

## USING THE 2" **TELETUBE XLS™** & **TELECAT XLS™** ADJUSTABLE SIGHT TUBE

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With the rapid proliferation of larger-aperture, low f-ratio Newtonian telescopes with 2" focusers and larger diagonal mirrors, the availability of a precision 2" Sight Tube is long overdue. Additionally, this novel “telescoping” collimation tool will allow the discriminating, performance-minded amateur to “customize” the sight tube length to EXACTLY MATCH the f-ratio of his Newtonian. Unlike “fixed” length (and f-ratio) sight tubes, the **TELETUBE XLS™** will allow you to offset the Secondary mirror in EXACTLY the right axial position to optimize the capture of the Primary light cone for maximum illumination and contrast of the image sent to the eyepiece. As an available option, the reflective ring Cheshire feature of the **BLACKCAT XL™** is added as an integral part of the **TELECAT XLS™** to provide dual collimation functionality.

### Preset the 2" **TELETUBE XLS™/TELECAT XLS™** to the correct f/no. Length

- ▲ Determine the f/no of your scope by dividing the Primary focal length by the Primary mirror diameter.
- ▲ Using the small hex wrench supplied, slightly loosen (but do not remove) the 2 small set screws at the crosshair end of the **TELETUBE XLS™/TELECAT XLS™** about ¼ turn so that the inside tube is free to slide back and forth. The set screws should still extend into the 2 milled grooves located on the outside of the sliding tube to prevent it from falling out.
- ▲ Using the accompanying special **TELETUBE XLS™/TELECAT XLS™** f/no. ruler, put the reference end against the underside of the **TELETUBE XLS™/TELECAT XLS™** outside tube shoulder at the eyepiece end and then adjust the projection position of the inside tube so that the crosshair end is next to the appropriate f/no mark on the ruler. If you have misplaced the f/no. ruler, refer to the table at the right to determine the overall tube length measured from the outside tube shoulder.
- ▲ Holding this position, gently tighten the 2 set screws to lock the inside tube into the correct f/no. position. DO NOT OVER-TIGHTEN. Excessive tightening will warp the tube end and prevent the **TELETUBE XLS™/TELECAT XLS™** from going into the focuser

| F/NO: | TUBE LENGTH (in.) |
|-------|-------------------|
| 3.0   | 4.527             |
| 3.1   | 4.703             |
| 3.2   | 4.879             |
| 3.3   | 5.055             |
| 3.4   | 5.231             |
| 3.5   | 5.407             |
| 3.6   | 5.582             |
| 3.7   | 5.758             |
| 3.8   | 5.934             |
| 3.9   | 6.110             |
| 4.0   | 6.286             |
| 4.1   | 6.462             |
| 4.2   | 6.638             |
| 4.3   | 6.814             |
| 4.4   | 6.990             |
| 4.5   | 7.166             |
| 4.6   | 7.341             |
| 4.7   | 7.517             |
| 4.8   | 7.693             |
| 4.9   | 7.869             |
| 5.0   | 8.045             |

## Using the **TELETUBE XLS™/TELECAT XLS™** to Square the Focuser

If you are confident your focuser mount is reasonably “square” to the Primary Axis, skip this procedure; otherwise, if focuser “squareness” is in doubt, here is the procedure I use:

- ▲ Remove the diagonal/holder assembly from the spider and then remove the focuser and any accessories attached to the scope directly behind it and within 12” to the rear.
- ▲ For most focusers, the mounting holes are symmetric about the focuser axis and form a rectangle or square. Draw light lines with a pencil on the tube connecting the focuser mounting holes. Then measure and mark a point at the center of each side of the drawn rectangle.
- ▲ Cut an 12” wide piece of poster board a little longer than the circumference of the tube. Wrap it tightly around the tube until the ends overlap and the machine-cut edge is flush with itself and mark the overlap point.
- ▲ Lay the posterboard out flat; mark a point halfway between the overlap mark and the end to indicate the “half” circumference distance around the tube. Re-wrap the posterboard tightly around the scope with the machine-cut edge again along one of the two rectangle sides going around the tube.
- ▲ Rotate the posterboard strip to position the “half” distance mark over the rectangle side center mark and while holding this position, draw a short arc on the opposite side of the tube along the posterboard edge; then mark the location of the overlap “half-distance” point on the arc.
- ▲ Move the posterboard over to the other rectangle side going around the tube and draw a second arc and “half-distance” point. Now draw a straight line on the tube between the two “half-distance” points. Measure and mark the center of this line between the arcs - **THIS POINT SHOULD BE THE PROJECTED FOCUSER AXIS INTERSECTION ON THE OPPOSITE SIDE OF THE TUBE.**
- ▲ Verify this axial position by aligning the machine-cut edge of the wrapped posterboard with the 2 center marks on the drawn rectangle sides **parallel** to the tube axis and insure the machine-cut edge on the opposite side intersects the focuser axial intersection point you marked. Once confirmed, drill a 1/16” small hole through the tube.
- ▲ Remount the focuser and insert **TELETUBE XLS™/TELECAT XLS™**. Shine a bright light behind the tube through the hole and check for alignment of the **TELETUBE XLS™/TELECAT XLS™** cross hairs intersection over the hole. If necessary, adjust the focuser base tilt via height adjustment screws (if available on the focuser base) or shims under the base corners at the attachment bolts.

## Initial “Vertical” Offset Adjustment of the Secondary Mirror

- ▲ For optimal “Axial” positioning of the Secondary using the **TELETUBE XLS™/TELECAT XLS™**, I highly recommend that you consider first setting the corresponding (and equal) vertical offset away from the focuser.
- ▲ Determine the f/no of your scope by dividing the Primary focal length by the Primary mirror diameter. Refer to the Offset cross-reference table on the last page and locate the nearest value to your Secondary mirror size (minor axis length) in the left-hand column; then read across to the f/no of your telescope listed across the top. The appropriate offset value is in inches.

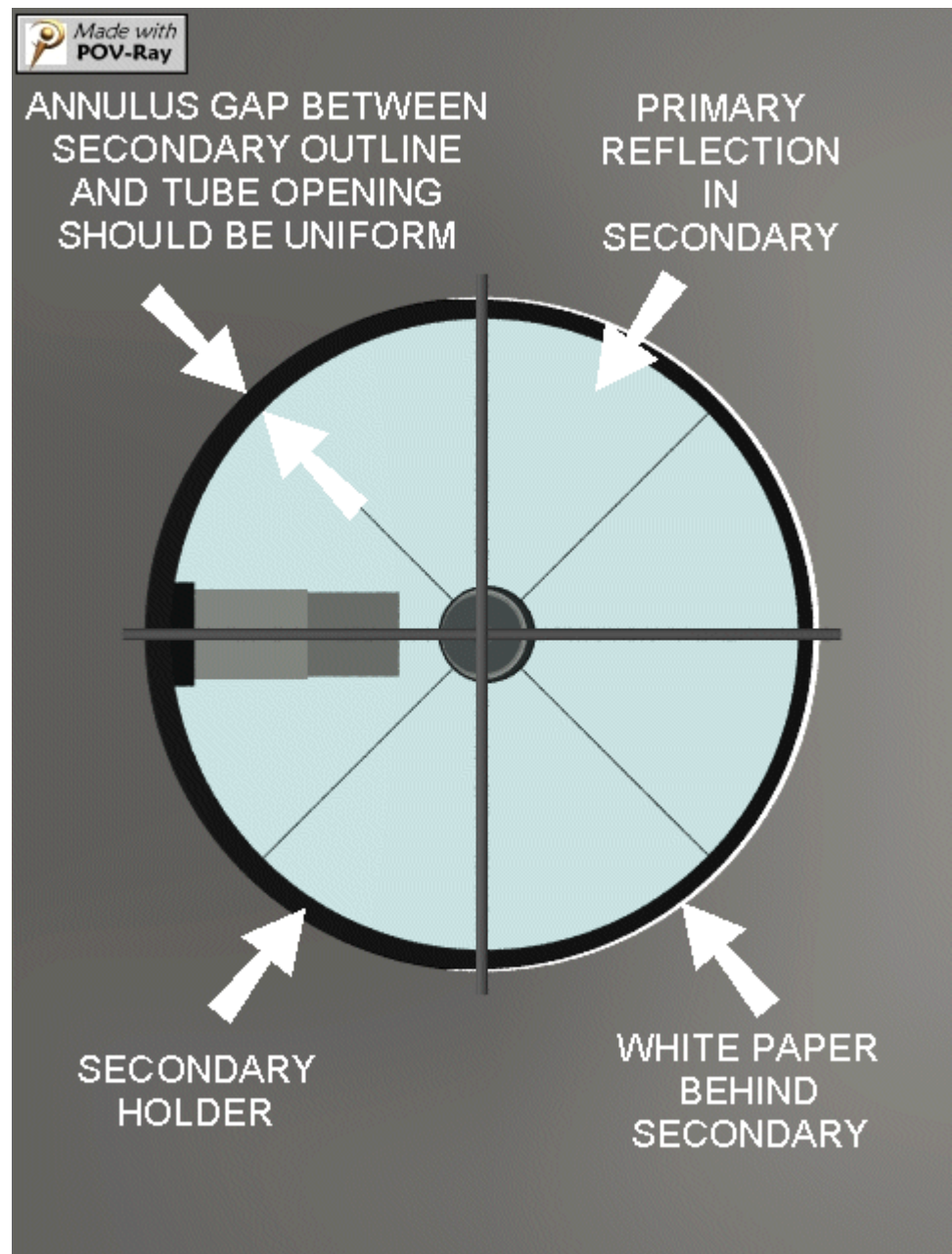
- ▲ If the required offset is less than 3/32" (.094"), your ability to accurately measure such a small distance may dictate that you should forego vertical offset adjustment all together and you can proceed directly to "Using the **TELETUBE XLS™/TELECAT XLS™** to the Axial Offset Position" below.
- ▲ For vertical offset distances greater than 3/32" (.094"), I recommend making effort to set the vertical adjustment offset. The goal is to move the Secondary geometric center point the prescribed distance AWAY from the focuser by the offset amount relative to the Primary axis centerline. Because you are going to use the scope tube or upper tube assembly inside surface as a reference point in this exercise, both the Primary mirror and Secondary Mirrors should be initially fairly well centered relative to the OTA (or UTA in the truss design).
- ▲ If possible, measure the distance from the primary mirror edge to the inside of the tube (or mirror box in a truss style) at 4 places at 90 degree intervals to determine if the Primary is reasonably centered on the tube axis; adjust to make them equidistant if lateral adjustment method is available.
- ▲ Insure that the Secondary is initially centered as well by measuring along the spider support arms to the Secondary holder center (usually a large bolt) and adjusting the spider attachment screws as needed (loosening one side and tightening the other) to shift the Secondary to the center position.
- ▲ Once you are confident the Primary & Secondary mirrors are centered relative to one another, then proceed to set the vertical offset in a direction AWAY FROM THE FOCUSER by once again adjusting the spider attachment screws. Ultimately, the difference in distance from the focuser side to the Secondary will be longer than the opposite side distance to the Secondary by TWICE THE OFFSET VALUE. The side-to-side distance should remain equal.

## Using the **TELETUBE XLS™/TELECAT XLS™** to adjust the "Axial" Offset Position of the Secondary Mirror

- ▲ Insure the **TELETUBE XLS™/TELECAT XLS™** length has been preset to the correct f/no (see procedure above).
- ▲ To aid in discerning the real edge of the diagonal holder, lay a blank white piece of paper against the tube wall opposite the focuser. Additionally, when practical, cover or remove the Primary to eliminate potentially confusing reflections during the procedure.
- ▲ Slightly loosen the main diagonal/spider attachment (usually a jamb nut on the main center bolt). While looking through the empty focuser, rotate the diagonal/holder in the spider mount until the projected outline of the Secondary/holder appears circular. Loosen/tighten the positional nut(s) to adjust its position along the tube axis until the Secondary outline is reasonably centered under the focuser.
- ▲ Rack the focuser all the way out and insert the preset **TELETUBE XLS™/TELECAT XLS™** fully into the focuser with the shoulder against the focuser rim. In the case of a smaller Primary, longer f-ratio scenario, the correct f-ratio extended tube will sometimes "hit" the Secondary when fully inserted in the focuser even at the racked out position. In this case it is better to pull the whole **TELETUBE XLS™/TELECAT XLS™** assembly up out of the focuser just enough to accomplish Secondary outlining rather than shortening the **TELETUBE XLS™/TELECAT XLS™**.
- ▲ While looking through the **TELETUBE XLS™/TELECAT XLS™**, slowly rack the focuser in until you can just perceive a thin annulus gap between the tube end and the Secondary. If the Secondary

mirror is significantly oversized, it may be necessary to pull the **TELETUBE XLS™/TELECAT XLS™** slightly up in the focuser to achieve the desired gap.

- ▲ Carefully fine tune the diagonal/holder rotation and axial position relative to the **TELETUBE XLS™/TELECAT XLS™** until the circular “gap” is uniform all around the Secondary. Rack the focuser slightly up and down & reassess several times to insure symmetrical Secondary mirror centering.
- ▲ Sometime the Secondary will also appear skewed in a cross-axis (up/down) direction. To correct this situation, it is sometimes necessary to shift the spider assembly to facilitate centering by loosening/tightening the spider tube mounting bolts. If this is not possible, slight tilting of the focuser with shims or focuser leveling screws may be needed. The illustration to the right depicts the view of the correctly centered Secondary.



- ▲ When the Secondary is symmetrically centered, carefully lock the Secondary/holder in position by tightening the mount jamb nut(s) and make one final position check with the **TELETUBE XLS™/TELECAT XLS™**. Sometimes locking down the Secondary will shift the position slightly so you may have to iterate the adjustments and tightening a couple of times to get it just right.

## Using the 2" **TELECAT XLS™** Cheshire feature to set the Tilt of the Primary

- ▲ For this procedure, it is recommended that the Primary mirror first be spotted with the **CATSEYE™** Self-Adhesive Reflective Triangle using the center-spotting procedure and Primary spotting template.
- ▲ Loosen the two tube retaining set screws just sufficiently to fully retract the extension tube for maximum brightness, and re-tighten the set screws. **DO NOT OVER-TIGHTEN**. Excessive tightening will warp the tube end and prevent the **TELECAT XLS™** from going into the focuser.
- ▲ For initial familiarization with the images seen with the **TELECAT XLS™**, collimation is best performed out-of-doors with the scope aimed at the horizon sky away from the sun or indoors with the scope aimed a brightly-lit wall.
- ▲ For nighttime use, shine a bright LED flashlight from the **FRONT END** of the scope **DIRECTLY** toward the Primary center spot. Hold the flashlight next to the diagonal holder as close to the center of the tube as possible. (A convenient “spider” clip can be easily fashioned from a “chip clip” to hold the flashlight in position for “hands-free” collimation.)
- ▲ With sufficient light aimed at the primary, both the reflective ring of the **TELECAT XLS™** and the **CATSEYE™** triangular center spot should be visible looking through the **TELECAT XLS™**.
- ▲ If careful spotting-template orientation was followed (“Primary Center-Spotting Procedure”), the points of the **CATSEYE™** triangle center spot will be oriented with the 3 adjustment screws of the primary mirror cell. Turn one of the Primary Cell adjustment screws and note the direction of movement of the triangle image relative to the **TELECAT XLS™** ring image. Likewise, turn a second Cell adjustment screw and note the relative movement. By correlating each adjustment with the resulting view obtained with the **TELECAT XLS™**, you will quickly learn the visual cues to know the required screw to turn and its turn direction to bring the triangle image inside the **TELECAT XLS™** reflective circle image.
- ▲ You will find that actually **you only need to turn any 2 of the 3 adjustment screws** to precisely center the triangle inside the annulus of the **TELECAT XLS™** reflective ring image. When the primary is collimated, the points of the triangle should just touch the inside circumference of the ring image; likewise, there should be an equal-sized dark gap between the sides of the triangle and the inside of the ring image.

Newtonian Diagonal Mirror Offset Calculation  
 Jim Fly (CATSEYE™) Collimation

| Diagonal<br>Size | Primary f/no: |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
|------------------|---------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                  | 3.0           | 3.1   | 3.2   | 3.3   | 3.4   | 3.5   | 3.6   | 3.7   | 3.8   | 3.9   | 4.0   | 4.1   | 4.2   | 4.3   | 4.4   | 4.5   | 4.6   | 4.7   | 4.8   | 4.9   | 5.0   |
| 1.80             | 0.150         | 0.145 | 0.141 | 0.136 | 0.132 | 0.129 | 0.125 | 0.122 | 0.118 | 0.115 | 0.113 | 0.110 | 0.107 | 0.105 | 0.102 | 0.100 | 0.098 | 0.096 | 0.094 | 0.092 | 0.090 |
| 1.85             | 0.154         | 0.149 | 0.145 | 0.140 | 0.136 | 0.132 | 0.128 | 0.125 | 0.122 | 0.119 | 0.116 | 0.113 | 0.110 | 0.108 | 0.105 | 0.103 | 0.101 | 0.098 | 0.096 | 0.094 | 0.093 |
| 1.90             | 0.158         | 0.153 | 0.148 | 0.144 | 0.140 | 0.136 | 0.132 | 0.128 | 0.125 | 0.122 | 0.119 | 0.116 | 0.113 | 0.110 | 0.108 | 0.106 | 0.103 | 0.101 | 0.099 | 0.097 | 0.095 |
| 1.95             | 0.162         | 0.157 | 0.152 | 0.148 | 0.143 | 0.139 | 0.135 | 0.132 | 0.128 | 0.125 | 0.122 | 0.119 | 0.116 | 0.113 | 0.111 | 0.108 | 0.106 | 0.104 | 0.102 | 0.099 | 0.098 |
| 2.00             | 0.167         | 0.161 | 0.156 | 0.152 | 0.147 | 0.143 | 0.139 | 0.135 | 0.132 | 0.128 | 0.125 | 0.122 | 0.119 | 0.116 | 0.114 | 0.111 | 0.109 | 0.106 | 0.104 | 0.102 | 0.100 |
| 2.05             | 0.171         | 0.165 | 0.160 | 0.155 | 0.151 | 0.146 | 0.142 | 0.139 | 0.135 | 0.131 | 0.128 | 0.125 | 0.122 | 0.119 | 0.116 | 0.114 | 0.111 | 0.109 | 0.107 | 0.105 | 0.103 |
| 2.10             | 0.175         | 0.169 | 0.164 | 0.159 | 0.154 | 0.150 | 0.146 | 0.142 | 0.138 | 0.135 | 0.131 | 0.128 | 0.125 | 0.122 | 0.119 | 0.117 | 0.114 | 0.112 | 0.109 | 0.107 | 0.105 |
| 2.15             | 0.179         | 0.173 | 0.168 | 0.163 | 0.158 | 0.154 | 0.149 | 0.145 | 0.141 | 0.138 | 0.134 | 0.131 | 0.128 | 0.125 | 0.122 | 0.119 | 0.117 | 0.114 | 0.112 | 0.110 | 0.108 |
| 2.20             | 0.183         | 0.177 | 0.172 | 0.167 | 0.162 | 0.157 | 0.153 | 0.149 | 0.145 | 0.141 | 0.138 | 0.134 | 0.131 | 0.128 | 0.125 | 0.122 | 0.120 | 0.117 | 0.115 | 0.112 | 0.110 |
| 2.25             | 0.187         | 0.181 | 0.176 | 0.170 | 0.165 | 0.161 | 0.156 | 0.152 | 0.148 | 0.144 | 0.141 | 0.137 | 0.134 | 0.131 | 0.128 | 0.125 | 0.122 | 0.120 | 0.117 | 0.115 | 0.113 |
| 2.30             | 0.192         | 0.185 | 0.180 | 0.174 | 0.169 | 0.164 | 0.160 | 0.155 | 0.151 | 0.147 | 0.144 | 0.140 | 0.137 | 0.134 | 0.131 | 0.128 | 0.125 | 0.122 | 0.120 | 0.117 | 0.115 |
| 2.35             | 0.196         | 0.190 | 0.184 | 0.178 | 0.173 | 0.168 | 0.163 | 0.159 | 0.155 | 0.151 | 0.147 | 0.143 | 0.140 | 0.137 | 0.134 | 0.131 | 0.128 | 0.125 | 0.122 | 0.120 | 0.118 |
| 2.40             | 0.200         | 0.194 | 0.187 | 0.182 | 0.176 | 0.171 | 0.167 | 0.162 | 0.158 | 0.154 | 0.150 | 0.146 | 0.143 | 0.140 | 0.136 | 0.133 | 0.130 | 0.128 | 0.125 | 0.122 | 0.120 |
| 2.45             | 0.204         | 0.198 | 0.191 | 0.186 | 0.180 | 0.175 | 0.170 | 0.166 | 0.161 | 0.157 | 0.153 | 0.149 | 0.146 | 0.142 | 0.139 | 0.136 | 0.133 | 0.130 | 0.128 | 0.125 | 0.123 |
| 2.50             | 0.208         | 0.202 | 0.195 | 0.189 | 0.184 | 0.179 | 0.174 | 0.169 | 0.164 | 0.160 | 0.156 | 0.152 | 0.149 | 0.145 | 0.142 | 0.139 | 0.136 | 0.133 | 0.130 | 0.128 | 0.125 |
| 2.55             | 0.212         | 0.206 | 0.199 | 0.193 | 0.188 | 0.182 | 0.177 | 0.172 | 0.168 | 0.163 | 0.159 | 0.155 | 0.152 | 0.148 | 0.145 | 0.142 | 0.139 | 0.136 | 0.133 | 0.130 | 0.128 |
| 2.60             | 0.217         | 0.210 | 0.203 | 0.197 | 0.191 | 0.186 | 0.181 | 0.176 | 0.171 | 0.167 | 0.163 | 0.159 | 0.155 | 0.151 | 0.148 | 0.144 | 0.141 | 0.138 | 0.135 | 0.133 | 0.130 |
| 2.65             | 0.221         | 0.214 | 0.207 | 0.201 | 0.195 | 0.189 | 0.184 | 0.179 | 0.174 | 0.170 | 0.166 | 0.162 | 0.158 | 0.154 | 0.151 | 0.147 | 0.144 | 0.141 | 0.138 | 0.135 | 0.133 |
| 2.70             | 0.225         | 0.218 | 0.211 | 0.205 | 0.199 | 0.193 | 0.188 | 0.182 | 0.178 | 0.173 | 0.169 | 0.165 | 0.161 | 0.157 | 0.153 | 0.150 | 0.147 | 0.144 | 0.141 | 0.138 | 0.135 |
| 2.75             | 0.229         | 0.222 | 0.215 | 0.208 | 0.202 | 0.196 | 0.191 | 0.186 | 0.181 | 0.176 | 0.172 | 0.168 | 0.164 | 0.160 | 0.156 | 0.153 | 0.149 | 0.146 | 0.143 | 0.140 | 0.138 |
| 2.80             | 0.233         | 0.226 | 0.219 | 0.212 | 0.206 | 0.200 | 0.194 | 0.189 | 0.184 | 0.179 | 0.175 | 0.171 | 0.167 | 0.163 | 0.159 | 0.156 | 0.152 | 0.149 | 0.146 | 0.143 | 0.140 |
| 2.85             | 0.237         | 0.230 | 0.223 | 0.216 | 0.210 | 0.204 | 0.198 | 0.193 | 0.187 | 0.183 | 0.178 | 0.174 | 0.170 | 0.166 | 0.162 | 0.158 | 0.155 | 0.152 | 0.148 | 0.145 | 0.143 |
| 2.90             | 0.242         | 0.234 | 0.227 | 0.220 | 0.213 | 0.207 | 0.201 | 0.196 | 0.191 | 0.186 | 0.181 | 0.177 | 0.173 | 0.169 | 0.165 | 0.161 | 0.158 | 0.154 | 0.151 | 0.148 | 0.145 |
| 2.95             | 0.246         | 0.238 | 0.230 | 0.223 | 0.217 | 0.211 | 0.205 | 0.199 | 0.194 | 0.189 | 0.184 | 0.180 | 0.176 | 0.172 | 0.168 | 0.164 | 0.160 | 0.157 | 0.154 | 0.151 | 0.148 |
| 3.00             | 0.250         | 0.242 | 0.234 | 0.227 | 0.221 | 0.214 | 0.208 | 0.203 | 0.197 | 0.192 | 0.188 | 0.183 | 0.179 | 0.174 | 0.170 | 0.167 | 0.163 | 0.160 | 0.156 | 0.153 | 0.150 |
| 3.05             | 0.254         | 0.246 | 0.238 | 0.231 | 0.224 | 0.218 | 0.212 | 0.206 | 0.201 | 0.196 | 0.191 | 0.186 | 0.182 | 0.177 | 0.173 | 0.169 | 0.166 | 0.162 | 0.159 | 0.156 | 0.153 |
| 3.10             | 0.258         | 0.250 | 0.242 | 0.235 | 0.228 | 0.221 | 0.215 | 0.209 | 0.204 | 0.199 | 0.194 | 0.189 | 0.185 | 0.180 | 0.176 | 0.172 | 0.168 | 0.165 | 0.161 | 0.158 | 0.155 |
| 3.15             | 0.262         | 0.254 | 0.246 | 0.239 | 0.232 | 0.225 | 0.219 | 0.213 | 0.207 | 0.202 | 0.197 | 0.192 | 0.188 | 0.183 | 0.179 | 0.175 | 0.171 | 0.168 | 0.164 | 0.161 | 0.158 |
| 3.20             | 0.267         | 0.258 | 0.250 | 0.242 | 0.235 | 0.229 | 0.222 | 0.216 | 0.211 | 0.205 | 0.200 | 0.195 | 0.190 | 0.186 | 0.182 | 0.178 | 0.174 | 0.170 | 0.167 | 0.163 | 0.160 |
| 3.25             | 0.271         | 0.262 | 0.254 | 0.246 | 0.239 | 0.232 | 0.226 | 0.220 | 0.214 | 0.208 | 0.203 | 0.198 | 0.193 | 0.189 | 0.185 | 0.181 | 0.177 | 0.173 | 0.169 | 0.166 | 0.163 |
| 3.30             | 0.275         | 0.266 | 0.258 | 0.250 | 0.243 | 0.236 | 0.229 | 0.223 | 0.217 | 0.212 | 0.206 | 0.201 | 0.196 | 0.192 | 0.188 | 0.183 | 0.179 | 0.176 | 0.172 | 0.168 | 0.165 |
| 3.35             | 0.279         | 0.270 | 0.262 | 0.254 | 0.246 | 0.239 | 0.233 | 0.226 | 0.220 | 0.215 | 0.209 | 0.204 | 0.199 | 0.195 | 0.190 | 0.186 | 0.182 | 0.178 | 0.174 | 0.171 | 0.168 |
| 3.40             | 0.283         | 0.274 | 0.266 | 0.258 | 0.250 | 0.243 | 0.236 | 0.230 | 0.224 | 0.218 | 0.213 | 0.207 | 0.202 | 0.198 | 0.193 | 0.189 | 0.185 | 0.181 | 0.177 | 0.173 | 0.170 |
| 3.45             | 0.288         | 0.278 | 0.270 | 0.261 | 0.254 | 0.246 | 0.240 | 0.233 | 0.227 | 0.221 | 0.216 | 0.210 | 0.205 | 0.201 | 0.196 | 0.192 | 0.188 | 0.184 | 0.180 | 0.176 | 0.173 |
| 3.50             | 0.292         | 0.282 | 0.273 | 0.265 | 0.257 | 0.250 | 0.243 | 0.236 | 0.230 | 0.224 | 0.219 | 0.213 | 0.208 | 0.203 | 0.199 | 0.194 | 0.190 | 0.186 | 0.182 | 0.179 | 0.175 |
| 3.55             | 0.296         | 0.286 | 0.277 | 0.269 | 0.261 | 0.254 | 0.247 | 0.240 | 0.234 | 0.228 | 0.222 | 0.216 | 0.211 | 0.206 | 0.202 | 0.197 | 0.193 | 0.189 | 0.185 | 0.181 | 0.178 |
| 3.60             | 0.300         | 0.290 | 0.281 | 0.273 | 0.265 | 0.257 | 0.250 | 0.243 | 0.237 | 0.231 | 0.225 | 0.220 | 0.214 | 0.209 | 0.205 | 0.200 | 0.196 | 0.191 | 0.188 | 0.184 | 0.180 |
| 3.65             | 0.304         | 0.294 | 0.285 | 0.277 | 0.268 | 0.261 | 0.253 | 0.247 | 0.240 | 0.234 | 0.228 | 0.223 | 0.217 | 0.212 | 0.207 | 0.203 | 0.198 | 0.194 | 0.190 | 0.186 | 0.183 |
| 3.70             | 0.308         | 0.298 | 0.289 | 0.280 | 0.272 | 0.264 | 0.257 | 0.250 | 0.243 | 0.237 | 0.231 | 0.226 | 0.220 | 0.215 | 0.210 | 0.206 | 0.201 | 0.197 | 0.193 | 0.189 | 0.185 |
| 3.75             | 0.313         | 0.302 | 0.293 | 0.284 | 0.276 | 0.268 | 0.260 | 0.253 | 0.247 | 0.240 | 0.234 | 0.229 | 0.223 | 0.218 | 0.213 | 0.208 | 0.204 | 0.199 | 0.195 | 0.191 | 0.188 |
| 3.80             | 0.317         | 0.306 | 0.297 | 0.288 | 0.279 | 0.271 | 0.264 | 0.257 | 0.250 | 0.244 | 0.238 | 0.232 | 0.226 | 0.221 | 0.216 | 0.211 | 0.207 | 0.202 | 0.198 | 0.194 | 0.190 |
| 3.85             | 0.321         | 0.310 | 0.301 | 0.292 | 0.283 | 0.275 | 0.267 | 0.260 | 0.253 | 0.247 | 0.241 | 0.235 | 0.229 | 0.224 | 0.219 | 0.214 | 0.209 | 0.205 | 0.201 | 0.196 | 0.193 |
| 3.90             | 0.325         | 0.315 | 0.305 | 0.295 | 0.287 | 0.279 | 0.271 | 0.264 | 0.257 | 0.250 | 0.244 | 0.238 | 0.232 | 0.227 | 0.222 | 0.217 | 0.212 | 0.207 | 0.203 | 0.199 | 0.195 |
| 3.95             | 0.329         | 0.319 | 0.309 | 0.299 | 0.290 | 0.282 | 0.274 | 0.267 | 0.260 | 0.253 | 0.247 | 0.241 | 0.235 | 0.230 | 0.224 | 0.219 | 0.215 | 0.210 | 0.206 | 0.202 | 0.198 |
| 4.00             | 0.333         | 0.323 | 0.313 | 0.303 | 0.294 | 0.286 | 0.278 | 0.270 | 0.263 | 0.256 | 0.250 | 0.244 | 0.238 | 0.233 | 0.227 | 0.222 | 0.217 | 0.213 | 0.208 | 0.204 | 0.200 |
| 4.05             | 0.337         | 0.327 | 0.316 | 0.307 | 0.298 | 0.289 | 0.281 | 0.274 | 0.266 | 0.260 | 0.253 | 0.247 | 0.241 | 0.235 | 0.230 | 0.225 | 0.220 | 0.215 | 0.211 | 0.207 | 0.203 |
| 4.10             | 0.342         | 0.331 | 0.320 | 0.311 | 0.301 | 0.293 | 0.285 | 0.277 | 0.270 | 0.263 | 0.256 | 0.250 | 0.244 | 0.238 | 0.233 | 0.228 | 0.223 | 0.218 | 0.214 | 0.209 | 0.205 |
| 4.15             | 0.346         | 0.335 | 0.324 | 0.314 | 0.305 | 0.296 | 0.288 | 0.280 | 0.273 | 0.266 | 0.259 | 0.253 | 0.247 | 0.241 | 0.236 | 0.231 | 0.226 | 0.221 | 0.216 | 0.212 | 0.208 |
| 4.20             | 0.350         | 0.339 | 0.328 | 0.318 | 0.309 | 0.300 | 0.292 | 0.284 | 0.276 | 0.269 | 0.263 | 0.256 | 0.250 | 0.244 | 0.239 | 0.233 | 0.228 | 0.223 | 0.219 | 0.214 | 0.210 |
| 4.25             | 0.354         | 0.343 | 0.332 | 0.322 | 0.313 | 0.304 | 0.295 | 0.287 | 0.280 | 0.272 | 0.266 | 0.259 | 0.253 | 0.247 | 0.241 | 0.236 | 0.231 | 0.226 | 0.221 | 0.217 | 0.213 |
| 4.30             | 0.358         | 0.347 | 0.336 | 0.326 | 0.316 | 0.307 | 0.299 | 0.291 | 0.283 | 0.276 | 0.269 | 0.262 | 0.256 | 0.250 | 0.244 | 0.239 | 0.234 | 0.229 | 0.224 | 0.219 | 0.215 |
| 4.35             | 0.362         | 0.351 | 0.340 | 0.330 | 0.320 | 0.311 | 0.302 | 0.294 | 0.286 | 0.279 | 0.272 | 0.265 | 0.259 | 0.253 | 0.247 | 0.242 | 0.236 | 0.231 | 0.227 | 0.222 | 0.218 |
| 4.40             | 0.367         | 0.355 | 0.344 | 0.333 | 0.324 | 0.314 | 0.306 | 0.297 | 0.289 | 0.282 | 0.275 | 0.268 | 0.262 | 0.256 | 0.250 | 0.244 | 0.239 | 0.234 | 0.229 | 0.224 | 0.220 |
| 4.45             | 0.371         | 0.359 | 0.348 | 0.337 | 0.327 | 0.318 | 0.309 | 0.    |       |       |       |       |       |       |       |       |       |       |       |       |       |