARES IDENTIFICACIÓN DE LOS TUBOS DE ALIMENTACIÓN | CHECK LIST DE ARRANQUE PROCESO | 2 | 32 | | | | | | | |
| | PESO INCORRECTO | - PIEZA RECHUPADA 7<br>- NO COMPACTADA 7<br>**- NO FUNCIONAL** 8<br>- ASPECTO NOK 7 | 8 | SC | VARIACION PARAMETROS DE MAQUINA. | 3 | BLOQUEO DE PARÁMETROS MEDIANTES TARJETAS PERSONALIZADAS Y AUTORIZADAS | CONTROL EN PROCESO CON BASCULA DE PRECISIÓN | 2 | 48 | | | | | | | |

# POTENTIAL
# FAILURE MODE AND EFFECTS ANALYSIS
# (PROCESS FMEA)

C0101i02
REV 2 27/2/2011

**Part number** 151.044.00
**Item** COLIMATORS MODULE LED **Process Responsibility** J. Dib
**Model Year(s)/Vehicle(s)** VW PASSAT CC 2017 **Drawing** DRW_L90113814_001 (12/05/2016)
**Core Team** I. Lorente, J Dib , C. Dura, C.Lopez

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**Prepared By** I.LORENTE
**FMEA Date (Orig.)** 30/09/2016 (Rev.) 1 30/09/2016

| Process Function / Requirements | Potential Failure Mode | Potential Effect(s) of Failure | Sev | Class | Potential Cause(s) / Mechanism(s) of Failure | Occur | Current Process Controls Prevention | Current Process Controls Detection | Detec | R.P.N. | Recommended Action(s) | Responsibility & Target Completion Date | Action Results: Actions Taken | Sev | Occ | Det | R.P.N. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 8 | | PARAMETROS FUERA DE TOLERANCIAS | 3 | SEGURIDAD DE PARÁMETROS DE MÁQUINA. | CONTROL EN PROCESO CON BASCULA DE PRECISIÓN | 2 | 48 | | | | | | | |
| | PIEZAS FUERA DE DIMENSIONES (GENERAL): | - PROBLEMAS EN MONTAJES POSTERIORES . - PIEZA NO MONTA EN VEHICULO DEL CLIENTE. | 7 | | - VARIACION PARAMETROS DE MAQUINA. | 2 | BLOQUEO DE PARÁMETROS MEDIANTES TARJETAS PERSONALIZADAS Y AUTORIZADAS | VERIFICACION CON CONTRAPARTE | 2 | 28 | | | | | | | |
| | | | 7 | | PARAMETROS FUERA DE TOLERANCIAS | 2 | SEGURIDAD DE PARÁMETROS DE MÁQUINA. | VERIFICACION CON CONTRAPARTE | 2 | 28 | | | | | | | |
| | | | 7 | | - TEMPERATURA DEL MOLDE NOK | 2 | CHECK LIST DE ARRANQUE DE PROCESO -PLAN DE MANTENIMIENTO DE MOLDE Y PERIFERICOS | VERIFICACION CON CONTRAPARTE | 2 | 28 | | | | | | | |
| | FALTA DE MATERIAL | PIEZA NO CUMPLE CON LOS REQUERIMIENTOS DE CLIENTE | 7 | | - VARIACION PARAMETROS DE MAQUINA. | 2 | BLOQUEO DE PARÁMETROS MEDIANTES TARJETAS PERSONALIZADAS Y AUTORIZADAS | AUTOCONTROL OPERARIO/ CONTROL PERIÓDICO CADA 2 H EN PROCESO/ CONTROL FINAL AUDITORIAS | 4 | 56 | | | | | | | |
| | | | 7 | | PARAMETROS FUERA DE TOLERANCIAS | 2 | SEGURIDAD DE PARÁMETROS DE MÁQUINA. | AUTOCONTROL OPERARIO/ CONTROL PERIÓDICO CADA 2 H EN PROCESO/ CONTROL FINAL AUDITORIAS | 4 | 56 | | | | | | | |
| | | | 7 | | - TEMPERATURA DEL MOLDE NOK | 2 | CHECK LIST DE ARRANQUE DE PROCESO -PLAN DE MANTENIMIENTO DE MOLDE Y PERIFERICOS | AUTOCONTROL OPERARIO/ CONTROL PERIÓDICO CADA 2 H EN PROCESO/ CONTROL FINAL AUDITORIAS | 4 | 56 | | | | | | | |

# POTENTIAL
# FAILURE MODE AND EFFECTS ANALYSIS
# (PROCESS FMEA)

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| | | | | | |
|---|---|---|---|---|---|
| **Part number** | 151.044.00 | | | **FMEA Number** | 1 |
| **Item** | COLIMATORS MODULE LED | **Process Responsibility** | J. Dib | **Page** | of |
| **Model Year(s)/Vehicle(s)** | VW PASSAT CC 2017 | **Drawing** | DRW_L90113814_001 (12/05/2016) | **Prepared By** | I.LORENTE |
| **Core Team** | I. Lorente, J Dib , C. Dura, C.Lopez | | | **FMEA Date (Orig.)** | 30/09/2016 (Rev.) 1 30/09/2016 |

| Process Function / Requirements | Potential Failure Mode | Potential Effect(s) of Failure | Sev | Class | Potential Cause(s) / Mechanism(s) of Failure | Occur | Current Process Controls Prevention | Current Process Controls Detection | Detec | R.P.N. | Recommended Action(s) | Responsibility & Target Completion Date | Action Results: Actions Taken | Sev | Occ | Det | R.P.N. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | RAFAGAS | PIEZA NO CUMPLE CON LOS REQUERIMIENTOS DE CLIENTE | 7 | | ESTADO DEL MOLDE TEMPERATURA DE MOLDE | 3 | PLAN DE MANTENIMIENTO PREVENTIVO/ CHECK LIST ARRANQUE DE PROCESO | AUTOCONTROL OPERARIO/ CONTROL PERIÓDICO CADA 2 H EN PROCESO/ CONTROL FINAL AUDITORIAS | 3 | 63 | | | | | | | |
| | | | 7 | | TRATAMIENTO DE MATERIAL INCORRECTO | 3 | REGISTRO EN EQUIPOS DE SECADO DE LA CARGA DE MATERIAL, TEMPERATURA Y HORA DE PUESTA EN MARCHA | AUTOCONTROL OPERARIO/ CONTROL PERIÓDICO CADA 2 H EN PROCESO/ CONTROL FINAL AUDITORIAS | 3 | 63 | | | | | | | |
| | | | 7 | | - VARIACION PARAMETROS DE MAQUINA. | 2 | BLOQUEO DE PARÁMETROS MEDIANTES TARJETAS PERSONALIZADAS Y AUTORIZADAS | AUTOCONTROL OPERARIO/ CONTROL PERIÓDICO CADA 2 H EN PROCESO/ CONTROL FINAL AUDITORIAS | 3 | 42 | | | | | | | |
| | | | 7 | | PARAMETROS FUERA DE TOLERANCIAS | 2 | SEGURIDAD DE PARÁMETROS DE MÁQUINA. | AUTOCONTROL OPERARIO/ CONTROL PERIÓDICO CADA 2 H EN PROCESO/ CONTROL FINAL AUDITORIAS | 3 | 42 | | | | | | | |
| | BRILLOS | PIEZA NO CUMPLE CON LOS REQUERIMIENTOS DE CLIENTE | 7 | | ESTADO DEL MOLDE / TEMPERATURA DE MOLDE | 3 | PLAN DE MANTENIMIENTO PREVENTIVO/ CHECK LIST ARRANQUE DE PROCESO / LIMPIEZA PERIODICA DEL MOLDE | AUTOCONTROL OPERARIO/ CONTROL PERIÓDICO CADA 2 H EN PROCESO/ CONTROL FINAL AUDITORIAS | 3 | 63 | | | | | | | |

# POTENTIAL FAILURE MODE AND EFFECTS ANALYSIS (PROCESS FMEA)

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**Part number** 151.044.00
**Item** COLIMATORS MODULE LED — **Process Responsibility** J. Dib
**Model Year(s)/Vehicle(s)** VW PASSAT CC 2017 — **Drawing** DRW_L90113814_001 (12/05/2016)
**Core Team** I. Lorente, J Dib , C. Dura, C.Lopez

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**Page** of
**Prepared By** I.LORENTE
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| Process Function / Requirements | Potential Failure Mode | Potential Effect(s) of Failure | Sev | Class | Potential Cause(s) / Mechanism(s) of Failure | Occur | Current Process Controls Prevention | Current Process Controls Detection | Detec | R.P.N. | Recommended Action(s) | Responsibility & Target Completion Date | Action Results: Actions Taken | Sev | Occ | Det | R.P.N. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LINEAS DE UNIÓN | PIEZA NO CUMPLE CON LOS REQUERIMIENTOS DE CLIENTE | 7 | | TEMPERATURA DE MOLDE | 3 | -MANTENIMIENTO DE MOLDE<br>-PERIFERICOS<br>BLOQUEO DE PARÁMETROS MEDIANTES TARJETAS PERSONALIZADAS Y AUTORIZADAS.<br>DISCRIMINACIÓN DE PARÁMETRO FUERA DE TOLERANCIA HOJA DE PARÁMETROS | AUTOCONTROL OPERARIO/ CONTROL PERIÓDICO CADA 2 H EN PROCESO/ CONTROL FINAL AUDITORIAS | 3 | 63 | | | | | | | |
| | | | 7 | | - VARIACION PARAMETROS DE MAQUINA. | 2 | BLOQUEO DE PARÁMETROS MEDIANTES TARJETAS PERSONALIZADAS Y AUTORIZADAS | AUTOCONTROL OPERARIO/ CONTROL PERIÓDICO CADA 2 H EN PROCESO/ CONTROL FINAL AUDITORIAS | 3 | 42 | | | | | | | |
| | PIEZA DEFORMADA | PIEZA FUNCIONAL NOK | 8 | | VARIACIÓN DE PARÁMETROS INYECCIÓN | 3 | -BLOQUEO DE PARÁMETROS MEDIANTES TARJETAS PERSONALIZADAS Y AUTORIZADAS<br>-DISCRIMINACIÓN DE PARÁMETROS FUERA DE TOLERANCIA HOJA DE PARÁMETROS | AUTOCONTROL OPERARIO/ CONTROL PERIÓDICO CADA 2 H EN PROCESO/ CONTROL FINAL AUDITORIAS | 2 | 48 | | | | | | | |
| | | | 8 | | ESTADO DE MOLDE / MAQUINA NOK | 2 | PLAN DE MANTENIMIENTO PREVENTIVO/ CHECK LIST ARRANQUE DE PROCESO | AUTOCONTROL OPERARIO/ CONTROL PERIÓDICO CADA 2 H EN PROCESO/ CONTROL FINAL AUDITORIAS | 2 | 32 | | | | | | | |

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# POTENTIAL
# FAILURE MODE AND EFFECTS ANALYSIS
# (PROCESS FMEA)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Part number** | 151.044.00 | | | **FMEA Number** | 1 | | |
| **Item** | COLIMATORS MODULE LED | **Process Responsibility** | J. Dib | **Page** | of | | |
| **Model Year(s)/Vehicle(s)** | VW PASSAT CC 2017 | **Drawing** | DRW_L90113814_001 (12/05/2016) | **Prepared By** | I.LORENTE | | |
| **Core Team** | I. Lorente, J Dib , C. Dura, C.Lopez | | | **FMEA Date (Orig.)** | 30/09/2016 | (Rev.) 1 | 30/09/2016 |

| Process Function / Requirements | Potential Failure Mode | Potential Effect(s) of Failure | Sev | Class | Potential Cause(s) / Mechanism(s) of Failure | Occur | Current Process Controls Prevention | Current Process Controls Detection | Detec | R.P.N. | Recommended Action(s) | Responsibility & Target Completion Date | Action Results: Actions Taken | Sev | Occ | Det | R.P.N. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 8 | | TEMPERATURA DE MOLDE | 3 | -MANTENIMIENTO DE MOLDE Y/O PERIFERICOS BLOQUEO DE PARÁMETROS MEDIANTES TARJETAS PERSONALIZADAS Y AUTORIZADAS. DISCRIMINACIÓN DE PARÁMETRO FUERA DE TOLERANCIA HOJA DE PARÁMETROS | AUTOCONTROL OPERARIO/ CONTROL PERIÓDICO CADA 2 H EN PROCESO/ CONTROL FINAL AUDITORIAS | 2 | 48 | | | | | | | |
| | CONTAMINACIÓN Y/O PUNTOS NEGROS FUERA DE LOS TAMAÑOS ESPECIFICADOS | PIEZA NO CUMPLE CON LOS REQUERIMIENTOS DE CLIENTE | 7 | | CONTAMINACIÓN DE LA MATERIA PRIMA | 2 | INSTRUCCIONES DE LIMPIEZA DE EQUIPOS DE SECADO Y TOLVAS DE MP Y COLOCACION ZONA ESPECIFICA MATERIALES TRANSPARENTES | AUTOCONTROL OPERARIO/ CONTROL PERIÓDICO CADA 2 H EN PROCESO/ CONTROL FINAL AUDITORIAS | 2 | 28 | | | | | | | |
| | | | 7 | | ESTADO DE MOLDE / MAQUINA NOK | 2 | PLAN DE MANTENIMIENTO PREVENTIVO/ CHECK LIST ARRANQUE DE PROCESO | AUTOCONTROL OPERARIO/ CONTROL PERIÓDICO CADA 2 H EN PROCESO/ CONTROL FINAL AUDITORIAS | 2 | 28 | | | | | | | |
| | | | 7 | | PARAMETROS FUERA DE TOLERANCIAS | 2 | SEGURIDAD DE PARÁMETROS DE MÁQUINA. | AUTOCONTROL OPERARIO/ CONTROL PERIÓDICO CADA 2 H EN PROCESO/ CONTROL FINAL AUDITORIAS | 2 | 28 | | | | | | | |
| | | | 7 | | VARIACIÓN DE PARÁMETROS INYECCIÓN | 2 | BLOQUEO DE PARÁMETROS MEDIANTES TARJETAS PERSONALIZADAS Y AUTORIZADAS | AUTOCONTROL OPERARIO/ CONTROL PERIÓDICO CADA 2 H EN PROCESO/ CONTROL FINAL AUDITORIAS | 2 | 28 | | | | | | | |
| | PIEZA RECHUPADA | PIEZA NO CUMPLE CON LOS REQUERIMIENTOS DE CLIENTE | 7 | | VARIACIÓN DE PARÁMETROS INYECCIÓN | 2 | BLOQUEO DE PARÁMETROS MEDIANTES TARJETAS PERSONALIZADAS Y AUTORIZADAS | AUTOCONTROL OPERARIO/ CONTROL PERIÓDICO CADA 2 H EN PROCESO/ CONTROL FINAL AUDITORIAS | 2 | 28 | | | | | | | |

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# POTENTIAL
# FAILURE MODE AND EFFECTS ANALYSIS
# (PROCESS FMEA)

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|---|---|---|---|---|---|---|
| **Part number** | 151.044.00 | | | **FMEA Number** | 1 | |
| **Item** | COLIMATORS MODULE LED | **Process Responsibility** | J. Dib | **Page** | of | |
| **Model Year(s)/Vehicle(s)** | VW PASSAT CC 2017 | **Drawing** | DRW_L90113814_001 (12/05/2016) | **Prepared By** | I.LORENTE | |
| **Core Team** | I. Lorente, J Dib , C. Dura, C.Lopez | | | **FMEA Date (Orig.)** | 30/09/2016 | (Rev.) 1 30/09/2016 |

| Process Function / Requirements | Potential Failure Mode | Potential Effect(s) of Failure | Sev | Class | Potential Cause(s) / Mechanism(s) of Failure | Occur | Current Process Controls Prevention | Current Process Controls Detection | Detec | R.P.N. | Recommended Action(s) | Responsibility & Target Completion Date | Action Results: Actions Taken | Sev | Occ | Det | R.P.N. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 7 | | TEMPERATURA DE MOLDE | 2 | -MANTENIMIENTO DE MOLDE Y/O PERIFERICOS BLOQUEO DE PARÁMETROS MEDIANTES TARJETAS PERSONALIZADAS Y AUTORIZADAS. DISCRIMINACIÓN DE PARÁMETRO FUERA DE TOLERANCIA HOJA DE PARÁMETROS | AUTOCONTROL OPERARIO/ CONTROL PERIÓDICO CADA 2 H EN PROCESO/ CONTROL FINAL AUDITORIAS | 2 | 28 | | | | | | | |
| | PIEZA CON QUEMAZOS | PIEZA NO CUMPLE CON LOS REQUERIMIENTOS DE CLIENTE | 7 | | PARAMETROS FUERA DE TOLERANCIAS | 2 | SEGURIDAD DE PARÁMETROS DE MÁQUINA. | AUTOCONTROL OPERARIO/ CONTROL PERIÓDICO CADA 2 H EN PROCESO/ CONTROL FINAL AUDITORIAS | 2 | 28 | | | | | | | |
| | | | 7 | | VARIACIÓN DE PARÁMETROS INYECCIÓN | 2 | BLOQUEO DE PARÁMETROS MEDIANTES TARJETAS PERSONALIZADAS Y AUTORIZADAS | AUTOCONTROL OPERARIO/ CONTROL PERIÓDICO CADA 2 H EN PROCESO/ CONTROL FINAL AUDITORIAS | 2 | 28 | | | | | | | |
| | | | 7 | | ESTADO DEL MOLDE NOK | 2 | PLAN DE MANTENIMIENTO PREVENTIVO/ CHECK LIST ARRANQUE DE PROCESO | AUTOCONTROL OPERARIO/ CONTROL PERIÓDICO CADA 2 H EN PROCESO/ CONTROL FINAL AUDITORIAS | 2 | 28 | | | | | | | |
| | PUNTOS FRIOS | PIEZA NO CUMPLE CON LOS REQUERIMIENTOS DE CLIENTE | 7 | | VARIACION PARAMETROS DE MAQUINA | 2 | BLOQUEO DE PARÁMETROS MEDIANTES TARJETAS PERSONALIZADAS Y AUTORIZADAS | AUTOCONTROL OPERARIO/ CONTROL PERIÓDICO CADA 2 H EN PROCESO/ CONTROL FINAL AUDITORIAS | 2 | 28 | | | | | | | |

# POTENTIAL FAILURE MODE AND EFFECTS ANALYSIS (PROCESS FMEA)

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|---|---|---|---|---|---|
| **Part number** | 151.044.00 | | | **FMEA Number** | 1 |
| **Item** | COLIMATORS MODULE LED | **Process Responsibility** | J. Dib | **Page** | of |
| **Model Year(s)/Vehicle(s)** | VW PASSAT CC 2017 | **Drawing** | DRW_L90113814_001 (12/05/2016) | **Prepared By** | I.LORENTE |
| **Core Team** | I. Lorente, J Dib , C. Dura, C.Lopez | | | **FMEA Date (Orig.)** | 30/09/2016 (Rev.) 1 30/09/2016 |

| Process Function / Requirements | Potential Failure Mode | Potential Effect(s) of Failure | Sev | Class | Potential Cause(s) / Mechanism(s) of Failure | Occur | Current Process Controls Prevention | Current Process Controls Detection | Detec | R.P.N. | Recommended Action(s) | Responsibility & Target Completion Date | Action Results: Actions Taken | Sev | Occ | Det | R.P.N. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 7 | | ESTADO DEL MOLDE NOK | 2 | PLAN DE MANTENIMIENTO PREVENTIVO/ CHECK LIST ARRANQUE DE PROCESO | AUTOCONTROL OPERARIO/ CONTROL PERIÓDICO CADA 2 H EN PROCESO/ CONTROL FINAL AUDITORIAS | 2 | 28 | | | | | | | |
| | PUNTO DE INYECCIÓN FUERA DE ESPECIFICACIÓN | PIEZA NO CUMPLE CON LOS REQUERIMIENTOS DE CLIENTE (FUNCIONALIDAD) | 7 | | RE-TRABAJO DEL BEBEDERO NOK | 5 | -MANTENIMIENTO DE LA HERRAMIENTO DE CORTE -DEFINICIÓN DE LA PAUTA ACORDE A LOS REQUERIMIENTOS | AUTOCONTROL OPERARIO/ CONTROL PERIÓDICO CADA 2 H EN PROCESO/ CONTROL FINAL AUDITORIAS | 3 | 105 | EVALUAR UTIL DE CORTE PARA VIDA SERIE | | | | | | |

☐ Prototipos ☐ Preseries ☑ Producción

# PLAN DE CONTROL

| | | | | |
|---|---|---|---|---|
| Referencia Novatec<br>151.044.00 | Responsable Novatec<br>**Irene Lorente** | Fecha Realización<br>**30/09/2016** | Fecha Revisión<br>30/09/2016 | **C0101i03**<br>**REV 3** |
| Referencia Cliente<br>90113814 | Fecha y nivel plano<br>DRW_L90113814_001 (12/05/2016) | Realizado por<br>Irene Lorente/Clara Lopez | | |
| Descripción<br>COLIMATORS MODULE LED | Cliente<br>VALEO | Aprobación cliente | Revisado por<br>Jorge Dib | |

| PROCESO | DESCRIPCION | MAQUINA UTILLAJE | CARACTERISTICAS NO. | PRODUCTO | PROCESO | CLASE ESPECI. | METODO ESPECIFICAION TOLERANCIA PRODUC/PROCES | METODO DE EVALUACION | MUESTRA TAMANO | FREC. | METODO CONTROL | PLAN DE ACCION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **10** | **Recepción de la materia prima: -PC Makrolon Led 2245 (206.020.10)** | **Almacen materia prima** | 1 | Cumplimiento de las normas de cliente | | | Especificaciones material según norma cliente norma GMW14797 | Certificado del proveedor | Con las muestras iniciales | A la homologación | recepción del certificado de proveedor | Rechazar material para el proyecto. Rehomologar un alternativo |
| | | | 2 | Características técnicas de la materia prima | | | Hoja técnica material Procesabilidad en condiciones estándar aprobadas | Pauta de control C03i05 | 2Kg. | Tres primeros lotes S/ proc AQP: PRC03_50 | Según Pauta PRC03_50 | Rechazo de la materia prima. Identificación y devolución al proveedor |
| | | | 3 | Condiciones de suministro | | | Según acuerdo comercial | Pauta de control C03i05; | Cada lote | Tres primeros lotes S/ proc AQP: PRC03_50 | Según Pauta PRC03_50 | Rechazo de la materia prima. Identificación y devolución al proveedor |
| **20** | **Tratamiento material** | **Secadora** | 4 | Contenido de humedad | | | Según ficha de material C03I02 | | Continuo | Continuo | El material esta embasado hermeticamente. Las bolsas no están abiertas | Detener la inyección hasta el secado correcto del material |
| **30** | **Arranque en serie** | **Máquina Inyección** | 5 | Liberación de muestra inicial | | | Proceso como el homologado S/ Pauta de control C04i06 | Aplicar Instrucción de arranque de producción ITP-PRC04/10 , y valorar 1ª muestra S/ Pauta de control C04i06 | 1 inyectada | Arranque | Muestra OK S/Pauta control C04i06 | Ajustar proceso hasta que la pieza cumpla con la especificación |
| **40** | **Inyección en serie** | **Máquina Inyección** | 6 | Comprobar material correcto | | | PC Makrolon Led 2245 (206.020.10) | Visual | N/A | Saco/ octabín | Comprobar referencia de material en el saco/octabín | Rechazar material |
| | | **Máquina Inyección** | 7 | Confirmación proceso homologado | | | Check list arranque de molde/proceso C04i09 | Check-list | N/A | Arranque | Evaluación inspector calidad | Corregir proceso hasta que esté como el homologado |
| | | **Máquina Inyección** | 8 | Liberación de muestra inicial | | | S/ Pauta de control C04i06 | Aplicar Instrucción de arranque de producción ITP-PRC04/10 , y valorar | 1 inyectada | Arranque | Muestra OK S/Pauta control C04i06 | Ajustar proceso hasta que la pieza cumpla con la especificación |
| | | **Máquina Inyección** | 9 | Peso | | SC | Peso pieza: 17+/-1gr | Medición mediante báscula de precisión | 1 inyectada | Se registra cada 8 horas | Control estadístico SPC | Identificar causas y tomar acciones correctivas. |

☐Prototipos ☐Preseries ☑Producción

# PLAN DE CONTROL

| Referencia Novatec | Responsable Novatec | Fecha Realización | Fecha Revisión | C0101i03 REV 3 |
|---|---|---|---|---|
| 151.044.00 | **Irene Lorente** | **30/09/2016** | 30/09/2016 | |
| Referencia Cliente: 90113814 | Fecha y nivel plano: DRW_L90113814_001 (12/05/2016) | Realizado por: Irene Lorente/Clara Lopez | | |
| Descripción: COLIMATORS MODULE LED | Cliente: VALEO — Aprobación cliente | Revisado por: Jorge Dib | | |

| PROCESO | DESCRIPCION | MAQUINA UTILLAJE | CARACTERISTICAS NO. | CARACTERISTICAS PRODUCTO | CARACTERISTICAS PROCESO | CLASE ESPECI. | METODO ESPECIFICAION TOLERANCIA PRODUC/PROCES | METODO DE EVALUACION | MUESTRA TAMAÑO | MUESTRA FREC. | METODO CONTROL | PLAN DE ACCION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Máquina Inyección** | 10 | Defectos dimensionales | | | VERIFICACION CON CONTRAPARTE | Comprobación con contraparte | 1 inyectada | Se registra cada 2 horas | Contraparte | Identificar causas y tomar acciones correctivas. |
| | | **Máquina Inyección** | 11 | Defectos generales de inyección | | | FALTA DE MATERIAL | Comprobación con pieza patrón | 1 inyectada | Se registra cada 2 horas | Visual | Parar proceso / Identificar causas y tomar acciones correctivas. |
| | | **Máquina Inyección** | 12 | Defectos generales de inyección | | | RAFAGAS | Comprobación con pieza patrón | 1 inyectada | Se registra cada 2 horas | Visual | Parar proceso / Identificar causas y tomar acciones correctivas. |
| | | **Máquina Inyección** | 13 | Defectos generales de inyección | | | BRILLOS | Comprobación con pieza patrón | 1 inyectada | Se registra cada 2 horas | Visual | Parar proceso / Identificar causas y tomar acciones correctivas. |
| | | **Máquina Inyección** | 14 | Defectos generales de inyección | | | LINEAS DE UNIÓN | Comprobación con pieza patrón | 1 inyectada | Se registra cada 2 horas | Visual | Parar proceso / Identificar causas y tomar acciones correctivas. |
| | | **Máquina Inyección** | 15 | Defectos generales de inyección | | | PIEZA DEFORMADA | Comprobación con pieza patrón | 1 inyectada | Se registra cada 2 horas | Visual | Parar proceso / Identificar causas y tomar acciones correctivas. |
| | | **Máquina Inyección** | 17 | Defectos generales de inyección | | | CONTAMINACIÓN Y/O PUNTOS NEGROS FUERA DE LOS TAMAÑOS ESPECIFICADOS | Comprobación con pieza patrón | 1 inyectada | Se registra cada 2 horas | Visual | Identificar causas y tomar acciones correctivas. |
| | | **Máquina Inyección** | 18 | Defectos generales de inyección | | | PIEZA RECHUPADA | Comprobación con pieza patrón | 1 inyectada | Se registra cada 2 horas | Visual | Identificar causas y tomar acciones correctivas. |
| | | **Máquina Inyección** | 19 | Defectos generales de inyección | | | PIEZA CON QUEMAZOS | Comprobación con pieza patrón | 1 inyectada | Se registra cada 2 horas | Visual | Identificar causas y tomar acciones correctivas. |
| | | **Máquina Inyección** | 20 | Defectos generales de inyección | | | PUNTOS FRIOS | Comprobación con pieza patrón | 1 inyectada | Se registra cada 2 horas | Visual | Identificar causas y tomar acciones correctivas. |
| | | **Máquina Inyección** | 21 | Defectos generales de inyección | | | PUNTO DE INYECCIÓN FUERA DE ESPECIFICACION | Comprobación con pieza patrón | 1 inyectada | Se registra cada 2 horas | Visual | Identificar causas y tomar acciones correctivas. |
| | | **Máquina Inyección** | 22 | Defectos generales de inyección | | | BURBUJAS | Comprobación con pieza patrón | 1 inyectada | Se registra cada 2 horas | Visual | Identificar causas y tomar acciones correctivas. |

☐ Prototipos ☐ Preseries ☑ Producción

# PLAN DE CONTROL

| Referencia Novatec | Responsable Novatec | Fecha Realización | Fecha Revisión | C0101i03 REV 3 |
|---|---|---|---|---|
| 151.044.00 | **Irene Lorente** | **30/09/2016** | 30/09/2016 | |
| Referencia Cliente: 90113814 | Fecha y nivel plano: DRW_L90113814_001 (12/05/2016) | Realizado por: Irene Lorente/Clara Lopez | | |
| Descripción: COLIMATORS MODULE LED | Cliente: VALEO — Aprobación cliente | Revisado por: Jorge Dib | | |

| PROCESO | DESCRIPCION | MAQUINA UTILLAJE | CARACTERISTICAS NO. | CARACTERISTICAS PRODUCTO | CARACTERISTICAS PROCESO | CLASE ESPECI. | METODO ESPECIFICAION TOLERANCIA PRODUC/PROCES | METODO DE EVALUACION | MUESTRA TAMANO | MUESTRA FREC. | METODO CONTROL | PLAN DE ACCION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Máquina Inyección** | 23 | Defectos generales de inyección | | | REBABAS GENERALES | Comprobación con pieza patrón | 1 inyectada | Se registra cada 2 horas | Visual | Identificar causas y tomar acciones correctivas. |
| | | **Máquina Inyección** | 24 | Defectos generales de inyección | | | SUCIEDAD / MANCHAS | Comprobación con pieza patrón | 1 inyectada | Se registra cada 2 horas | Visual | Identificar causas y tomar acciones correctivas. |
| | | **Máquina Inyección** | 25 | Defectos generales de inyección | | | MARCAS / GOLPES | Comprobación con pieza patrón | 1 inyectada | Se registra cada 2 horas | Visual | Identificar causas y tomar acciones correctivas. |
| | | **Máquina Inyección** | 26 | Defectos generales de inyección | | | AGUJEROS POSICIONADORES NOK | Comprobación con pieza patrón | 1 inyectada | Se registra cada 2 horas | Visual | Identificar causas y tomar acciones correctivas. |
| | | **Máquina Inyección** | 27 | Defectos generales de inyección | | | HUMO | Comprobación con pieza patrón | 1 inyectada | Se registra cada 2 horas | Visual | Identificar causas y tomar acciones correctivas. |
| | | **Máquina Inyección** | 28 | Defectos generales de inyección | | | GRIETAS | Comprobación con pieza patrón | 1 inyectada | Se registra cada 2 horas | Visual | Identificar causas y tomar acciones correctivas. |
| | | **Máquina Inyección** | 29 | Defectos generales de inyección | | | AMARILLEAMIENTO | Comprobación con pieza patrón | 1 inyectada | Se registra cada 2 horas | Visual | Identificar causas y tomar acciones correctivas. |
| **50** | **Embalaje** | **Puesto de trabajo** | 30 | Cantidad correcta de piezas | | | Según hoja de embalaje | Comparación con documentación de proceso | 100% embalajes | 100% embalajes | Visual | Retener en producción hasta asegurar la cantidad correcta |
| | | **Puesto de trabajo** | 31 | Embalaje y etiquetado correcto | | | Según pauta de embalaje/ instrucción de identificación | Comparación con documentación de proceso | 100% embalajes | 100% embalajes | Liberación contenedor producto elaborado | Retener en producción hasta etiquetar correctamente |
| **60** | **Auditorías PT** | **Puesto de revision auditorias** | 32 | Pieza Ok según pauta auditorias PT | | | Pauta auditorías PT | Visual | 1 | Cada unidad de embalaje **Según plan de auditorias** | Comprobación con pieza patrón | Retener envío y buscar corte |
| | | **Puesto de revision auditorias** | 33 | Embalaje incorrecto de las referencias | | | Pauta auditorías PT | Visual | 1 | Cada unidad de embalaje | Comprobación con hoja de embalaje y presentación producción | Colocar las piezas en su embalaje correspondiente según hoja de embalaje |
| | | **Puesto de revision auditorias** | 34 | Configuración de embalaje etiquetaje según especificación de cliente | | | Pauta de embalaje/ expedición | Carga configurada y etiquetada según la pauta | 100% unidad embalaje | 100% unidad embalaje | Autocontrol en auditorías | Reetiquetar |
| **70** | **Stock almacén producto terminado** | **Almacén** | 35 | Embalaje sin daños | | | Según pauta de embalaje estándar de la industria | Carga sin deterioro | 100% unidad embalaje | 100% unidad embalaje | Visual | Enviar cargas defectuosas a auditorías |

☐ Prototipos ☐ Preseries ☑ Producción

# PLAN DE CONTROL

| Referencia Novatec | Responsable Novatec | | Fecha Realización | Fecha Revisión | C0101i03 REV 3 |
|---|---|---|---|---|---|
| 151.044.00 | **Irene Lorente** | | **30/09/2016** | 30/09/2016 | |
| Referencia Cliente | Fecha y nivel plano | | Realizado por | | |
| 90113814 | DRW_L90113814_001 (12/05/2016) | | Irene Lorente/Clara Lopez | | |
| Descripción | Cliente | Aprobación cliente | Revisado por | | |
| COLIMATORS MODULE LED | VALEO | | Jorge Dib | | |

| PROCESO | DESCRIPCION | MAQUINA UTILLAJE | CARACTERISTICAS | | | CLASE ESPECI. | METODO | | | | | PLAN DE ACCION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | NO. | PRODUCTO | PROCESO | | ESPECIFICAION TOLERANCIA PRODUC/PROCES | METODO DE EVALUACION | MUESTRA TAMAÑO | MUESTRA FREC. | METODO CONTROL | |
| | | **Almacén** | 36 | Configuración de embalaje y etiquetaje según especificación de cliente | | | Pauta de embalaje/ expedición | Carga configurada y etiquetada según la pauta | 100% unidad embalaje | 100% unidad embalaje | Autocontrol en expediciones | Reetiquetar |
| **80** | **Expedición** | **Almacen** | 37 | Configuración de envio y albaran según especificación de cliente | | | Pauta de expedicion | Carga configurada y etiquetada según la pauta | 100% unidad embalaje | 100% unidad embalaje | Autocontrol en expediciones | Revisar albaran/carga antes de envio |

| | | |
|---|---|---|
| REV 1 | 27/09/2016 | EMISIÓN DEL DOCUMENTO |
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# ANEXO 2: CERTIFICADOS DE INSPECCIÓN DE MATERIAL

1. CERTIFICADO PRIMERO .......... 2
2. CERTIFICADO SEGUNDO .......... 3
3. CERTIFICADO TERCERO .......... 5
4. CERTIFICADO CUARTO .......... 7

# Certificado de inspec. (EN 10204-3.1)

Covestro Deutschland AG
Kaiser-Wilhelm-Allee
51373 Leverkusen

VALEO ILUMINACION S.A.
Enrique Serrano
c/Torneros(muelles) c/Forja(oficina
23600 MARTOS (JAEN)
SPANIEN

Fecha 2016-12-08



| **Nombre del producto** | **Número de producto** |
|---|---|
| MAKROLON LED2245<br>550207<br>PE-BAG 25KG HT-PAL 1250KG | 61502082 |

## Datos del pedido del cliente

| Destinatario de la mercancía | Cantidad pedida | Número de pedido del cliente | Número de producto del cliente |
|---|---|---|---|
| 999247 COV-c/o ValeoIluminacion | 12500 KG | 5502010833 | 90095818 |

## Datos del pedido

| Número de pedido | Número de albarán | Cantidad a enviar | Número de unidades enviadas |
|---|---|---|---|
| 3009645505 / 10 | 4002337607 / 10 | 12500 KG | 10 |

## Datos del lote

| Lote n° | Cantidad a enviar |
|---|---|
| 01PM6L0830 | 12500 KG |

| Inspecciones | Metodo | Resultado | Especificación | Unidad |
|---|---|---|---|---|
| MVR | ISO 1133<br>300°C / 1.2 kg | 33,0 | 30,0 - 38,0 | cm³/10min |
| MFR | ASTM D 1238<br>300°C / 1.2 kg | 34,8 | 31,7 - 40,1 | g/10min |
| Delta a | DIN 6174 / ASTM D 2244 | -0,01 | -0,15 - 0,15 | |
| Delta b | DIN 6174 / ASTM D 2244 | -0,11 | -0,30 - 0,30 | |

Para cualquier pregunta, su interlocutor es:
Dr. Michael Mutz PCS-RD-TPQM-PSM
Fax: +49 214 6009 963142
Mail: michael.mutz@covestro.com

1. El presente documento ha sido creado de forma electrónica y es válido sin necesidad de firma.
2. La información y los valores mencionados no aseguran la adecuación de la sustancia para ningún fin determinado ni conllevan ninguna garantía. Dicha información no exime al cliente de realizar los controles de recepción de mercancías.
3. Estos valores han sido confirmados por un inspector de recepción independiente contratado por Covestro.

# Certificado de inspec. (EN 10204-3.1)

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Kaiser-Wilhelm-Allee
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Enrique Serrano
c/Torneros(muelles) c/Forja(oficina
23600 MARTOS (JAEN)
SPANIEN

Fecha 2017-01-27



| **Nombre del producto** | **Número de producto** |
|---|---|
| M.LED2245P 000000 BA125X | 61502074 |
| Kunden-Mat.Nr. 90008133/5502001666 | |

## Datos del pedido del cliente

| Destinatario de la mercancía | Cantidad pedida | Número de pedido del cliente | Número de producto del cliente |
|---|---|---|---|
| 999247 COV-c/o ValeoIluminacion | 20000 KG | 5502001666 | 90008133 |

## Datos del pedido

| Número de pedido | Número de albarán | Cantidad a enviar | Número de unidades enviadas |
|---|---|---|---|
| 3009678143 / 10 | 4002445468 / 10 | 20200 KG | 17 |

## Datos del lote

| Lote n° | Cantidad a enviar |
|---|---|
| 01PM6N1120 | 200 KG |

| Inspecciones | Metodo | Resultado | Especificación | Unidad |
|---|---|---|---|---|
| MVR | ISO 1133<br>300°C / 1.2 kg | 34,9 | 30,0 - 38,0 | cm³/10min |
| MFR | ASTM D 1238<br>300°C / 1.2 kg | 36,8 | 31,7 - 40,1 | g/10min |
| Yellowness Index | ASTM E 313 ( D65/10° ) | 1,0 | <= 1,8 | |

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23600 MARTOS (JAEN)
SPANIEN

Fecha 2017-01-27



## Nombre del producto

M.LED2245P 000000 BA125X
Kunden-Mat.Nr. 90008133/5502001666

## Número de producto

61502074

## Datos del pedido del cliente

| Destinatario de la mercancía | Cantidad pedida | Número de pedido del cliente | Número de producto del cliente |
|---|---|---|---|
| 999247 COV-c/o ValeoIluminacion | 20000 KG | 5502001666 | 90008133 |

## Datos del pedido

| Número de pedido | Número de albarán | Cantidad a enviar | Número de unidades enviadas |
|---|---|---|---|
| 3009678143 / 10 | 4002445468 / 10 | 20200 KG | 17 |

## Datos del lote

| Lote n° | Cantidad a enviar |
|---|---|
| 01PM7A0080 | 20000 KG |

| Inspecciones | Metodo | Resultado | Especificación | Unidad |
|---|---|---|---|---|
| MVR | ISO 1133<br>300°C / 1.2 kg | 34,4 | 30,0 - 38,0 | cm³/10min |
| MFR | ASTM D 1238<br>300°C / 1.2 kg | 32,6 | 31,7 - 40,1 | g/10min |
| Yellowness Index | ASTM E 313 ( D65/10° ) | 0,9 | <= 1,8 | |

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23600 MARTOS (JAEN)
SPANIEN

Fecha 2017-01-27



**Nombre del producto**
M.LED2245P 000000 BA125X
Kunden-Mat.Nr. 90008133/5502001666

**Número de producto**
61502074

## Datos del pedido del cliente

| Destinatario de la mercancía | Cantidad pedida | Número de pedido del cliente | Número de producto del cliente |
|---|---|---|---|
| 999247 COV-c/o ValeoIluminacion | 20000 KG | 5502001666 | 90008133 |

## Datos del pedido

| Número de pedido | Número de albarán | Cantidad a enviar | Número de unidades enviadas |
|---|---|---|---|
| 3009678143 / 10 | 4002445468 / 10 | 20200 KG | 17 |

## Datos del lote

| Lote n° | Cantidad a enviar |
|---|---|
| 01PM6N1120 | 200 KG |

| Inspecciones | Metodo | Resultado | Especificación | Unidad |
|---|---|---|---|---|
| MVR | ISO 1133<br>300°C / 1.2 kg | 34,9 | 30,0 - 38,0 | cm³/10min |
| MFR | ASTM D 1238<br>300°C / 1.2 kg | 36,8 | 31,7 - 40,1 | g/10min |
| Yellowness Index | ASTM E 313 ( D65/10° ) | 1,0 | <= 1,8 | |

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23600 MARTOS (JAEN)
SPANIEN

Fecha 2017-01-27



| **Nombre del producto** | **Número de producto** |
|---|---|
| M.LED2245P 000000 BA125X | 61502074 |
| Kunden-Mat.Nr. 90008133/5502001666 | |

## Datos del pedido del cliente

| Destinatario de la mercancía | Cantidad pedida | Número de pedido del cliente | Número de producto del cliente |
|---|---|---|---|
| 999247 COV-c/o ValeoIluminacion | 20000 KG | 5502001666 | 90008133 |

## Datos del pedido

| Número de pedido | Número de albarán | Cantidad a enviar | Número de unidades enviadas |
|---|---|---|---|
| 3009678143 / 10 | 4002445468 / 10 | 20200 KG | 17 |

## Datos del lote

| Lote n° | Cantidad a enviar |
|---|---|
| 01PM7A0080 | 20000 KG |

| Inspecciones | Metodo | Resultado | Especificación | Unidad |
|---|---|---|---|---|
| MVR | ISO 1133<br>300°C / 1.2 kg | 34,4 | 30,0 - 38,0 | cm³/10min |
| MFR | ASTM D 1238<br>300°C / 1.2 kg | 32,6 | 31,7 - 40,1 | g/10min |
| Yellowness Index | ASTM E 313 ( D65/10° ) | 0,9 | <= 1,8 | |

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23600 MARTOS (JAEN)
SPANIEN

Fecha 2017-02-08

Página 1

| Nombre del producto | | | Número de producto |
|---|---|---|---|
| M.LED2245P | 000000 | BA125X | 61502074 |
| Kunden-Mat.Nr. 90008133/5502001666 | | | |

## Datos del pedido del cliente

| Destinatario de la mercancía | Cantidad pedida | Número de pedido del cliente | Número de producto del cliente |
|---|---|---|---|
| 999247 COV-c/o ValeoIluminacion | 20000 KG | 5502001666 | 90008133 |

## Datos del pedido

| Número de pedido | Número de albarán | Cantidad a enviar | Número de unidades enviadas |
|---|---|---|---|
| 3009678144 / 10 | 4002476343 / 10 | 20000 KG | 16 |

## Datos del lote

| Lote n° | Cantidad a enviar |
|---|---|
| 01PM7A0080 | 6250 KG |

| Inspecciones | Metodo | Resultado | Especificación | Unidad |
|---|---|---|---|---|
| MVR | ISO 1133<br>300°C / 1.2 kg | 34,4 | 30,0 - 38,0 | cm³/10min |
| MFR | ASTM D 1238<br>300°C / 1.2 kg | 32,6 | 31,7 - 40,1 | g/10min |
| Yellowness Index | ASTM E 313 ( D65/10° ) | 0,9 | <= 1,8 | |

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3. Estos valores han sido confirmados por un inspector de recepción independiente contratado por Covestro.

# Certificado de inspec. (EN 10204-3.1)

Covestro Deutschland AG
Kaiser-Wilhelm-Allee
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VALEO ILUMINACION S.A.
Enrique Serrano
c/Torneros(muelles) c/Forja(oficina
23600 MARTOS (JAEN)
SPANIEN

Fecha 2017-02-08



| Nombre del producto | | | Número de producto |
|---|---|---|---|
| M.LED2245P | 000000 | BA125X | 61502074 |

Kunden-Mat.Nr. 90008133/5502001666

## Datos del pedido del cliente

| Destinatario de la mercancía | Cantidad pedida | Número de pedido del cliente | Número de producto del cliente |
|---|---|---|---|
| 999247 COV-c/o ValeoIluminacion | 20000 KG | 5502001666 | 90008133 |

## Datos del pedido

| Número de pedido | Número de albarán | Cantidad a enviar | Número de unidades enviadas |
|---|---|---|---|
| 3009678144 / 10 | 4002476343 / 10 | 20000 KG | 16 |

## Datos del lote

| Lote n° | Cantidad a enviar |
|---|---|
| 01PM7A0920 | 13750 KG |

| Inspecciones | Metodo | Resultado | Especificación | Unidad |
|---|---|---|---|---|
| MVR | ISO 1133<br>300°C / 1.2 kg | 32,9 | 30,0 - 38,0 | cm³/10min |
| MFR | ASTM D 1238<br>300°C / 1.2 kg | 34,7 | 31,7 - 40,1 | g/10min |
| Yellowness Index | ASTM E 313 ( D65/10° ) | 1,0 | <= 1,8 | |

Para cualquier pregunta, su interlocutor es:

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# ANEXO 3: ESPECIFICACIONES TÉCNICAS DEL MATERIAL


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# The chemical resistance of Makrolon®

The property values listed in the Makrolon® Technical Information have been established on standardized test specimens produced in accordance with the standardized procedures. The tests are generally performed in a surrounding medium of clean air. If a finished part in Makrolon® is in contact with other media, its properties may undergo considerable change.

## 1. Influencing parameters

The extent to which the properties of the material are influenced is a function of the:

- composition of the surrounding media
- temperature
- duration of exposure
- level of inherent or applied stress and strain prevailing in the molded part

## 2. Types of damage

A distinction can be drawn between different types of damage. It is also possible for individual surrounding media to act simultaneously following more than one type of damage.

### Dissolution or swelling

Low-molecular, aromatic, halogenated and polar components migrate into the polycarbonate. The damage can range from a tacky surface to complete dissolution.

### Stress cracking

A number of chemicals penetrate the surface slightly, in small quantities, and cause a concentration gradient to develop in the polycarbonate, thereby loosening the bonding forces between the molecules. Stresses prevailing in the molded part then relax by causing stress cracks to form. Stress cracks can affect the appearance of a molded part. The pronounced notched effect of the stress cracks leads to a pronounced deterioration in a number of mechanical properties - and particularly in those that can be derived from the impact, flexural and tensile tests. With transparent grades, the stress cracks are generally easy to see. In opaque grades it is frequently impossible to detect them. Mechanical tests are then required, with the impact strength or flexural strength generally being taken as indicator properties in laboratory tests.

### Molecular degradation

A number of the properties of Makrolon® are determined by the size of its molecules. If a contact medium causes a reduction in molecular weight through a chemical reaction then this will affect especially the tough and resilient properties of the material. The molecular weight level has virtually no influence on electrical properties and only a slight influence on thermal properties.

As an ester of bisphenol A and carbonic acid, polycarbonate will gradually be split into these components again by water at a high temperature, for instance. Alkalis act as pronounced catalysts during hydrolysis. Acid catalysis is only weak. Alcohols and carboxylic acids can similarly lead to molecular degradation through ester interchange. Amines can cause pronounced molecular damage in some cases through transamination. Ammonia and low-molecular, aliphatic, primary and secondary amines are particularly aggressive in the presence of traces of water. High-molecular, slightly basic amines are less critical.

### Oxidative damage

The potential oxidative damage that can occur with a number of other polymers, such as natural rubber and polypropylene plays a relatively minor role with polycarbonate. Makrolon® is relatively stable vis-à-vis oxidizing agents. Hence, the reaction with atmospheric oxygen is only of minor significance, even in the absence of stabilizers and at temperatures in excess of 100 °C. This is why Makrolon® displays remarkably high stability vis-à-vis 10 % nitric acid and hydrogen peroxide by comparison to a large number of other polymers.

**Influence of temperature and duration of exposure**

The time that elapses before damage occurs becomes shorter as the temperature rises. The exposure time required for initial damage ranges from just a few seconds to more than 1000 hours as a function of the chemical involved, the temperature and the stress level. When molded parts with pronounced stresses are immersed in propylene carbonate, for instance, stress cracks will occur in less than one minute. Low-stress moldings in appropriate Makrolon® grades, by contrast, will withstand frequent cleaning with a 2 % aqueous sodium hydroxide solution at 80 °C. The residence time should be kept short and the aggressive medium removed from the molded part surface in its entirety after use.

## 3. Molded part testing to meet practical requirements

If finished parts are likely to come into contact with aggressive media during use, then it is essential to subject them to the appropriate form of testing. Information on compatibility that has been obtained in the laboratory can only be viewed as a guide. The stress states prevailing in the molded part, together with the force acting from outside, can lead to considerably different results.

Short-time contact with aggressive media at below the damage threshold assumes that the medium is removed in its entirety and does not remain in prolonged contact with the material through capillary forces, such as at screw connections or the like. Practical tests are absolutely essential for applications of this type.

In the case of contact with what are essentially compatible solids, it is possible for a component which is capable of migration to move over to the polycarbonate in the course of long-term contact and damage it. One example of this is the contact between polycarbonate and plasticized PVC, in components like terminal strips and PVC insulation, where plasticizers such as dioctyl phthalate, which trigger stress corrosion cracking, cause damage to the polycarbonate.

Stress crack will only develop, however, if tensile stresses prevail in the molded part as a result of its production and/or are applied from the outside. If the molded part is completely stress free or is subject solely to compressive stress, then no stress cracking will occur. If a plasticized PVC tube is mounted on a stress-free polycarbonate pipe, for instance, the polycarbonate will simply swell slightly (the amount of swelling increasing with the plasticizer migration), and the components will weld together. Practical tests on the finished part are absolutely essential in this case too.

It should be borne in mind that the composition of a number of technical substances is subject to change. A laboratory test can only supply information on the batch that has been tested.

Our test laboratories have tested a series of chemicals and commercial products to establish the influence that they have on polycarbonate. If the information given below does not suffice for your purposes, kindly contact your Bayer service representative, who will establish whether we have any further experience in respect of your particular question.

## 4. Compatibility assessment methods

The simplest method is the template method (flexural strip method to DIN 53449-3). This involves test pieces of 80 x 10 x 4 $mm^3$ in size being clamped to curved templates in such a way that a graduated outer fiber strain ranging from 0 to 2 % is applied. A comparative study must be conducted in air under otherwise identical conditions. What is compared is the reduction in maximum strain that produces no damage both with and without the medium.

Details on this can be found in our Technical Information Sheet "Environmental Stress Cracking - Bend strip test".

## 5. Assessment criteria

The information given in the Table that follows is based on tests to reveal the outer fiber strain as of which Makrolon® 2800 suffered damage at 23 °C, or at a higher temperature where this is indicated, over a period of 6 days. Components that lead to damage with an outer fiber strain of ε < 1.0 % are routinely classified as incompatible.

## 6. Resistance

**Resistance to chemicals**
(see table on page 4)

**Resistance to oils, greases, waxes and fuels**

Makrolon® is resistant to most of the industrial oils, greases and waxes tested in our laboratory over 6 days at 23 °C. A series of the products tested did not produce any inadmissible changes in test pieces made of Makrolon® 2800 after 6 days at 60 °C either. Resistance is only assured if the technical products are free of low-molecular, aromatic and polar components and of other components that trigger stress corrosion cracking. It should be borne in mind that oils heated to a high temperature can decompose and then form aggressive components. Makrolon® is not resistant to the standard carburetor and diesel fuels. The low-molecular, aromatic hydrocarbons that are present in carburetor fuel, in particular, cause cracking in parts that are subject to stress.

**Resistance to sealing compounds and plastics**

Makrolon® is resistant to a large number of sealing compounds for 6 days at 23 °C and for 6 days at 60 °C.

Details on this can be found in our Technical Information Sheet "Sealing compounds for use with Makrolon®".

A condition of this resistance is that there should be no aggressive components, such as plasticizers or solvents, which migrate out of the compound and attack the polycarbonate. The same situation also applies to contact with other plastics. Although high-molecular plastics have an inert effect on Makrolon®, the polycarbonate can be damaged by migrating plasticizer (e.g. plasticized PVC), physical blowing agents (from a number of foamed plastics) and out gassing amines (e.g. decomposition products from vulcanization accelerators in rubber or amines from amino plastic). In the same way, if polycarbonate is subjected to joint heat treatment with polyamide 6, it is possible for ε caprolactam to migrate from the PA to the PC and cause degradation.

Tests should thus be conducted in each case in order to establish whether the material components will be sufficiently compatible in service.

**Resistance to adhesives**

Makrolon® is resistant to a series of adhesives.

Details on this can be found in our Technical Information Sheet "The Adhesive Bonding of Makrolon®".

**Resistance to paints**

In the case of paints containing solvents, stress cracking or swelling may occur as a function of the solvent and the flash-off conditions. Through correctly-tailored solvent aggressiveness and flash-off conditions, it is possible to achieve paints that do not damage polycarbonate. The hardened paint can even enhance the media compatibility of the finished part.

Makrolon® is also sufficiently resistant to two-component paints if the individual components do not cause any damage in the short period between the application and the hardening of the paint. Makrolon® is not resistant to turpentine and hence not resistant to paints containing turpentine either.

## Resistance to chemicals

| | 6 days / 23 °C | 6 days / 50 °C |
|---|---|---|
| Acetic acid, 10 % in water | **+** | **+** |
| Acetone | **swells** | |
| Ammonia, 0.1 % in water | **-** | |
| Ammonium nitrate, 10 % in water/neutral | **+** | **-** |
| Benzene | **swells** | |
| Benzine (free from aromatic hydrocarbons) | **+** | **+** |
| Butyl acetate | **-** | |
| Carbon tetrachloride | **swells** | |
| Chloroform | **dissolves** | |
| Citric acid, 10 % in water | **+** | |
| Dibutyl phthalate | **-** | |
| Diethyl ether | **-** | |
| Dimethyl formamide | **dissolves** | |
| Dioctyl phthalate | **-** | |
| Dioxane | **dissolves** | |
| Ethanol (pure) | **+** | **+** |
| Ethyl acetate | **swells** | |
| Ethylamine | **-** | |
| Ethylene chloride | **swells** | |
| Ethylene glycol, 1:1 with water | **+** | **+** |
| Glycerin | **reacts** | |
| Hexane | **+** | **+** |
| Hydrochloric acid, 10% in water | **+** | **+** |
| Hydrogen peroxide, 30 % in water | **+** | |
| Iron(III) chloride, saturated/aqueous solution | **+** | **+** |
| Isooctane (2,2,4-trimethyl pentane), pure | **+** | **+ (40 °C)** |
| Isopropanol (pure) | **+** | |
| Methanol | **-** | |
| Methyl ethyl ketone | **swells** | |
| Methylamine | **reacts** | |
| Methylene chloride | **dissolves** | |
| Nitric acid, 10 % in water | **+** | |
| n-propanol | **- (30 °C)** | |
| Ozone, 1 % in air | **-** | |
| Paraffin, paraffin oil, pure/free from aromatic hydrocarbons | **+** | **+** |
| Phosphoric acid, 1 % in water | **+** | **-** |
| Potassium hydroxide, 1 % in water | **-** | |
| Propane | **+** | **+** |
| Silicone oil | **+** | **+** |
| Sodium carbonate (soda), 10 % in water | **+** | **- (70 °C)** |
| Sodium chloride, saturated/aqueous solution | **+** | **+** |
| Sodium hydroxide (caustic soda), 1 % in water | **-** | |
| Sodium nitrate, 10 % in water | **+** | |
| Styrene | **-** | |
| Sulfuric acid, 10 % in water | **+** | **+** |
| Tetrachloroethane | **swells** | |
| Tetrachloroethylene | **-** | |
| Trichloroethylene | **swells** | |
| Tricresyl phosphate | **-** | |
| Triethylene glycol | **+** | **+** |
| Xylene | **swells** | |

**+** = resistant **-** = non resistant

### Resistance to cleaning and washing agents

Cleaning and washing agents are a class of products with many different compositions. These frequently contain individual components to which Makrolon® is not resistant.

Makrolon® is resistant to normal soaps but not to amines, ammonia, a small number of solvent components and a large number of high-gloss drying aids. Rinsing agents incorporating high-gloss drying aids are also unsuitable for polycarbonate in some cases.

Although high-gloss drying aids can generally be classified as compatible on the basis of short-time tests, which correspond to the short rinsing times that prevail, the decisive factor is that part of the dilute high-gloss drying aid solution is left on the surface of the polycarbonate, where it concentrates and remains on the molded part for a prolonged period of time.

Details on this can be found in our Technical Information Sheet "Cleaning, Disinfection and Sterilisation of Parts in Makrolon®".

### Resistance to foods and luxury foods

Makrolon® does not normally undergo any changes when in contact with the majority of foods and luxury foods, under standard conditions of use. Makrolon® is incompatible with a number of herbal and medicinal teas incorporating ethereal oils, as well as with a number of spices. Cloves, nutmeg and pimento can damage Makrolon®. It has been seen with fennel tea that brewed tea produced from fruits can contain ethereal oils in quantities that cause polycarbonate to swell.

### Resistance to disinfectants, drugs and cosmetics

Some of these contain solvents or active ingredients which damage Makrolon®. Polycarbonate is incompatible with nail varnish remover and nail varnish, for instance.

If the composition and action of the individual ingredients is known, it is frequently possible to estimate the influence that the substance will have on the properties of Makrolon®. It is even better to put the finished part through an appropriate practical test. If no empirical values are available, then a test on the finished part will always be necessary.



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# Makrolon LED2245

**Grades / Light guides**

Formerly Makrolon DP1-1857; MVR (300 °C/1.2 kg) 34 cm³/10 min; light guides; PC with highest transmission; low viscosity; easy release; injection molding - melt temperature 280 - 320 °C; available in color code 000000 only

**ISO Shortname**

ISO 7391-PC,MRT,(,,)-24-9

**Rheological properties**

| | Property | Test Condition | Unit | Standard | Value |
|---|---|---|---|---|---|
| C | Melt volume-flow rate | 300 °C; 1.2 kg | cm³/10 min | ISO 1133 | 34 |
| C | Molding shrinkage, parallel | 60x60x2 mm; 500 bar | % | ISO 294-4 | 0.65 |
| C | Molding shrinkage, normal | 60x60x2 mm; 500 bar | % | ISO 294-4 | 0.7 |

**Mechanical properties (23 °C/50 % r. h.)**

| | Property | Test Condition | Unit | Standard | Value |
|---|---|---|---|---|---|
| C | Tensile modulus | 1 mm/min | MPa | ISO 527-1,-2 | 2350 |
| C | Yield stress | 50 mm/min | MPa | ISO 527-1,-2 | 63 |
| C | Yield strain | 50 mm/min | % | ISO 527-1,-2 | 6.0 |
| C | Nominal strain at break | 50 mm/min | % | ISO 527-1,-2 | > 50 |
| | Stress at break | 50 mm/min | MPa | ISO 527-1,-2 | 60 |
| | Strain at break | 50 mm/min | % | b.o. ISO 527-1,-2 | 125 |
| | Flexural modulus | 2 mm/min | MPa | ISO 178 | 2350 |
| | Flexural strength | 2 mm/min | MPa | ISO 178 | 97 |
| | Flexural strain at flexural strength | 2 mm/min | % | ISO 178 | 7.1 |
| | Flexural stress at 3.5 % strain | 2 mm/min | MPa | ISO 178 | 73 |
| C | Charpy impact strength | 23 °C | kJ/m² | ISO 179-1eU | N |
| C | Charpy impact strength | -30 °C | kJ/m² | ISO 179-1eU | N |
| | Charpy impact strength | -60 °C | kJ/m² | ISO 179-1eU | N |
| | Charpy notched impact strength | 23 °C; 3 mm | kJ/m² | ISO 7391/b.o. ISO 179-1eA | 60P(C) |
| | Charpy notched impact strength | -30 °C; 3 mm | kJ/m² | ISO 7391/b.o. ISO 179-1eA | 12C |
| | Izod notched impact strength | 23 °C; 3 mm | kJ/m² | ISO 7391/b.o. ISO 180-A | 60P(C) |
| | Izod notched impact strength | -30 °C; 3 mm | kJ/m² | ISO 7391/b.o. ISO 180-A | 12C |
| | Izod notched impact strength | 23 °C; 3.2 mm | kJ/m² | b.o. ISO 180-A | 65P(C) |
| | Izod notched impact strength | -30 °C; 3.2 mm | kJ/m² | b.o. ISO 180-A | 12C |
| C | Puncture maximum force | 23 °C | N | ISO 6603-2 | 4900 |
| C | Puncture maximum force | -30 °C | N | ISO 6603-2 | 5900 |
| C | Puncture energy | 23 °C | J | ISO 6603-2 | 55 |
| C | Puncture energy | -30 °C | J | ISO 6603-2 | 60 |
| | Ball indentation hardness | | N/mm² | ISO 2039-1 | 115 |

# Makrolon LED2245

| | Property | Test Condition | Unit | Standard | Value |
|---|---|---|---|---|---|
| | **Thermal properties** | | | | |
| C | Glass transition temperature | 10 °C/min | °C | ISO 11357-1,-2 | 145 |
| C | Temperature of deflection under load | 1.80 MPa | °C | ISO 75-1,-2 | 125 |
| C | Temperature of deflection under load | 0.45 MPa | °C | ISO 75-1,-2 | 138 |
| C | Vicat softening temperature | 50 N; 50 °C/h | °C | ISO 306 | 145 |
| | Vicat softening temperature | 50 N; 120 °C/h | °C | ISO 306 | 146 |
| C | Coefficient of linear thermal expansion, parallel | 23 to 55 °C | $10^{-4}$/K | ISO 11359-1,-2 | 0.65 |
| C | Coefficient of linear thermal expansion, transverse | 23 to 55 °C | $10^{-4}$/K | ISO 11359-1,-2 | 0.65 |
| C | Burning behavior UL 94 [UL recognition] | 0.75 mm | Class | UL 94 | V-2 (CL) |
| | Burning behavior UL 94 [UL recognition] | 2.9 mm | Class | UL 94 | HB (CL) |
| C | Oxygen index | Method A | % | ISO 4589-2 | 28 |
| | Thermal conductivity | 23 °C | W/(m·K) | ISO 8302 | 0.20 |
| | Resistance to heat (ball pressure test) | | °C | IEC 60695-10-2 | 136 |
| | Relative temperature index (Tensile strength) [UL recognition] | 1.5 mm | °C | UL 746B | 125 |
| | Relative temperature index (Tensile impact strength) [UL recognition] | 1.5 mm | °C | UL 746B | 115 |
| | Relative temperature index (Electric strength) [UL recognition] | 1.5 mm | °C | UL 746B | 125 |
| | Glow wire test (GWFI) | 1.0 mm | °C | IEC 60695-2-12 | 850 |
| | Glow wire test (GWFI) | 1.5 mm | °C | IEC 60695-2-12 | 875 |
| | Glow wire test (GWFI) | 3.0 mm | °C | IEC 60695-2-12 | 930 |
| | Glow wire test (GWIT) | 0.75 mm | °C | IEC 60695-2-13 | 875 |
| | Glow wire test (GWIT) | 1.5 mm | °C | IEC 60695-2-13 | 875 |
| | Glow wire test (GWIT) | 3.0 mm | °C | IEC 60695-2-13 | 900 |
| | Burning rate (US-FMVSS) | >=1.0 mm | mm/min | ISO 3795 | passed |
| | Flash ignition temperature | | °C | ASTM D1929 | 480 |
| | Self ignition temperature | | °C | ASTM D1929 | 550 |
| | **Electrical properties (23 °C/50 % r. h.)** | | | | |
| C | Relative permittivity | 100 Hz | - | IEC 60250 | 3.1 |
| C | Relative permittivity | 1 MHz | - | IEC 60250 | 3.0 |
| C | Dissipation factor | 100 Hz | $10^{-4}$ | IEC 60250 | 5 |
| C | Dissipation factor | 1 MHz | $10^{-4}$ | IEC 60250 | 95 |
| C | Volume resistivity | | Ohm·m | IEC 60093 | 1E14 |
| C | Surface resistivity | | Ohm | IEC 60093 | 1E16 |
| C | Electrical strength | 1 mm | kV/mm | IEC 60243-1 | 34 |
| C | Comparative tracking index CTI | Solution A | Rating | IEC 60112 | 250 |
| | Comparative tracking index CTI M | Solution B | Rating | IEC 60112 | 125M |
| | **Other properties (23 °C)** | | | | |
| C | Water absorption (saturation value) | Water at 23 °C | % | ISO 62 | 0.30 |
| C | Water absorption (equilibrium value) | 23 °C; 50 % r. h. | % | ISO 62 | 0.12 |
| C | Density | | kg/m³ | ISO 1183-1 | 1190 |
| | Bulk density | Pellets | kg/m³ | ISO 60 | 660 |
| | **Material specific properties** | | | | |
| | Refractive index | Procedure A | - | ISO 489 | 1.584 |
| | Haze for transparent materials | 3 mm | % | ISO 14782 | < 0.5 |
| | Luminous transmittance (clear transparent materials) | 1 mm | % | ISO 13468-2 | 90 |
| C | Luminous transmittance (clear transparent materials) | 2 mm | % | ISO 13468-2 | 90 |
| | Luminous transmittance (clear transparent materials) | 3 mm | % | ISO 13468-2 | > 89 |
| | Luminous transmittance (clear transparent materials) | 4 mm | % | ISO 13468-2 | > 89 |

# Makrolon LED2245

| | Property | Test Condition | Unit | Standard | Value |
|---|---|---|---|---|---|
| | **Processing conditions for test specimens** | | | | |
| C | Injection molding-Melt temperature | | °C | ISO 294 | 280 |
| C | Injection molding-Mold temperature | | °C | ISO 294 | 80 |
| C | Injection molding-Injection velocity | | mm/s | ISO 294 | 200 |

**C** These property characteristics are taken from the CAMPUS plastics data bank and are based on the international catalogue of basic data for plastics according to ISO 10350.

Impact properties: N = non-break, P = partial break, C = complete break

# Makrolon LED2245

**Disclaimer**

General

The manner in which you use and the purpose to which you put and utilize our products, technical assistance and information (whether verbal, written or by way of production evaluations), including any suggested formulations and recommendations, are beyond our control. Therefore, it is imperative that you test our products, technical assistance and information to determine to your own satisfaction whether they are suitable for your intended uses and applications. This application-specific analysis must at least include testing to determine suitability from a technical as well as health, safety and environmental standpoint. Such testing has not necessarily been done by us. Unless we otherwise agree in writing, all products are sold strictly pursuant to the terms of our standard conditions of sale which are available upon request. All information and technical assistance is given without warranty or guarantee, and is subject to change without notice. It is expressly understood and agreed that you assume and hereby expressly release us from all liability, in tort, contract or otherwise, incurred in connection with the use of our products, technical assistance and information. Any statement or recommendation not contained herein is unauthorized and shall not bind us. Nothing herein shall be construed as a recommendation to use any product in conflict with patents covering any material or its use. No license is implied or in fact granted under the claims of any patent. Unless specified to the contrary, the property values given have been established on standardized test specimens at room temperature. The figures should be regarded as typical values only and not as binding limiting values. Please note that the properties can be affected by the design of the mold/die, the processing conditions and coloring. With respect to health, safety and environment precautions, the relevant Material Safety Data Sheets (MSDS) and product labels must be observed prior to working with our products.

Publisher: Global Innovations - Polycarbonates

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# The Injection Molding of High-Quality Molded Parts – Preparing the Material: Drying

- **Injection molding**

## Why is drying necessary?

The correct drying of plastics saves waste, disruptions to production and complaints. Moisture in and on the granules evaporates at the temperatures that prevail during processing and forms surface streaks and, in some cases, bubbles in the molded parts and semi-finished products. This will generally not be as severe as the examples shown in Fig. 1. In the case of plastics that are sensitive to hydrolysis, degradation of the molecular chains will also occur, causing a deterioration in the mechanical properties.

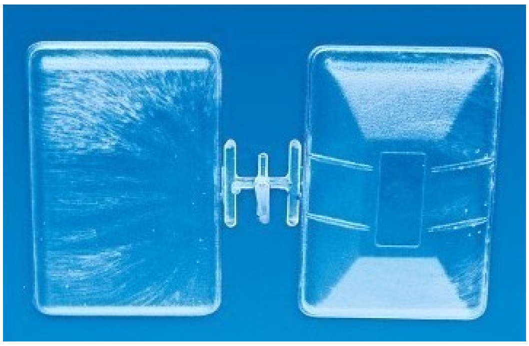

**Fig. 1: Molded part in material processed while moist.**

With a lower level of moisture and a higher flow resistance as the injection mold is being filled, it is possible for the escape of gas from the melt to be impeded. The molded part is then defect-free on the outside. Despite this, the material may have still been damaged through degradation, causing the part to undergo premature failure in use, such as through brittle fracture (Fig. 2). If this fault is not noticed, very expensive complaints will generally result.

Figure 3 shows the development of faults (which can occur in parallel) and offers drying as a remedy. In fact, adequate drying is indeed the only way to avoid the faults referred to above, together with the associated waste, disruptions to production and complaints.

**Fig. 2: Brittle fracture on a part made of hydrolytically degraded material.**

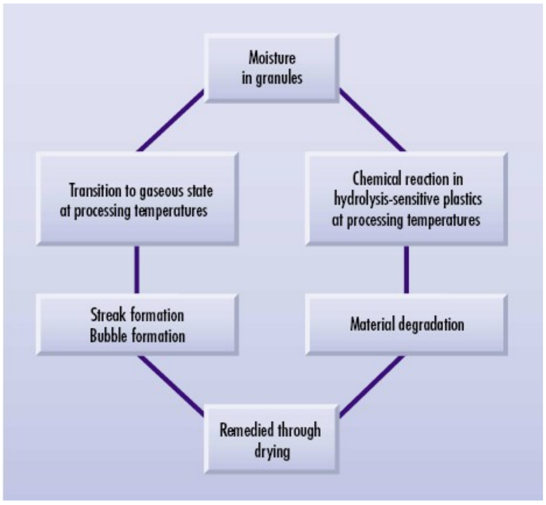


**Fig. 3: Fault development during the processing of moist material.**

The different chemical structures of Bayer MaterialScience´s thermoplastics and resultant sensitivity to hydrolysis lead to the following product classification in terms of the faults that can be expected if the material is processed in the moist state (Fig. 4).

| | | |
|---|---|---|
| PC<br>PC-HT | Makrolon®<br>Apec® | Surface imperfections<br>and always hydrolytic degradation |
| (PC-ABS) | Bayblend® | Surface imperfections, hydrolytic degradation<br>as a function of PC content; with a high ABS content behavior similar to ABS |
| (PC-PET)<br>(PC-PBT) | Makroblend® | Surface imperfections (not always visible)<br>and always hydrolytic degradation. |
| TPU | Desmopan® | Surface imperfections, possibly also hydrolytic<br>degradation as a function of the grade |

**Fig. 4: Faults caused by processing moist materials.**

Figure 5 shows the two fundamental approaches to drying. Details will first be given of "solids drying", i.e. the drying of the granules prior to processing. Drying the melt by means of vented plasticization will be covered separately. The following types of dryers are used to dry plastics:

- circulating air dryers (50 % fresh air)
- high-speed dryers operating with fresh air
- high-speed dryers with partially recirculated air
- dry-air dryers
- vacuum dryers

Dry-air dryers are generally used in central drying units.

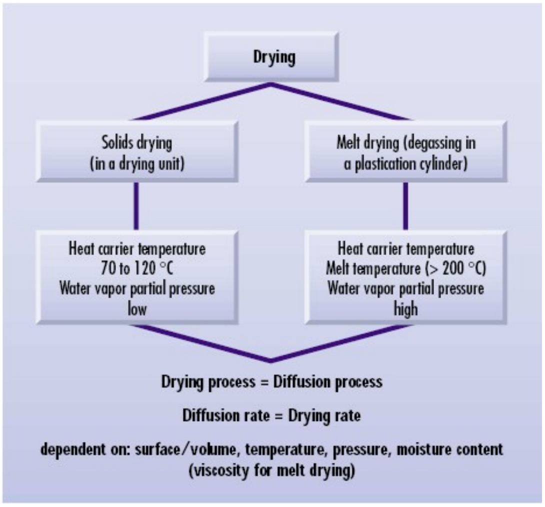


**Fig. 5: The two fundamental approaches to drying.**

Figure 6 shows empirical values for drying conditions which give the required drying results for injection

molding, providing that the equipment is operated correctly and is in perfect working order. Where a range is given, the lowest values are minimum values. The higher values are intended more for extrusion.

The table also shows that almost all Bayer MaterialScience thermoplastics can be dried on all the different drying units.

Vacuum or dry-air dryers are thus recommended for these materials, although vacuum drying is only used very rarely in practice (due to the very low drying capacity, among other things).

| Engineering thermoplastic | Drying temperature in °C | Drying time/ h | | |
|---|---|---|---|---|
| | | Circulating dryer (50 % fresh air) | Fresh air dryer | Dry air dryer |
| Apec® | 130 | 4 to 12 | 2 to 4 | 2 to 3 |
| Bayblend®1) | 100 to 110[1)] | 4 to 8 | 2 to 6 | 2 to 5 |
| Bayblend® FR[1)] | 85 to 110[1)] | | | |
| Makrolon® | 120 | 4 to 12 | 2 to 4 | 2 to 3 |
| Makroblend® | | | | |
| PC/PBT | 100 to 105 | 4 to 12 | 2 to 4 | 2 to 4 |
| PC/PET | 110 | 4 to 12 | 2 to 4 | 2 to 4 |

1) Depending on the grade 10 °C below the Vicat VST/B120 temperature, but not higher as the recommended values.
The above data apply to containers that have been stored at room temperature.
In the event of stoppages lasting four hours or more, we recommend reducing the temperature of the dryer by 40 °C.

**Fig. 6: Drying conditions.**

## Selecting a drying unit

The drying unit is therefore selected on the basis of the task in hand and the granule throughput rate. Drying cabinets are still in use today in cases where there are only small quantities of granules to be dried. On account of the low air-circulation rate in these cabinets, the granule layer should not be more than 3 cm deep if satisfactory drying results are to be attained within the specified times. Different types of high-speed and fresh-air dryer are available.

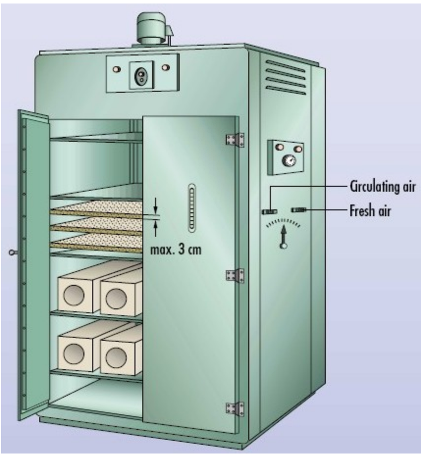


**Fig. 7: Drying cabinet.**

All high-speed dryers have a high air throughput rate. This increases the danger of dust from the surroundings being deposited on the granules via the air inlet, which is unfortunately a relatively frequent cause of faults on the molded part.

An intake filter can provide a remedy here and this ought to be cleaned at regular intervals. A clogged filter will reduce the air throughput and increase the required drying time.

The air outlet should similarly be equipped with a filter. This will prevent any plastic dust in with the granules from being blown into the surroundings. In the case of glass fiber reinforced plastics, this dust can even contain fine particles of glass.

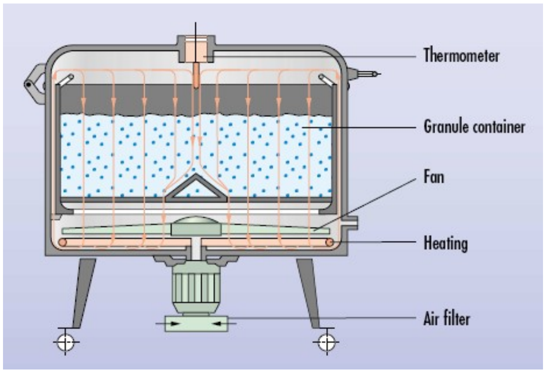


**Fig. 8: Operating principle of a high-speed dryer – air is sucked through the granules from above.**

**Fig. 9: Hot-air dryer (PIOVAN, Munich).**

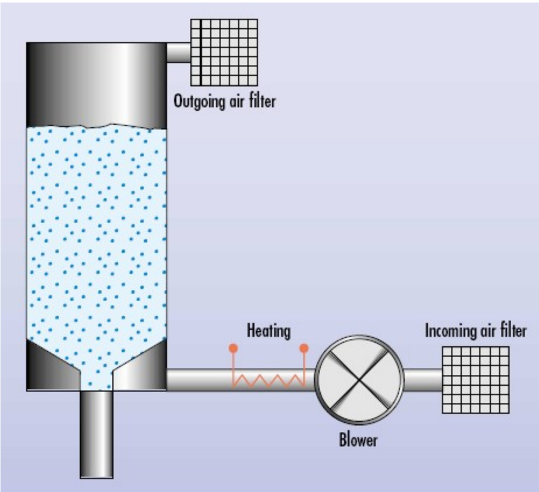


**Fig. 10: Operating principle of a high-speed dryer – air is blown through the bed of granules from below.**

The measurement results in Fig. 11 show that, even with “high-speed dryers ”, the drying process cannot be sped up at will. After the drying temperature has been reached in the lower section of the bed of granules, it will take a further 70 minutes or so for the permitted level of residual moisture to be achieved. It will then take the same amount of time again for the granules to heat up to the drying temperature in the upper section too and for drying to commence there. It can also be seen from the curve that the material in the lower third of the granule container will be sufficiently dry after about two hours (see Fig. 14 for the permitted moisture contents). As of this point in time, granules can be removed in portions for processing. If the amount of material required is more than the container will hold at one go, then the granules taken from below should be replaced with fresh granules at the top. With automatic dryer and machine feeds, this is best achieved with filling-level limiters.

The size or drying capacity of the dryer to be used should be determined on the basis of the granule throughput rate in each case. The rule of thumb is that the container should hold at least four times the hourly throughput. An air flow of 2.2 to 3.0 $m^3/h$ per kilogram of granules to be dried will ensure that the granules heat up sufficiently rapidly to the drying temperature.

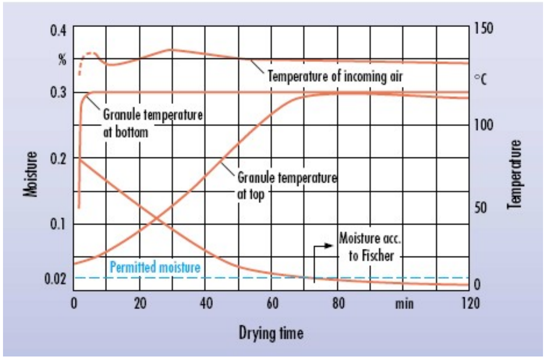


**Fig. 11: Drying process in a high-speed dryer operating with fresh air (example of measured results for Makrolon®).**

In very humid climates, drying cannot be conducted with the dryers described so far. It is necessary to use dry-air dryers (Fig. 12) in these areas and – as already mentioned. The diagram of the operating principle shows that the dry-air dryer is essentially similar in design to the high-speed dryer. In the dry-air dryer, however, the air is predried with drying agents before it enters the granule bed. This is generally done by using two drying-agent batteries connected up in parallel, with one being regenerated while the other is being used. The wide range of units of this type that are available would suggest that this type of unit is gaining ground. This is no doubt due to the fact that the drying result is not affected by the ambient humidity.

Apart from the intake filter for the fresh air, it is also necessary to filter the air coming from the granule container in order to ensure that the drying agent is not soiled by either dust from outside or plastic dust from the granules. These filters similarly require regular cleaning. It must also be ensured that the air is no hotter than 50 °C (operating temperature of the drying agent) when it enters the particular battery that is being used to dry the air. It may need to be cooled.

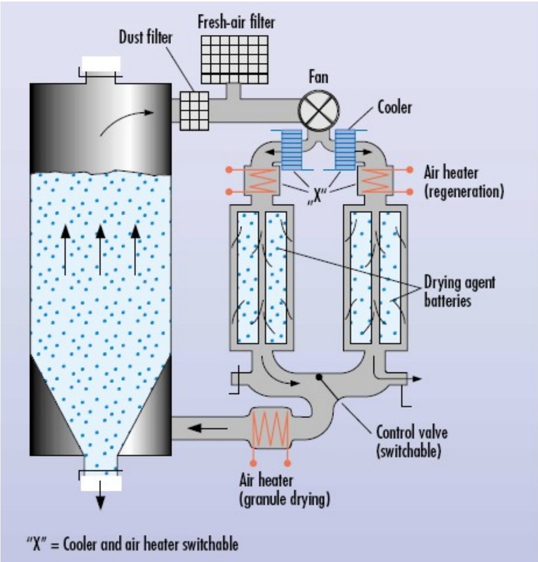


**Fig. 12: Operating principle of a dry-air dryer.**

Compressed air dryers operate using treated compressed air from the plant 's own compressed air network. The compressed air is decompressed immediately before the drying tank to bring the dew point down to values between minus 17 °C and minus 40 °C (depending on how the compressed air is pretreated). As the systems are not energy-efficient in operation, they are normally only used for drying small quantities of material (up to approx. 25 kg/h). In most cases the dryers are mounted directly on the machine.

**Fig. 13: Compressed air dryer (style Montan).**

The advantages of compressed air dryers are the easy set-up and that drying agents are not necessary anymore compared to dry-air dryers.

The residual moisture in the granules that is permitted for injection molding varies according to the material and is very low in some cases (Fig. 14). For extrusion even higher degrees of drying can be necessary.

| **Engineering thermoplastic** | **Permissible residual moisture content in weight % (injection molding)** |
|---|---|
| Apec® 1) | 0.02 |
| Bayblend® | 0.02 |
| Makrolon® 1) 2) | 0.01 to 0.02 |
| Makroblend® | 0.01 |

Fig. 14: Permitted residual moisture content for processing.

1) An adequate idea of dryness of Apec® and Makrolon® can be obtained by the TVI test.

2) For Makrolon® 0.01 weight % applies for critical parts (ODS, optical parts).

## Determining the residual moisture

The following measuring methods are used to determine the moisture content of solid materials:

- Karl-Fischer-titration,
- TVI test,
- weighing with IR drying,
- direct/indirect microwaves
- carbide method.

The low moisture contents specified in Fig. 14 can only be determined sufficiently accurately by sophisticated laboratory methods.

The following practical tests are also available, however, for establishing whether the material is too moist.

### TVI Test

The TVI test, which is very simple and can be conducted with a minimum of apparatus, works only with non-reinforced Makrolon® and Apec®. It can only distinguish between a sufficient degree of drying and an insufficient degree, however. The test essentially involves a number of granules being heated on a temperature-controlled hotplate (for Makrolon®: 270 ±5 °C and for Apec® 310 ±5 °C) and then being pressed flat between two glass microscope slides to give a diameter of approximately 1 cm. If there are no bubbles in the specimen after a further minute on the hotplate and subsequent cooling, then the granules have been sufficiently dried. Good drying results for Makrolon® and Apec® within the framework of the specified drying conditions (temperature and time) are also an indication of the fact that the dryer in question is functioning correctly.

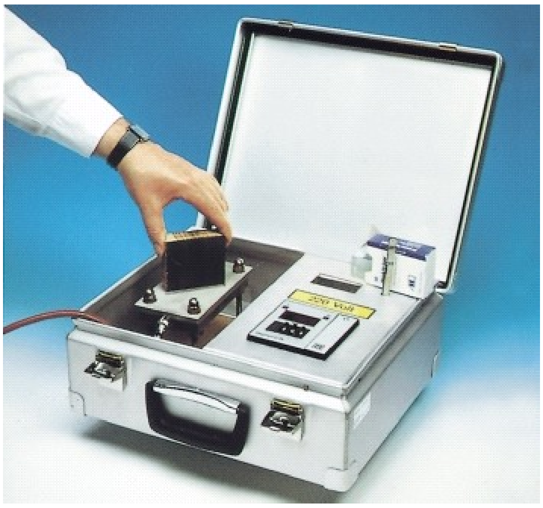


**Fig. 15: TVI test unit.**

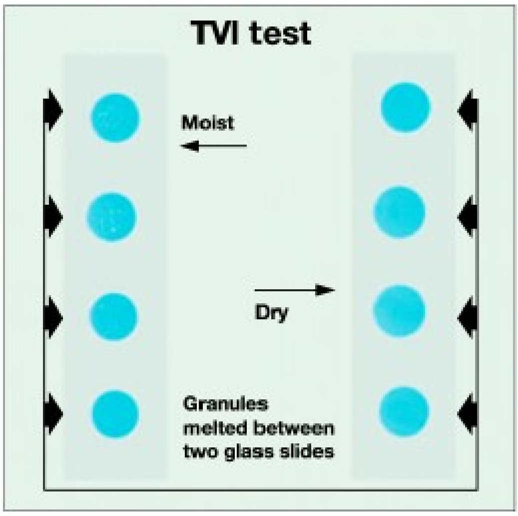


**Fig. 16: TVI test sample for Makrolon®.**

## Observing the melt strand

During processing, moisture in the material manifests itself through bubbles in the melt strand. With very moist material, the melt strand will have a foamy appearance and a matt, streaky surface (Fig. 17).

**Fig. 17: Appearance of the melt strand with dry (left) and moist (right) material.**

## Partial filling of the mold

Material that has been processed in the moist state also reveals a foamy and streaky flow front with partial filling of the mold. This constitutes a further means of checking that the material is sufficiently dry.

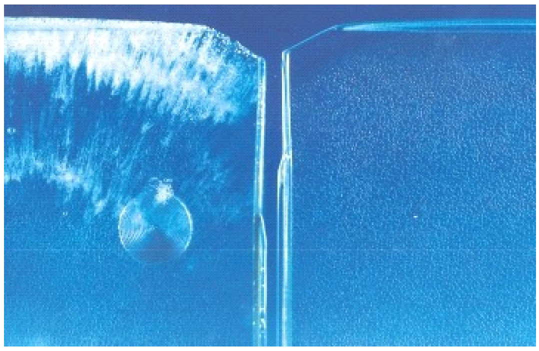

**Fig. 17: Foamy flow front when the mold is partially filled with material that is being processed in the moist state (left side).**

## Determining degradation

The degree of degradation that occurs in materials that are sensitive to hydrolysis when processed in the moist state can be determined from viscosity measurements, since the destruction of the molecule chains reduces the viscosity. To this end the solution viscosity can be measured, or the familiar melt viscosity or melt mass-flow rate measurements can be conducted. In all cases, the samples taken from the molded part should be carefully dried prior to testing.

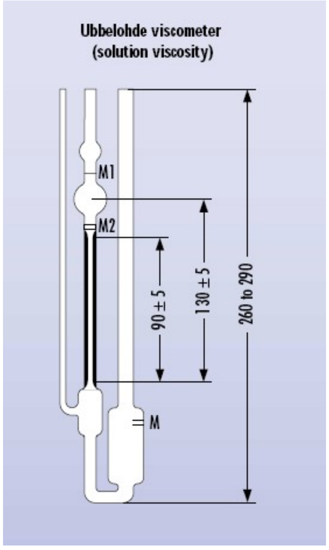


**Fig. 19: Determining the viscosity of solutions.**

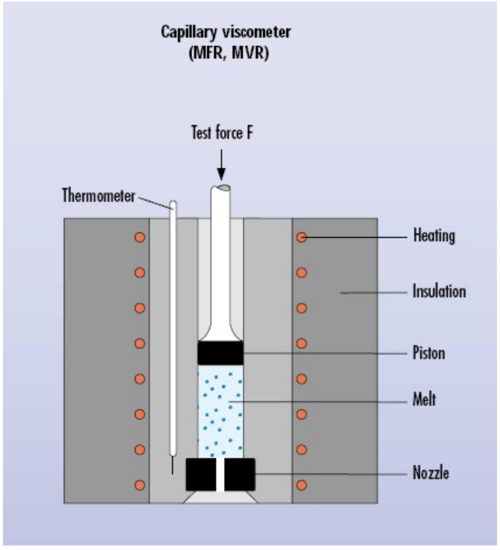


**Fig. 20: Determining the viscosity of melts.**

## Drying faults

Drying faults have very simple causes in some cases and can generally be rectified by simple means. The list of the most frequent faults (Fig. 21) is designed to help locate and eliminate the cause as rapidly as possible. As far as possible, all the faults should be eliminated right from the start by means of an effective quality assurance system. This table and the explanations that follow also provide assistance here.

### Fault 1:

The drying conditions given for the individual plastics will, of course, only lead to a satisfactory result if the temperatures specified (setpoint temperatures) are actually attained in the granule bed.
Whether the dryer is supplying the requisite heating capacity in general terms can normally be established by whether the controller switches at the setpoint temperature or not. In cases of doubt, an attempt must be made to place an additional temperature sensor in the granule container.
Controller deviations and excessive control fluctuations are generally caused by the incorrect positioning of the sensor, an insufficiently sensitive controller and/or poor coordination of the control circuit. An excessively high heating capacity can also lead to greater control deviations. Excessively high temperature peaks damage the material or lead to the formation of lumps. The best way to detect control fluctuations and achieve the optimum control circuit setting is by recording the temperature profile for a while. A simple point recorder will suffice for this.
The installation of better controllers can similarly make a key contribution towards quality assurance and save money by eliminating fault sources. The application of an acoustic and/or optical sensor element for notifying malfunctions in the dryer will also serve this same purpose.

### Fault 2:

If the dryer is operating at reduced efficiency, then this will generally be due to clogged filters or to the fan rotating in the wrong direction. Both these causes reduce the air flow capacity to such an extent that a sufficient level of drying is no longer possible. A reduced air flow capacity in conjunction with an unfavorably positioned temperature sensor and an incorrect setting for the control circuit can lead to an excessively high air temperature in the inflow zone of the granule bed at the same time.

### Fault 3:

The use of air filters has already been described and recommended. If the container lid is missing, this will lead both to material soiling and to the release of material dust into the environment.

### Fault 4:

The recommended drying conditions (Fig. 6) apply to dryers of sufficiently large dimensions. On these dryers too, the requisite drying time can be longer if the quantities removed are not replenished in time.

| | Faults | Causes |
|---|---|---|
| 1 | Deviations from setpoint temperature controller | • deviation/control fluctuations<br>• heating capacity too low/too high<br>• heating element(s) defective<br>• heating switched off by excess temperature detector |
| 2 | Reduced efficiency<br>= air flow too low (longer drying times required) | • fan rotating in wrong direction<br>• filter clogged up |
| 3 | Soiled granules<br>= soiled molded parts | • no filter<br>• drying container insufficiently cleaned<br>• container lid missing |
| 4 | Fluctuations in requisite drying time | Dryer not filled on a constant basis<br>Rule of thumb: Container content ≥ four times the throughput |
| 5 | Reabsorption of moisture after sufficient drying | • excessively long residence time in the unheated hopper<br>• hopper not insulated<br>• long conveying paths/granules conveyed with cold, atmospheric air |
| 6 | Energy consumption too high | Container/hopper not insulated |
| 7 | Granules cake together | Inflow temperature too high through:<br>• excessively high drying temperature<br>• excessively high control fluctuations<br>• blocked suction filter<br>• fan rotating in wrong direction |
| 8 | • Color changes<br>• Impaired mechanical properties | • long drying times for materials that react to this<br>• excessively high drying temperature |

**Fig. 21: Frequent faults during drying and their causes.**

### Fault 5:

The old rule which states that the residence time of the dry, still-warm granules in the unheated hopper should not exceed 30 minutes applies here too. This time can be extended by insulating or heating the hopper.

Lengthy distances from the dryer to the machine cause the granules to cool down a great deal. This cooling is speeded up still further through conveyance with cold atmospheric air.

The granules also absorb moisture again, as a function of the moisture content of this air. This can be prevented by conveying the granules with hot dry air taken from the dryair dryer. This is doubtless a further reason why dry-air dryers are currently gaining in popularity.

### Fault 6:

Insulating the granule holder on the dryer will help save energy.

If the machine hopper is insulated, it may be possible to get by without heating it.

### Fault 7:

If the inflow of drying air is at too high a temperature, then the granules can cake together. A slight sintering process will take place in the lower section of the granule bed, which is promoted by the pressure of the granule layers above it. In most cases, only the central core of the container contents remains free-flowing. The granule throughput rate is then too high there, and insufficiently dried material is sent for processing.

A rapid emergency solution is to reduce the filling level in the dryer (after breaking up the sintered areas), although this inevitably reduces the drying capacity.

It is naturally better to eliminate the causes of the excessively high air temperature in the inflow zone

**Fault 8:**

A considerably longer drying time than that indicated will generally be avoided on account of the energy costs and for capacity reasons. If prolonged drying times do result, however, then color changes and possibly slight material damage can be caused to materials that are susceptible to this.

| | Faults | Causes |
|---|---|---|
| 9 | Variable drying performance in the individual containers | Airflow division not uniform with a shared air generator, due to<br>• unequally-filled granule containers<br>• incorrectly tuned airflow distribution<br>Flow measuring unit = useful aid for tuning the airflow |
| 10 | Temperature of return air too high, > 50 °C | Controller/return air cooler defective |
| 11 | Little or no drying effect | Drying agent used up<br>Service life of drying agent 2 to 3 years |
| 12 | Reduced drying capacity | "Collapsed" drying agent<br>Leakage air flow without re-drying |

**Fig. 22: Special faults with dry-air dryers.**

**Fault 9:**

If more than one drying container is fed by a dry-air generator, as shown in Fig. 23, then the air flow will preferentially follow the route of least resistance. If there are no setting or control facilities available, then care should be taken to ensure that an identical filling level is achieved in all the drying containers. It is, of course, better if there is a means of aligning the airflow distribution with the aid of throttle valves and flow measurement units.

**Fault 10:**

The return air should be cooled to the working temperature of the drying agent, i.e. to about 50 °C, before it flows through the drying-agent battery. It is important to observe the operating instructions.

**Fault 11:**

The drying agent is gradually used up; it has a service life of 2 to 3 years and should be replaced in good time.

**Fault 12:**

The drying agent can also "collapse". Leakage air flows develop, which reach the air circuit again without being redried. The drying-agent containers should thus be topped up again from time to time.

## Conclusion

Correct material drying and the maintenance and monitoring of a sufficient degree of drying are vital aspects of quality assurance for the production of molded parts and semifinished products.

In the case of injection molding, this drying is generally conducted in the form of solids drying prior to processing. In extrusion, use is frequently made of melt drying, in the form of vented plastication. This is also possible with injection molding and is being successfully used in cases where conditions are favorable.

Proper drying also makes a contribution towards the conservation of resources. It prevents rejects, production stoppages and complaints and thus makes production more cost-efficient. It is also impossible to recycle material that has suffered hydrolytic degradation as a result of being processed in the moist state.

**Fig. 23: Several granule containers are fed hot air from one hot-air generator.**

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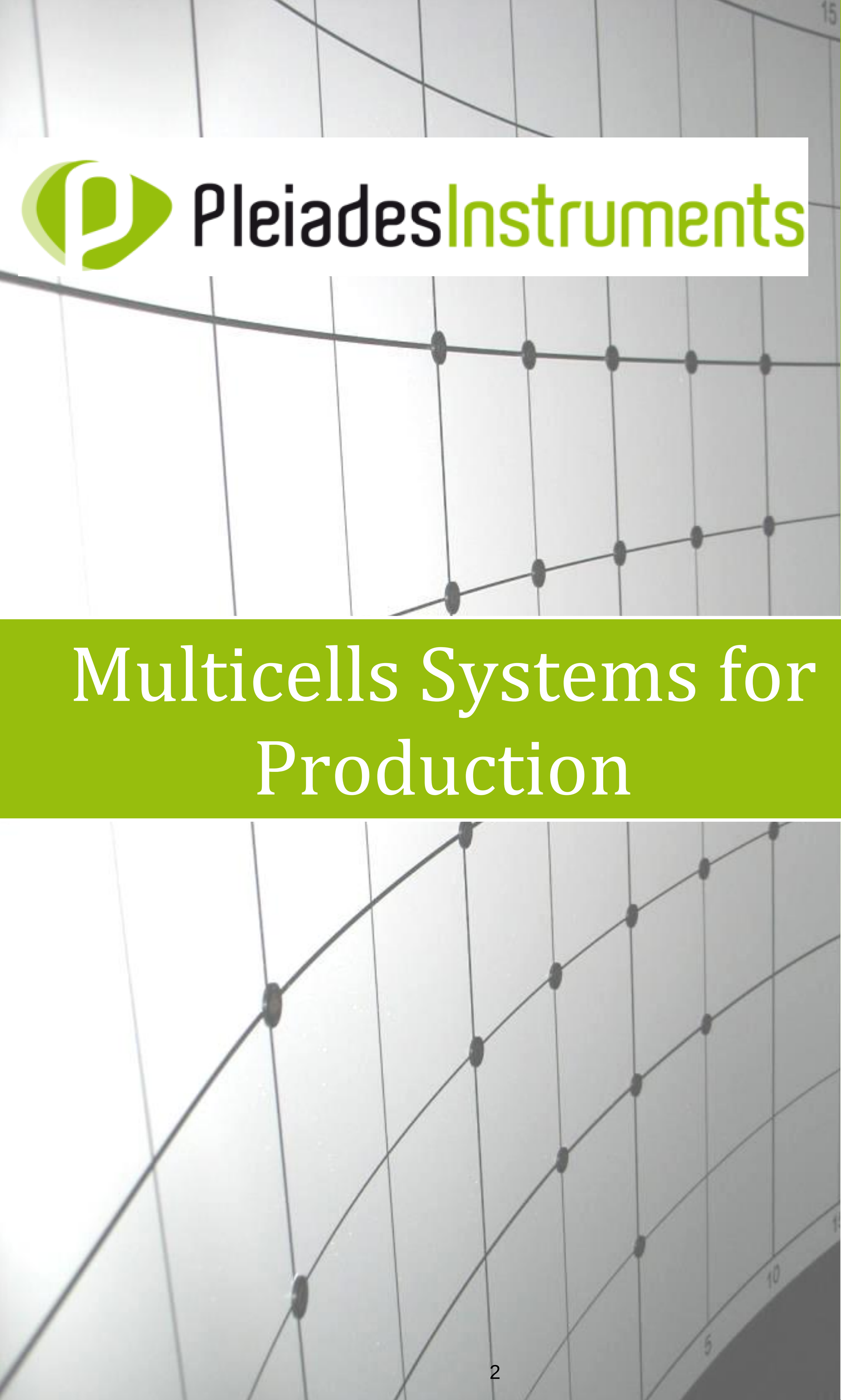
# ANEXO 4: BANCO FOTOMÉTRICO

1. INSTRUCCIONES PLEIADES INSTRUMENTS ........................................................................................ 2

2. RESULTADOS DE ENSAYOS DE VALEO ......................................................................................... 10



# Multicells Systems for Production

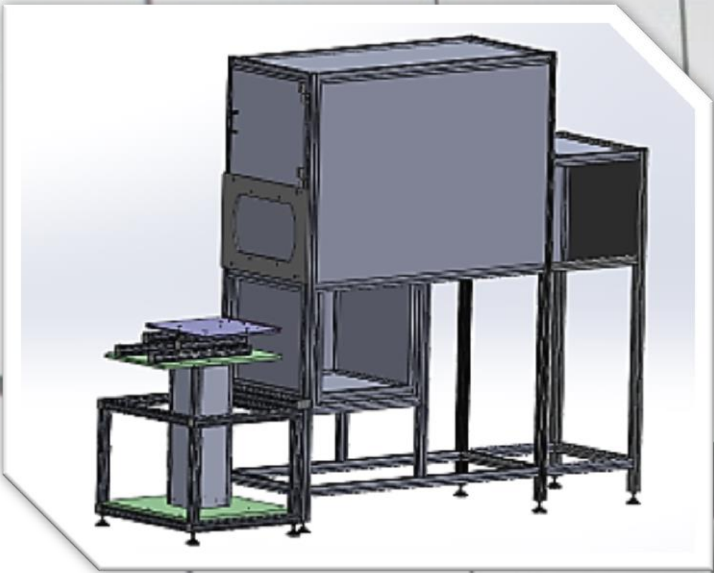
PleiadesInstruments

# Multicells Systems for Production

Multicells reduced photometric systems allow measurement and qualification of products according to different standards (SAE, ECE, China, Japan) on short distance through a lens. Thanks to these devices our customers can test and certify many different products.

Those equipment especially designed for production are set up in industrial environment of automotive lighting industry. **They allow checking products integrity before and after resistance, mechanical, vibration, temperature tests and many others**.

The software has also been designed for a very easy use.



Our multicells systems for production have many assets :

- Stand-alone system.
- Compact.
- High maximum load (25kg/55pounds).
- Large measurement range: 0.01 to 1500C for signaling and 0.01 to 450 lux for lighting.
- High photometric resolution.
- Thanks to their design, our devices are among the most compact on the market.
- Short measurement distance.
- Enclosed system avoiding straight light.
- Motorized rotating and vertical stages.
- Configurable number and position of cells.
- Different measurements modes.
- High quality and repeatability of the measurements.
- Instant measurement.
- No photometric room required.
- Easy to use software, allowing different kinds of measures, with a large range of standards and products.
- Our devices allow tests and qualifications according to many different standards: ECE, SAE, Japan… etc.
- High quality maintenance with our reliable, timely, cost effective services for soft/hardware and our reactive after sales service.
- Reasonable price.

# Multicells Systems for Signaling MES_SP

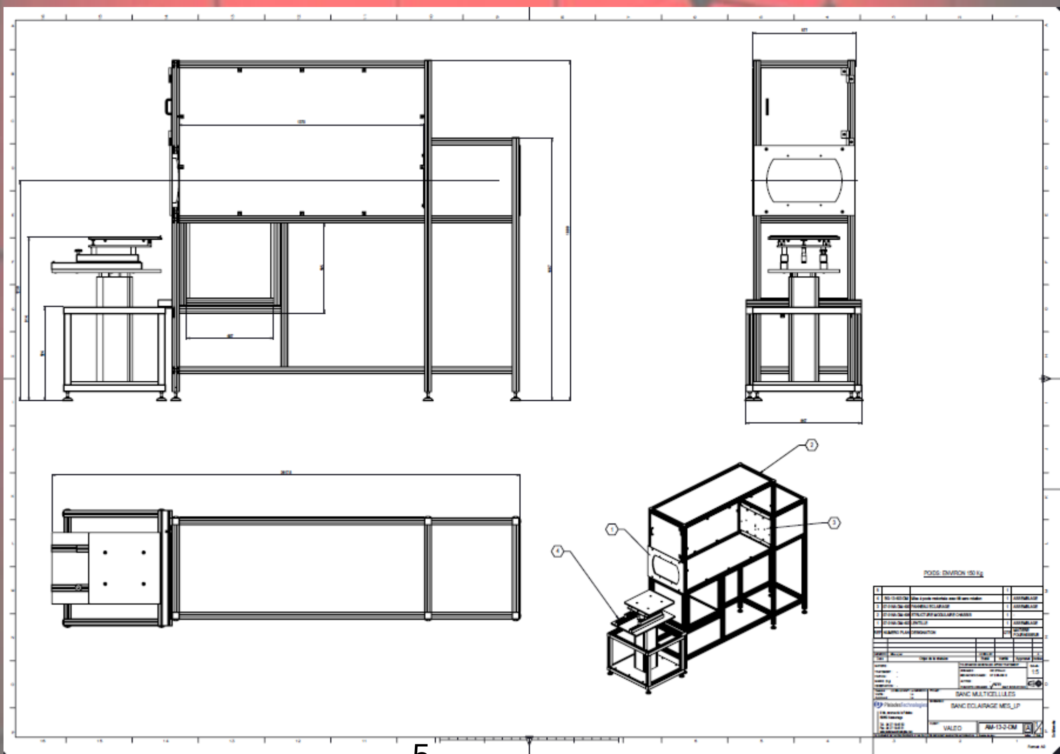
Multicells system for signaling characteristics:

MES_SP has been designed to control all the signaling functions of rear products: Day Running Light (DRL), Turn, Tail, Stop…

This kind of equipment is compatible with different technologies: LED (continuous or PWM mode), discharge lamp, Xenon technology…

The system is equipped with a motorized stage to place the product easily and safely.

| | |
|---|---|
| Measurement cells | 7 cells |
| Photometric range | 0,01 to 1500 Candela |
| Photometric resolution | 4 digits |
| Display frequency | 1 Hz |
| Measurement Mode | Continuous |
| | PWM |
| | Blinking |
| Power Supply | One power supply: 25V/7A |
| | Setting accuracy |
| | 1µV ±(0,05% FS)<br>0,01mA ±(0,2% FS) |
| | Weight: 120Kg |
| Multicells System Signaling Size | Height: 1882 mm |
| | Width: 648 mm |
| | Length: 2618 mm |
| Power requirements | 230V/50Hz/16A |
| PC requirements | Processor: DualCore 2.7 GHz |
| | RAM: 2Go |
| | Software: ALPES |



# Multicells System for Lighting MES_LP

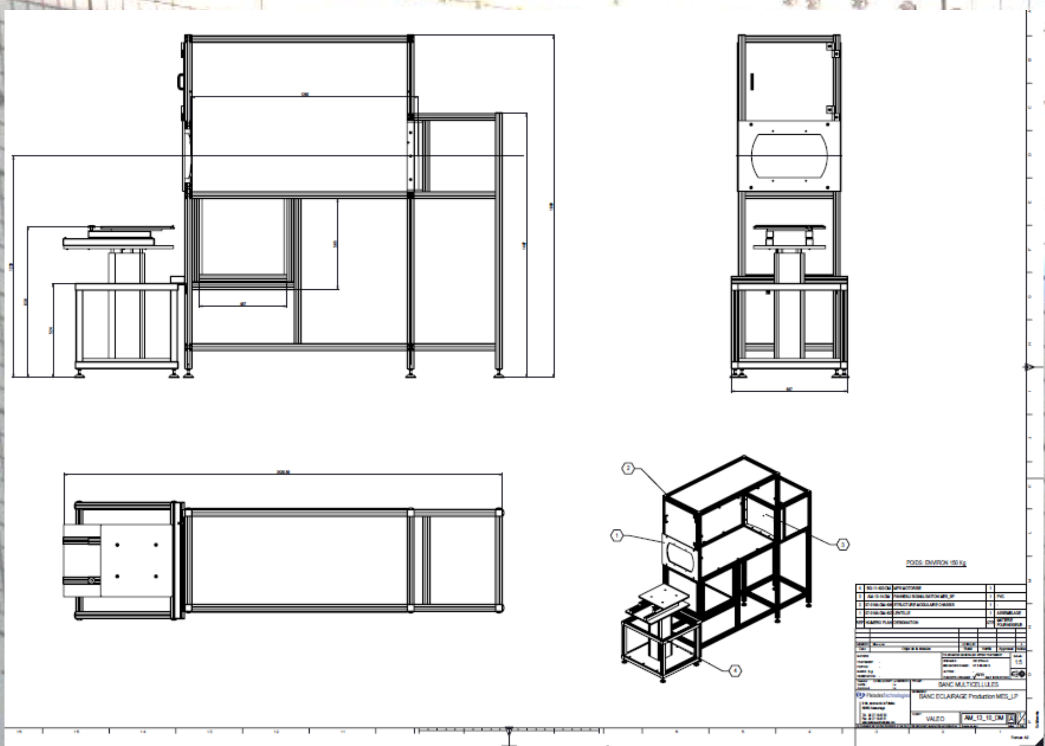
Multicells system for lighting characteristics:

MES_LP has been designed to control all the lighting functions of head products: high beam, low beam…

This kind of equipment is compatible with different technologies: LED (continuous or PWM mode), discharge lamp, Xenon technology…

As the MES_SP, the system is equipped with a motorized stage to place the product both: easily and safely.

| | |
|---|---|
| Measurement cells | 8 cells |
| Photometric range | 0,01 to 450 lux |
| Photometric resolution | 4 digits |
| Display frequency | 1 Hz |
| Measurement Mode | Continuous |
| | PWM |
| Power Supply | One power supply: 18V/20A |
| | Setting accuracy |
| | 1µV ±(0,05% FS) / 0,01mA ±(0,2% FS)<br>10µV ±(0,1% FS) / 0,01mA ±(0,2% FS) |
| | Weight: 120Kg |
| Multicells System Lighting Size | Height: 1882 mm |
| | Width: 648 mm |
| | Length: 2618 mm |
| Power requirements | 230V/50Hz/16A |
| PC requirements | Processor: DualCore 2.7 GHz |
| | RAM: 2Go |
| | Software: ALPES |



# The ALPES Software

Thanks to years of experience in the field of automotive lighting certification, Pleiades Instruments has developed a new version of its famous software ALPES, **especially dedicated for the production equipment**. The software provides specific prior/after reports to check whether the testing (mechanical, vibrating, temperature…) are not damaging for the products.

*ALPES (Automotive Lighting Photometric Equipment Software) is an application used for controlling and running the photometric systems manufactured by Pleiades Instruments. It offers a user friendly and simplified user interface for operators in production mode, or a fully customizable software for administrators and Research & Development users.*

*ALPES is used for all the systems sold by Pleiades Instruments: goniophotometer and multi-cells, and for different products: signaling and lighting.*

*This software allows a large spectrum of measurements for complex analysis, production… A database of standards that can be tested is provided with the system. ALPES provides a report indicating if a measurement is conform to the standards.*

*The administrator mode allows the user to prepare the measurements and to calibrate the cells if necessary; then, the operator has just to start the measurement and to analyze results.*

*Updates are also regularly available online.*


This version has been designed to meet and solve usual issues of the testing in Automotive Lighting industry.

Indeed, Pleiades Instruments' software department has developed an application which is both: easier to use and more ergonomic with a specific Man-Machine Interface (MMI).

**Thus, it is far simpler for operators to detect problems on production lines and to check the integrity of products**.

AFNOR CERTIFICATION

# Certificat

Certificate

N° 2012/51560.1

AFNOR Certification certifie que le système de management mis en place par :
*AFNOR Certification certifies that the management system implemented by:*

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*and is developed on the following locations:*

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Ce certificat est valable à compter du (année/mois/jour) *This certificate is valid from (year/month/day)* 2012-08-22 Jusqu'au *until* 2015-08-21

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afnor CERTIFICATION

PleiadesInstruments

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afaq ISO 9001 Qualité AFNOR CERTIFICATION

# VW - Module MultiLED
## Injection HB Collimators in MD Moldes

Pre-FDPR Test Series

**Ana Belén Prieto, Q PTM**

March 2014



# VW - Module MultiLED - Injection HB Collimators in MD Moldes

## Summary

- 19-12-16:
  Meeting in MD office (Leiria), with Joaquim Laúdo, Ana Belén Prieto, Francisco Servant, on FDPR and star of tests next day in the morning.
- 20-12-16:
  In MD Moldes (Vades) in the morning, the mould wasn´t finished so in the affternoon with Pedro Rodrigues, Francisco Servant and Ana B. Prieto, different collimators with **Makrolon** material was injected, in ten diferent tests (K1 to K11).

  These collimators was measurement with multiled dummy, when system was stabilized after 30min.
- 21-12-16:
  In the morning, with the best parameters of day before, was injected other test series (K12 to K18)

  These collimators was measurement with multiled dummy and K16 and K17 injection was the best tests.

  In the afternoon, it was FDPR about 4 hours with good results (see FDPR-HB collimators 201216 file).

  The last injection of FDPR was measurement with multiled dummy, and with more hours of injection, the results are better.

# VW - Module MultiLED - Injection HB Collimators in MD Moldes

- 20-12-2016: **Test Series – Cavity 3. Measurement with dummy**

| Measurement:<br>**Test K3 Cavity 4.**<br>(Injection November 2016) | Martos<br>MD Moldes<br>(Vades) | 114,6 lx<br>**110** lx<br>(-4,6lx ) |
|---|---|---|

| Cavity 3. (lx) | K1 | K2 | K3 | K4 | K5 | K7 | K8 | K9 | K10 | K11 |
|---|---|---|---|---|---|---|---|---|---|---|
| Part 1 | 101 | 102 | 102 | 96 | 102 | 95,7 | 96,7 | 98 | 99,2 | 97,4 |
| Part 2 | 101 | 103 | 104 | 100 | 103 | | | | | |
| Part 3 | 101 | | | | | | | | | |

**Best tests: K1-K2-K3-K5**



# VW - Module MultiLED - Injection HB Collimators in MD Moldes

- 21-12-2016: **Same Parts previus day–Cavity 3. Measurement with dummy**

| Measurement:<br>**Test K3 Cavity 4.**<br>(Injection November 2016) | Martos<br>MD Moldes<br>(Vades) | 114,6 lx<br>**105** lx<br>(-9,6lx ) |
|---|---|---|

| Cavity 3. (lx) | K1 | K2 | K3 | K4 | K5 | K7 | K8 | K9 | K10 | K11 |
|---|---|---|---|---|---|---|---|---|---|---|
| Part 1 | | | 100 (-2) | 93 (-3) | | | | 96 | | |
| Part 2 | | | 100 (-4) | 98 (-2) | | | | 96 | | |

Similary measurement that before day but with -3 lux aprox.

# VW - Module MultiLED

21-12-2016: **New tests –Measurement with dummy all cavities**

| | | |
|---|---|---|
| Measurement:<br>**Test K3 Cavity 4.**<br>(Injection November 2016) | Martos | 114,6 lx |
| | MD Moldes (Vades) | **At the beginning: 105** lx |
| | | **At the end: 107** lx |

| (lx) | 1 | 2 | 3 | 4 | 1. | 2. | 3. | 4. |
|---|---|---|---|---|---|---|---|---|
| K12 (2 injections) | 99,8 | 107 | 97,3 | 104 | 98,6 | 104 | 101 | 105 |
| | | 105 | | | | | | 103 |
| K13 | 98,2 | 106 | | | | | | |
| K14 | | 106 | | | | | | |
| K15 | | 106 | | | | | | |
| **K16** (2 injections) | 104 | 109 | 103 | 106 | 104 | 107 | 105 | 108 |
| | 102 | 109 | 103 | 107 | 103 | 108 | 105 | 109 |
| Similary to K16 | | 110 | | | | 108 | | 109 |
| K17 | 101 | 108 | | 106 | | | | |
| K18 | | 99,5 | | | | | | 97,1 |
| Last injection | 107 | 111 | 106 | 110 | 106 | 109 | 108 | 110 |





Valeo

# VW - Module MultiLED

- Best test: **K16** Best cavity: **2** Worst cavity: **3** (in all tests)

| (lx) | 1 | 2 | 3 | 4 | 1. | 2. | 3. | 4. |
|---|---|---|---|---|---|---|---|---|
| K12 (2 injections) | 99,8 | 107 | 97,3 | 104 | 98,6 | 104 | 101 | 105 |
| | | 105 | | | | | | 103 |
| K13 | 98,2 | 106 | | | | | | |
| K14 | | 106 | | | | | | |
| K15 | | 106 | | | | | | |
| **K16** (2 injections) | 101 | 99,3 | 103 | 106 | 104 | 107 | 105 | 108 |
| | 102 | 10 | 103 | 107 | 103 | 108 | 105 | 109 |
| Similary to K16 | | 110 | | | | 108 | | 109 |
| K17 | 101 | 108 | | 106 | | | | |
| K18 | | 99,5 | | | | | | 97,1 |

- So FDPR begins with K16 parameters





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# VW - Module MultiLED

- 21-12-2016 **Measurement last injection with dummy all cavities**

| Measurement: **Test K3 Cavity 4.** (Injection November 2016) | Martos | 114,6 lx |
|---|---|---|
| | MD Moldes (Vades) | **At the beginning: 105** lx |
| | | **At the end: 107** lx |

| (lx) | 1 | 2 | 3 | 4 | 1. | 2. | 3. | 4. |
|---|---|---|---|---|---|---|---|---|
| FDPR Last injection | 107 | 111 | 106 | 110 | 106 | 109 | 108 | 110 |





Valeo

Automotive technology, naturally