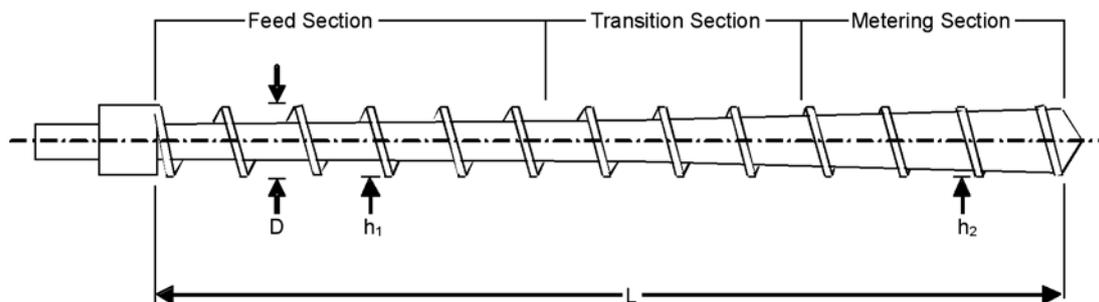


PolyOne's range of OnFlex™ thermoplastic elastomer (TPE) compounds includes TPE-S, TPE-V, TPE-O and TPE-U. This range, combined with excellent experience in TPE application design and processing, positions PolyOne very well to address the overall thermoplastic product needs of various industries.

This document provides general advice on extrusion processes for use with PolyOne OnFlex™-V Extrusion compounds. OnFlex™-V is designed to give the performance of traditional vulcanised rubber, but with the processability of a thermoplastic. OnFlex™-V thermoplastic elastomer compounds are based on a polyolefin phase with a cross-linked EPDM phase dispersed into it. This new "next generation" vulcanized thermoplastic elastomers (TPE-V) overcome the previous colorability limitations of TPE-V based on conventional technology. OnFlex™-V has a consistent base color with a low yellowness index allowing bright colors. The information provided in this document is intended only as a guide to use together with your past experience with extrusion techniques where applicable, using these materials. Our staff will be happy to assist in any areas where this document does not provide a satisfactory solution.

EXTRUDER AND SCREW DESIGN

A standard extruder with an L:D ratio above 24:1 is recommended. Shorter extruders may struggle to produce a uniform melt, but this can occasionally be achieved by increasing the back pressure and reducing the output rate. A compression ratio from 2.5:1 to 3.5:1 and a high screw speed is generally recommended.



L:D Ratio: Ratio of the extruder screw length and diameter

Compression Ratio: Ratio of the volume of the feed and metering sections of the screw, relative to the screw flight depths h₁ and h₂.

SCREEN PACK

Screen packs of 80/60/40/20 mesh are recommended, and should be positioned as close to the die as possible. Screen packs can help to build up back pressure and minimize surging of the extrudate.

DIE DESIGN

For OnFlex™-V Extrusion compounds, a die with a very short land length (around 5mm) generally is most effective, especially with softer grades. Land lengths greater than about one cross-section or diameter of the extrudate may lead to surface roughness if drawdown is used to control the extrudate size. Whilst excessive drawdown should be avoided, around 10-20% can improve the extrudate strength through orientation of the compound.

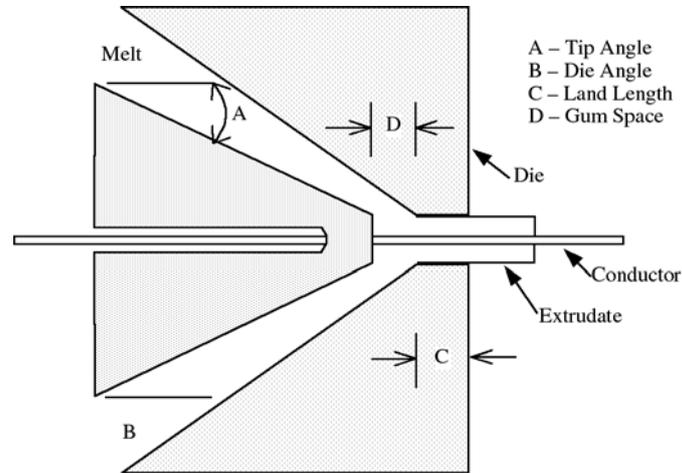


Figure 1: Typical Pressure Type Cable Extrusion Die

CABLE JACKETING

For cable jacketing with OnFlex™-V Extrusion compounds, it is recommended to pre-heat the wire to between 90° and 125° C. This will improve the adhesion between the compound and the wire, reduce cavitation and void formation, and can improve the tensile strength and heat aging properties of flame-retardant materials.

DRYING

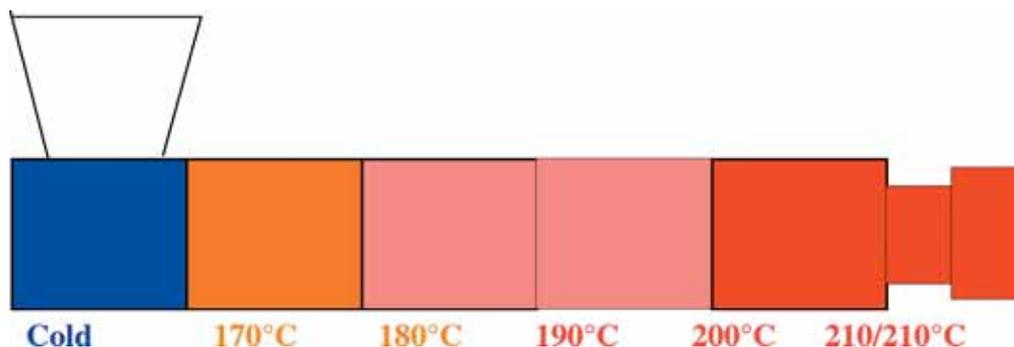
OnFlex™-V compounds are slightly hygroscopic and can absorb some moisture. OnFlex™-V is supplied pre-dried, and packaged in PE/aluminium foil bags. In most cases it can be used straight from the bag without any further action. To ensure best quality the bags should be opened immediately before use, and any unused material should be tightly sealed in the original packaging. Under certain storage conditions, some surface moisture can be present, and may cause problems in processing. In this case, drying is necessary; typically three hours at 80° C should be suitable.

PURGING AND REGRIND

Cleaning of extrusion equipment can be performed with PP, but PE may also be suitable. Contamination with polar engineering thermoplastics should be avoided. If the machine is to be left unused for some time, run until empty and then purge before re-starting. Scrap from OnFlex™-V production generally can be reground and used at levels of up to 20% with virgin compounds.

PROCESSING CONDITIONS

The following diagram provides guidelines for extrusion parameters:



The melt viscosity of OnFlex™-V Extrusion compounds shows a strong dependency on shear rate, and is not as sensitive to changes in temperature as other thermoplastics.

TROUBLESHOOTING GUIDE

Problem	Cause	Solution
Rough extrudate	Melt too cold	<ul style="list-style-type: none"> • Increase extruder temperature • Increase die temperature
	Melt not mixed	<ul style="list-style-type: none"> • Use higher compression ratio screw, or screw with mixing section
	Poor die design	<ul style="list-style-type: none"> • Decrease land length
	Heater(s)/Controls not working properly	<ul style="list-style-type: none"> • Check thermocouples and heater bands
Uneven cross section	Surging	<ul style="list-style-type: none"> • Decrease extrusion rate • Use screw with longer feed or metering section • Use more restrictive screen pack to increase back pressure • Decrease die temperature
Black specks or undispersed lumps	Contamination	<ul style="list-style-type: none"> • Purge with low MFI PP or PE • Check that color concentrate is suitable for compound and confirm thermal stability. Identify stagnant flow areas
High extruder pressure/low throughput	Melt too cold	<ul style="list-style-type: none"> • Increase extruder temperature • Increase die temperature
	Clogged screen packs	<ul style="list-style-type: none"> • Clean screen pack • Replace if necessary
	Heater(s)/Controls not working properly	<ul style="list-style-type: none"> • Check thermocouples and heater bands
Odor or yellowing	Melt too hot	<ul style="list-style-type: none"> • Decrease barrel temperature • Decrease die temperature • Decrease screw rpm • Use less restrictive screen pack • Use lower compression ratio screw
	Heater(s)/Controls not working properly	<ul style="list-style-type: none"> • Check thermocouples and controllers
Internal voids Porosity Blisters	Uneven Cooling	<ul style="list-style-type: none"> • Adjust quenching conditions (longer air gap, hot water quench) • Reduce mass temperature
	Moist material	<ul style="list-style-type: none"> • Pre-dry material before use • Use hopper-dryer • Reduce extrusion temperature
	Air entrapment in melt	<ul style="list-style-type: none"> • Reduce screw rpm
Longitudinal dimensional variations	Uneven take-off speed	<ul style="list-style-type: none"> • Check haul off

We determined this information about our product(s) using lab-scale equipment, estimation and information obtained from our customers. We provide this information to help you process our products. Your processes can significantly alter polymer physical properties. Test our product thoroughly for suitability in your specific application after processing on your production equipment. You assume all responsibility for product selection and suitability for your intended use. **We make no other warranties, express or implied, including any implied warranties of merchantability or fitness for purpose**, respecting this information or this product. Nothing herein constitutes permission, recommendation, or inducement to practice any patented invention without permission from its owner.

CONTACT US

EUROPE	EUROPE	EUROPE	ASIA	AMERICAS
<p>PolyOne Th. Bergmann GmbH Adolf-Dambach-Str. 2 76751 Gaggenau Germany</p> <p>Tel.: +49 (0) 7225 68020</p> <p>Fax: +49 (0) 7225 680210 onflex@polyone.com www.polyone.com</p>	<p>PolyOne Espana S.L.U. Pol.Industrial Valle del Cinca S/N Apartado 18 22300 Barbastro Spain</p> <p>Tel.: +34 (0) 974 310 314</p> <p>Fax: +34 (0) 974 314 311 onflex@polyone.com www.polyone.com</p>	<p>PolyOne Turkey Ikitelli Organize Sanayi Bölgesi Turgut Özal Caddesi No: 103 34306K. Cekmece-Istanbul-Türkiye</p> <p>Tel.: +90(0) 212 549 2256</p> <p>Fax: +90 (0) 212 549 2241 onflex@polyone.com www.polyone.com</p>	<p>PolyOne Singapore Pte. Ltd. 22 Tuas West Road Singapore 638380 Singapore</p> <p>Tel.: +65 (0) 6861 9325</p> <p>Fax: +65 (0) 6861 9327</p> <p>onflex@polyone.com www.polyone.com</p>	<p>PolyOne Corporation PolyOne Center Avon Lake, OH 44012 U.S.A.</p> <p>Tel.: +1 440 930 1000</p> <p>www.polyone.com</p>



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